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Recent Studies on the Mean Atmospheric Circulation

BY C. E. P. BROOKS, D.Sc.

A recent paper by the Rev. C. E. Deppermann (1)* gives a series of charts of resultant winds for five-degree squares in the Indian and South Pacific Oceans. The resultants were calculated from the wind roses on the pilot charts published by the United States Hydrographic Office, using the mean Beaufort force of the wind, converted to metres per second, as well as the frequency, from each direction. For the Indian Ocean, charts are given for each month, for the South Pacific, only for the four seasons.

A few years ago S. T. A. Mirrlees and I constructed four charts of monthly stream-lines over tropical and sub-tropical Africa (2) and it was a matter of interest to combine Deppermann's charts with these. His resultant arrows were easily connected up to show the main stream-lines. Deppermann's charts were expressly made as an extension of a monthly series by Werenskiold (3) for the North Pacific; these also were included and the maps were completed as far as possible by the addition of seasonal stream-lines for Europe (4) and south-west Asia (5), conventionalised wind arrows for U.S.A. (6) and some isolated wind resultants for India (7) and Siberia (8). No resultant winds could be found for South America, the Atlantic or Australia, though for the Atlantic there would be no difficulty in computing them from the existing pilot charts.

* The numbers in brackets refer to the bibliography on p. 110.

The charts of stream-lines for January and July are shown in Figs. 1 and 2 (see pp. 108-9), necessarily somewhat simplified from the originals. The lines for Africa, U.S.A., Siberia and the Indian and North Pacific Oceans refer to the actual months of January and July, those for Europe, south-west Asia and the South Pacific to the seasons December to February and June to August.

The chart for January shows clearly the wind axis extending across Europe from France to Asia, where it merges with the Siberian anticyclone. On the northern side of this axis southerly or south-westerly winds blow towards the Arctic circle. On the southern side, and from the south-east of a similar wind shed in Spain, north-westerly winds pass into the north-easterly harmattan of northern Africa, except in Italy and Syria, where the wind structure appears to be complicated. The Siberian winter anticyclone is only slightly indicated in the north, but the great systems of outflowing winds on its eastern and southern sides are clearly seen. Africa appears as the battleground of four great systems of winds, blowing from Europe and the Mediterranean, south-west Asia, the south Indian Ocean and the south-east Atlantic; in south-west Africa especially the intermingling of these streams is complex.

In the North Pacific the most interesting features are the circulation round the Aleutian low and the great concentration of air on the rainy coast of British Columbia. Werenskiöld shows the centre of the sub-tropical anticyclonic circulation in the North Pacific as a well-defined point; by contrast the centres of the circulation in the Indian and South Pacific oceans appear less definite, but for the South Pacific at least this may be due in part to the method of construction of the stream-lines. Werenskiöld actually carries his lines to meet at a common point of convergence, but Deppermann remarks that "he could not help but feel that many of the lines of convergence and divergence on Werenskiöld's maps, for regions where the resultant air flow is very small, have but little significance in fact and might easily lead to wrong impressions." I agree with this criticism, and in constructing Figs. 1 and 2 I opened out Werenskiöld's lines a little, and left blank the area of rather indefinite winds in the centre of the South Pacific high.

The main "fronts" between the various air masses are shown by broken lines. For the Pacific these fronts follow fairly closely those laid down by T. Bergeron (9), but no attempt is made here to discriminate between warm and cold fronts. Bergeron distinguishes "tropic," "temperate" and "arctic" (or "antarctic") fronts. The tropic front generally separates the two trade-wind systems or a trade-wind and monsoon, but it is liable to extensive displacements over the continents. In January, starting north of the equator in West Africa, the heated land surface carries a line of wind convergence well into South Africa. In the Indian Ocean it remains a few degrees south of the equator but another southward bend is

indicated in Australia. In the western Pacific the tropic front lies about 10° S., but about Long. 180° it seems to be duplicated. Part of the SE. trade wind crosses the equator, the eastern branch meeting the NE. trade wind in about 10° N., while the western branch turns southward and meets an easterly wind, also of southern origin, at a secondary front in about 10° S. East of 160° W. the latter disappears, and the northern front becomes the main region of convergence, but it is probable that this also turns southward over South America.

While in January air from the northern hemisphere plays a rather larger part in tropical regions than air from the southern hemisphere, there can be no doubt that in July (Fig. 2) the greater part of the tropics is dominated by southerly air. The tropic front between the northern and southern air crosses Africa in about 20° N. and then turns north-eastward into Asia, where currents from the South Indian Ocean spread over the whole of India, and those from the south-western Pacific travel as far north as Korea. In the central Pacific however the front lies only a few degrees north of the equator, shifting gradually to about 15° N. in Central America.

The "temperate" fronts are less clearly shown. They are much less stable than the tropic front, varying greatly from day to day, so that an apparently simple picture represents merely the summation of a constantly fluctuating series of barometric situations, and is not comparable with the almost unchanging systems of the subtropical trade winds. In January there are indications of a continuation of the main Atlantic front extending from the Bay of Biscay to the Mediterranean, and a more clearly marked front between Siberian or Arctic and Pacific air runs from north of New Guinea right across the Pacific to the coast of British Columbia and southern Alaska, where it joins a "coastal front" caused by the high coastal mountains. Traces of temperate fronts appear also in the southern Indian Ocean near Africa and in the South Pacific about 150° W.

In July the temperate fronts have disappeared from the northern hemisphere, but in the South Pacific there is a well-marked front extending from a few degrees south of the equator east of New Guinea, to the coast of South America in about 40° S.; this front is closely analogous to that of the North Pacific in the northern winter. The charts do not extend into sufficiently high latitudes to show the arctic and antarctic fronts, except for a trace north-west of Saghalien in July.

In the Indian Ocean the convergence of winds near the equator in January is replaced in July by a right-angled bend in the great southerly current; Deppermann's charts show that while this bend lies almost exactly on the equator in the western Indian Ocean, further east the change of direction appears to begin in about latitude 3° S., the resultant winds for $0-5^{\circ}$ S. showing a component from west in all squares between 75° E. and the coast of Sumatra. A similar bend is indicated in the eastern Pacific east of 120° W.,

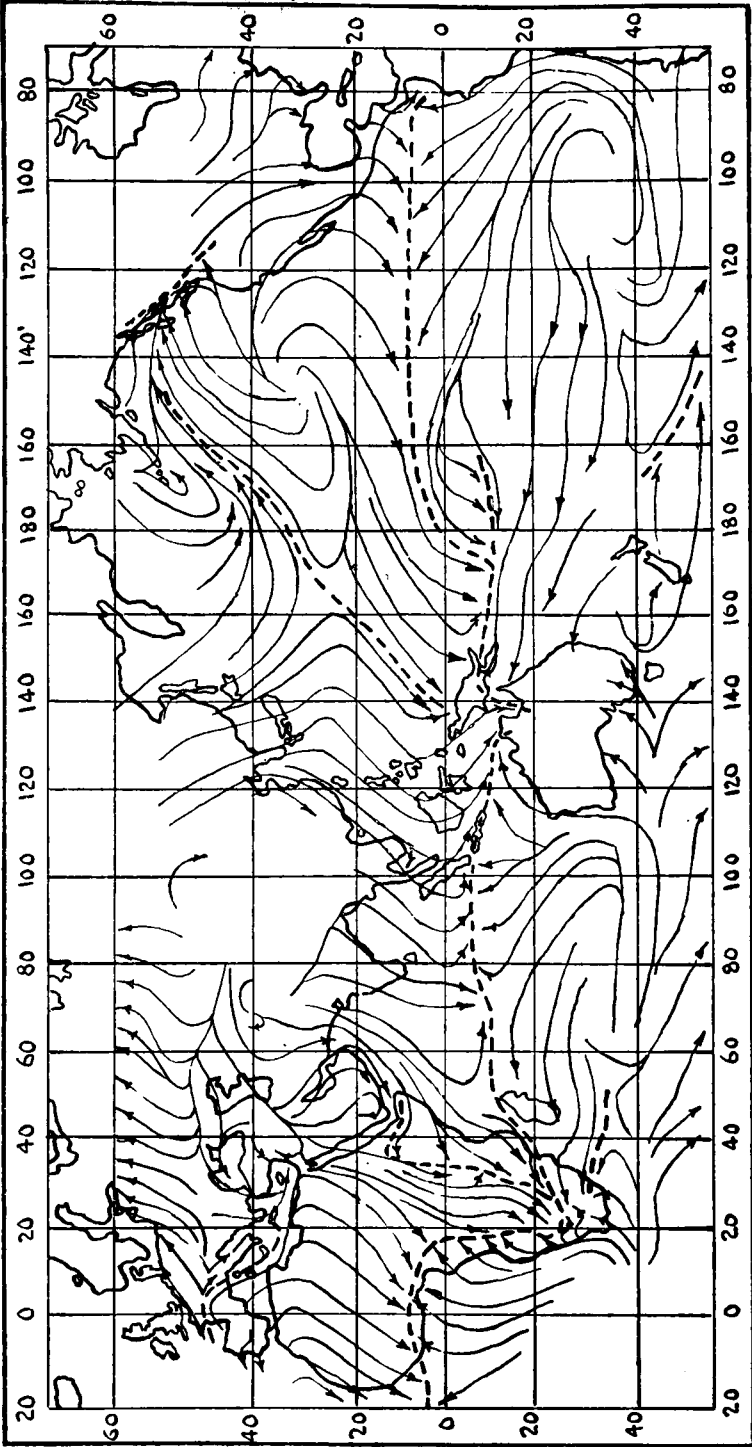


FIG. 1.—JANUARY

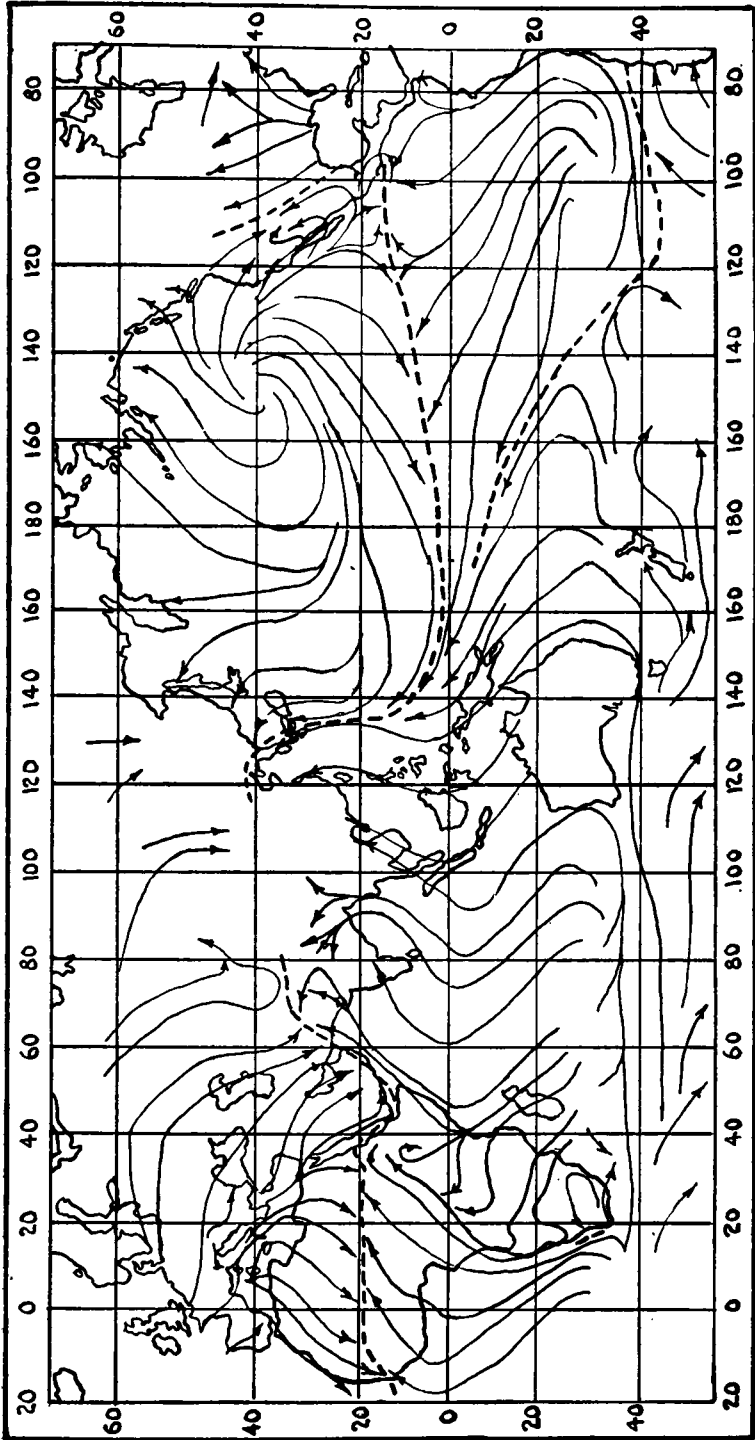


FIG. 2—JULY

where however the stream-lines become complex. For the northern Pacific generally the situation is simplified by the suppression of the Aleutian low pressure centre, and the coast of British Columbia becomes an area of divergence rather than of convergence.

In interpreting the maps it must not be assumed that a packet of air starting at the beginning of one of the arrows will necessarily or even probably follow it to its conclusion. Vertical interchange is constantly in progress with higher layers of air, in which the prevailing motion may be different in direction from that of the surface layers. But though the component particles may change, the general stream goes on, and it is the divergence and convergence of these great currents of air which govern the positions, season by season, of the great dry and rainy regions of the globe.

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Diurnal Variation of Wind

It is well known that on the average the surface wind speed is at a minimum at about dawn and increases to a maximum during the afternoon, subsequently falling off towards night. With light winds this effect is often very conspicuous on a Dines anemogram during periods when there is no variation in the gradient of pressure during the 24 hours, but with strong winds there are usually changes in the pressure field and the effect is not apparent. I have been unable to find anywhere any discussion as to whether the average variation of strong winds was greater or less than that for light winds, and so I have tabulated some figures for Kew which give an answer. I have taken from the hourly values the frequencies of winds of different speeds, using the months January and July and the hours 7h. and 13h. G.M.T. for January and 3h. and 13h. G.M.T. for July. The results are shown graphically in Fig. 1. The curves of this figure give the percentage frequency with which any given wind

speed was not exceeded, for instance, a wind speed of 2 m/sec. was not exceeded on 8 per cent of occasions at 13h. in July, on 18 per cent at 13h. in January, on 30 per cent at 7h. in January and 51 per cent at 3h. in July.

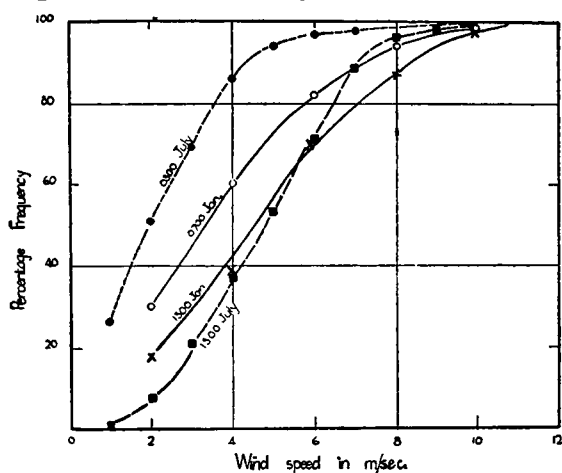


FIG. 1.

January is 2.0 m/sec. and at 13h. in the same month is 3.0 m/sec. ; in July, on the other hand, at 3h. it is 1.2 m/sec. and at 13h. it is 3.6 m/sec. Thus the range for that type of day is 1.0 m/sec. in January and 2.4 m/sec. in July. Similarly the ranges may be computed for other typical days as has been done in the table below :—

TABLE I.—SPEEDS AND DIURNAL RANGES ON TYPICAL DAYS.

Type of day (Windier than)	30%	50%	70%	80%	90%	95%
Speed 7h. January	2.0	3.4	4.8	5.8	7.2	8.1
Speed 13h. January	3.0	4.5	6.1	7.0	8.3	9.2
Range, January	1.0	1.1	1.3	1.2	1.1	1.1
Speed 3h. July	1.2	2.0	3.1	3.6	4.4	5.2
Speed 13h. July	3.6	4.8	5.9	6.4	7.0	7.7
Range, July	2.4	2.8	2.8	2.8	2.6	2.5

This shows quite clearly that, provided the pressure field remains unaltered, there is little difference in the increase of wind between dawn and afternoon whether the wind speed is great or little.

It would have been interesting to have seen in a comparable way how the direction of the wind and the cloudiness of the sky affected the diurnal variation, but such an investigation would need a considerable amount of labour.

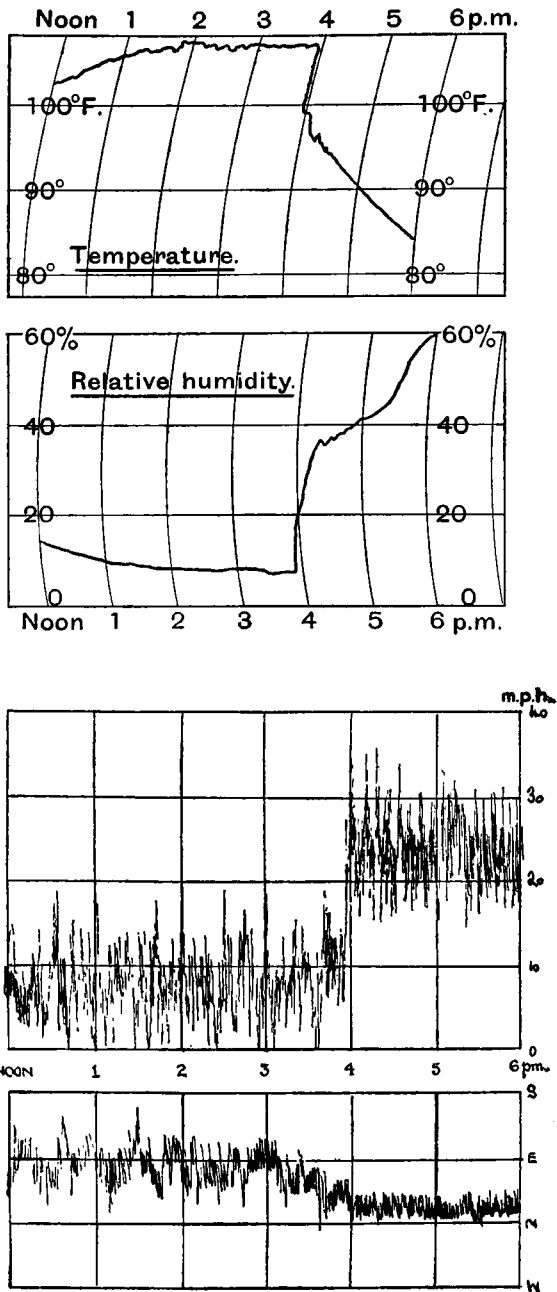
C. S. DURST.

Minor "Haboob" at Ismailia, Egypt

A marked feature of the weather at Ismailia and neighbouring districts during the summer months is a cool breeze which develops during the late afternoon. The onset of this cool breeze, which is

locally referred to as a "sea breeze," is accompanied by a sudden decrease in temperature, a sharp rise in relative humidity, an increase in wind velocity and either a change in wind direction or a decrease of the gustiness of the air current which is indicated on an anemograph by a narrowing of the direction trace. These phenomena accompanying the onset of the sea breeze are, on occasions, much more marked than on others, and an instance of extreme sharpness occurred on June 18th, 1932. On this day the sea breeze reached Ismailia at 3.55 p.m. when temperature suddenly fell 8° F., relative humidity increased by nearly 30 per cent in 20 minutes, wind velocity increased suddenly from 10 to 25 m.p.h., and the wind direction backed from NE. to NNE. (Fig. 1).

The movement of the "front" of the sea breeze towards the station was easily observed. At about 3.30 p.m. a bank of sand or haze appeared to the north of Ismailia and stretched as far as the eye could see to east and west—across a front of at least 10 miles. This bank, which was 2,500–3,000 ft. high, rapidly approached Ismailia and at 3.50 p.m. the sky immediately above the station was being obscured by sand haze at a height of approximately 2,000 ft. (Fig. 2). The base of this haze bank lowered and the "haze front" at the surface



FIGS. 1 AND 2

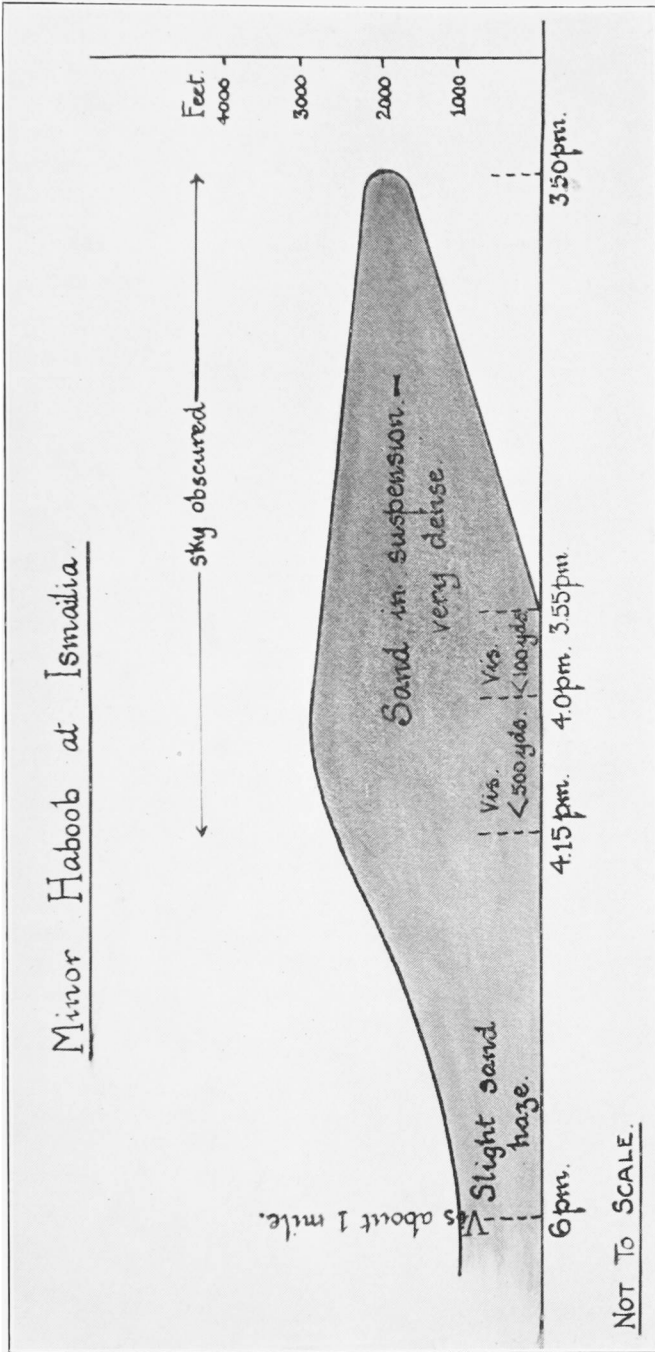


FIG. 2.

arrived at 3.55 p.m. when visibility suddenly decreased to less than 100 yards. Visibility improved slightly after 4.0 p.m. but was still less than 500 yards until 4.15 p.m., after which it gradually improved, although there was still sand in suspension at 6.0 p.m. A sketch made at the time (Fig. 2), indicates the apparent form of the advancing sea breeze which had all the characteristics of a "haboob" or severe sandstorm. The anemogram for Abu Sueir (Fig. 3),

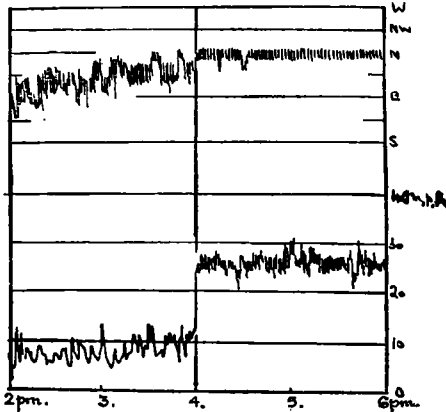


FIG. 3

8 miles west of Ismailia, shows that the sea breeze was also well marked when it passed that station, while at Port Fouad on the coast, 47 miles north of Ismailia, the wind was reported to have increased from ENE., force 3 at noon, to NNE., force 5 before 4 p.m.

In a discussion of haboobs in the Sudan, Sutton * concludes that the majority have their origin in the diurnal variation of temperature and

pressure, so that if the phenomenon experienced at Ismailia was in the nature of a sea breeze the diurnal change of pressure and temperature near the coast and inland would need to be considered.

The Mediterranean Sea lies to the north of Ismailia with the coast running approximately north-west to south-east, 47 miles distant at Port Said (Port Said and Port Fouad are on opposite banks of the Suez Canal). Pressure at Port Said decreased by 1.9 mb. from 1012.7 mb. and temperature increased from 81° F. to 84° F. between 8 a.m. and 2 p.m., while the corresponding changes at Ismailia were 3.7 mb. from 1012.1 mb. and 80° F. to 106° F. The respective maximum temperatures were 88° F. and 107° F. Further, at Ismailia pressure decreased by 2.4 mb. during the three hours preceding 2 p.m. Thus at 8 a.m. the pressure gradient between Port Said and Ismailia was 1.25 mb. per 100 miles and increased to 5.1 mb. per 100 miles at 2 p.m., while at the same time the average horizontal temperature gradient increased from +2° F. to -47° F. per 100 miles. This latter is almost certainly equal to gradients occurring in the Sudan and it is probable that the very steep temperature gradient was restricted to a relatively narrow strip between Kantara, 30 miles north of Ismailia, on the banks of the shallow Lake Menzaleh, and Port Said. The mean pressure gradients and horizontal temperature gradients per 100 miles between Port Said and Ismailia for June, 1932, were respectively 0.5 mb. and +6° F. at 8 a.m. and 2.7 mb. and -22° F. at 2 p.m. which are considerably less than those experienced on June 18th.

WILLIAM D. FLOWER.

* London, *Quart. J.R. met. Soc.*, 57, 1931, p. 155.

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday, May 20th, at 49, Cromwell Road, South Kensington, Dr. F. J. W. Whipple, F.Inst.P., President, in the Chair.

The following papers were read and discussed :—

E. A. Cornish.—*On the secular variation of the rainfall at Adelaide, S. Australia.*

A detailed analysis of the rainfall of Adelaide, South Australia, has shown that throughout the 95 years 1839–1933, there has been a definite oscillation, with a period and amplitude of approximately 23 years and 30 days respectively in the incidence and duration of the winter rains. The amplitude is about 20 per cent of the length of the rainfall season. The total quantity precipitated has shown no statistically significant changes.

Richmond T. Zoch.—*On the frequency distribution of rainfall at the Liverpool Observatory.*

The desirability of a detailed study of the frequency distribution of rainfall by methods familiar to statisticians is emphasized, and the work of Messrs. A. T. Doodson and H. J. Bigelstone on 60 years' observations of rainfall at Liverpool is discussed. A rough check on the computation of the Pearson frequency curve is explained, and the 60 years' observations are graduated by a different method.

T. E. W. Schumann, M.Sc., Ph.D.—*Interpolation of monthly rainfall data.*

In this paper particular attention is given to the average errors involved when interpolation of missing monthly rainfall figures is carried out according to approved methods. In order to compute the monthly rainfall at a station O the method adopted here is to multiply the monthly rainfall at a control station A by the ratio of the average annual rainfall at O and A respectively.

Computing the rainfalls for 20 consecutive Januaries from 20 control stations in the neighbourhood of the Pretoria Meteorological Office, and comparing these with the actual January rainfalls as measured at the latter station, it is possible to determine the average deviation of the interpolated from the true values. When these average deviations are plotted against the respective distances of the control stations from the central station the line of regression of the deviation upon the distance may be drawn. By employing the results of two or more control stations simultaneously an appreciable reduction in the magnitude of the errors is attained, and hence it is always advisable to determine a missing rainfall figure from more than one neighbouring station. Before attempting any interpolation it is essential that one should first investigate the magnitude of the probable errors attaching to the interpolated values in order to find out the limits to which interpolation may legitimately be carried out.

Correspondence

To the Editor, *Meteorological Magazine*

Unusually severe Thunderstorm in Bedfordshire

An unusually severe thunderstorm occurred in the Dunstable district on the afternoon of Wednesday, May 6th, 1936. Mr. H. Simmons, Clerk of the Works at Whipsnade Zoological Park, is the authority for most of the following statements. His staff come from the towns and villages in the neighbourhood of Dunstable, so that he had excellent opportunities for ascertaining the facts.

During the afternoon distant thunder could be heard from Whipsnade in the east, afterwards moving towards north. Dunstable town caught the storm very badly. Many basements were flooded out, and considerable damage was done to gardens and fruit trees. The hailstones were in some instances fully an inch in diameter. Locally the floods in the streets reached a depth of 4 ft. 6 in. At Houghton Regis, about a mile north of Dunstable town, the rainfall, as measured by the Manager of the Dunstable Cement Works, was 2.08 in. between 16h. 55m. and 17h. 40m. G.M.T. The total for the day was 2.12 in. The Plough Inn, on the Icknield Way, just below Dunstable Downs, suffered severely. Many pigs were drowned in mud washed from the hillside fields by torrential rain. At Edlesborough, about 3 miles west-south-west of Dunstable, measurements made by Mr. Simmons himself gave seven-eighths of an inch as the diameter of some of the hailstones. Great damage was done to greenhouses in the track of the storm, and also to Waterlow's, the printers, of Dunstable. At Whipsnade Zoological Park 0.25 in. of rain was registered. The hail there was extremely local: some fell at the Tiger Pit, but none at the Lion Pit, a short distance away. Ivinghoe, on the south-west margin of the storm area, had only a little rain.

E. L. HAWKE.

Caenwood, The Valley Road, Rickmansworth, Herts., May 11th, 1936.

Peculiar Gloom Phenomena

In her letter, published in the April number of the *Meteorological Magazine*, Miss Cecily M. Botley describes conditions of peculiar gloom at Hastings.

Similar conditions are sometimes observed here with northerly winds, as for instance, on the afternoon of April 12th, 1936, when a cumulonimbus cloud with anvil gave a snow shower, which was accompanied by a thick brown murk, that lasted about half an hour and caused enough darkness to render necessary the use of artificial light. On occasions such as the above the obscurity seems to be attributable to three causes: the considerable vertical extent of the clouds; the presence of smoke particles in the surface air; and the evaporation of precipitation.

Cases of obscurity accompanying the passage of fronts, such as that described by Mr. F. K. Hare, whose letter Miss Botley mentions, are not, in my experience, remarkable for any unusual gloom here, though winds veering to northerly in the rear of a front or depression generally cause a change to a brownish or dirty orange-coloured sky. Changes of this type are, I believe, most pronounced during the colder months, especially with a slack pressure gradient.

My own observation suggests that examples of remarkable gloom are most likely to occur here during the late afternoon in showery weather with a gradient for northerly winds, particularly in the spring. At this time of day the development of convection clouds is likely to be near its maximum, while there is, in cold weather, a plentiful output of smoke from London and the suburbs which, with northerly winds, drifts over this district.

It seems probable that in this locality the spring and autumn would be the seasons most favourable to the occurrence of this phenomenon, since in winter cumulonimbus clouds are not often seen, and since in summer there is less smoke haze in the surface air, owing partly to more active convection and partly to the reduction in the amount of domestic fuel burnt.

I have no recollection of gloom like that of April 12th, previously mentioned, occurring here on a generally foggy day, even with an overcast sky, although in the "Meteorological Glossary," s.v. Fog, it is stated that in London fog may in certain circumstances produce darkness in the middle of the day equal to that of night.

C. STUART BAILEY.

Longbridge, 76, Woodcote Valley Road, Purley, Surrey, May 5th, 1936.

NOTES AND QUERIES

The Cold Spells in May

The treacherous weather of spring is expressed in the advice not to cast a clout till May be out, and the marked fluctuations of temperature during May, 1936, gave an unusual amount of justification to this proverb. At the time of writing full data are not yet available, but by taking the mean of six well-distributed stations in England and Wales (Tynemouth, Birmingham, Llandudno, Clacton, Kensington Palace and Bournemouth) it is possible to form a general idea of the changes during the month. The normal May temperature of these six stations is 52.7° F., and the average for May, 1936 was 52.5° F., so that as a whole the month was very nearly normal, but the mean temperatures of the individual days ranged over more than 12° F. The beginning was cool, the average for May 1st-3rd being only 48° F., but after this temperature rose steadily to 55° F. on the 6th. By the 9th the mean had fallen again to 50° F. and as this is the first day of Buchan's third cold spell (May 9th-14th) there were numerous references to yet another verification of Buchan.

The coincidence was illusory, however, for May 10th–14th were all above the normal for May, temperature climbing steadily to 60° F. on the 18th, which proved to be the warmest day of the month. On this day the maxima exceeded 75° F. at several stations. In the next three days, however, the thermometer fell more than 10° F., the mean remaining below 50° F. from the 21st to 23rd. May 25th–27th were again warm, but the 28th brought a third cold spell which continued over the Whitsun holidays into the first week of June.

The mean temperatures for these periods, together with the mean daily maxima and minima, are set out in the following table:—

	May	1st- 3rd.	5th- 7th.	8th- 9th.	11th- 19th.	21st- 23rd.	25th- 27th.	30th- 31st.	Mean.	Normal.
		°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Mean	...	48	54	51	56	49	54	49	53	53
Mean Max.	...	54	61	55	63	55	62	54	59	60
Mean. Min.	...	41	47	47	49	43	47	43	46	45

For so little does the simple annual variation of temperature count in our climate that the last day of May was actually the coldest of the whole month.

A rather surprising feature of the month was that, in spite of the deficiency of rain and the frequency of north-easterly winds, the daily range of temperature was slightly less than the normal. There were, however, some severe ground frosts. At Rickmansworth the grass minimum fell to 30° F. or less on 15 occasions, reaching 18° F. on the 22nd and 29th; on the latter day the screen minimum fell to 24° F.

The average pressure distribution for May, 1936, shows a belt of pressure, more than 5 mb. above normal, extending from mid-Atlantic west of the Azores across Scotland to Scandinavia and northern Russia. The greatest excess, 8 mb., occurred west of Ireland, and taking the month as a whole there was a distinct tendency for north-easterly winds over the British Isles. This distribution persisted through the greater part of May without much change, except that from May 1st–20th the two main anticyclones lay over the Azores and Finland, with a depression centred over southern Greenland, while from May 21st–31st the Atlantic anticyclone lay directly west of Ireland in about 30° W. and exceeded 1030 mb. in its centre, while the European anticyclone occupied central Russia. During the latter period the winds over the British Isles were persistently of Arctic origin. During nearly all May the rainfall had been slight—the first fortnight was completely rainless at many stations—but on June 1st a shallow complex depression developed over England and gave less settled, though still cold, weather in the first week of June.

Forecasting Weather from Height of Barometer and Temperature of Wet Bulb

The interesting results for Grayshott from Mr. S. E. Ashmore shown

in the table and diagram in the February, 1936 issue of this magazine, though more irregular than those for St. Mary's, Scilly, may be analysed in the following manner:—

It is first necessary to find the "critical barometric pressure" which Mr. Ashmore calls K . To do so a direction line may be obtained by plotting the average percentage number of cases of no rain in 24 hours at 980.5 mb., 990.5 mb., 1,000.5 mb., 1,011.5 mb., 1,021.5 mb. and 1,031.5 mb. These averages are obtained by first combining the wet bulb results given in the table as "34°–38°" and "below 34°" (as was done by Lt. Cmdr. T. R. Beatty) when the percentage number of cases of "no rain in 24 hours" for wet bulb "below 39°" become 0, 20, 50, 50, 57, 75 and 90 respectively in column 5. The results "above 48°" do not appear at each of the seven barometric heights and should, therefore, be omitted, and also the small values of 6 at 44°–48° and 9 at 39°–43° when the barometer was above 1,035 mb. The averages of the three divisions in column 5 then become 4, 19.7, 23, 31.6, 48 and 64.3 at each of the consecutive pressures from "Below 986 mb." to "1,026–1,035 mb." These have been plotted in large circles on the diagram and the direction line obtained from them leads to 977 mb. as the "critical barometric pressure".

It is then a simple matter to obtain the value 10 and so the formula becomes $P = 10 \frac{B - 977}{T' - 32}$ for Grayshott.

The figures for "above 48° F." have not been plotted but the straight line obtained from the formula passes close to the average 11.4 for the five irregular readings if plotted at 1,000.5 mb.

The results for "no rain in 12 hours" have also been plotted but are not indicated here and the "critical barometric pressure" obtained therefrom was also 977 mb.

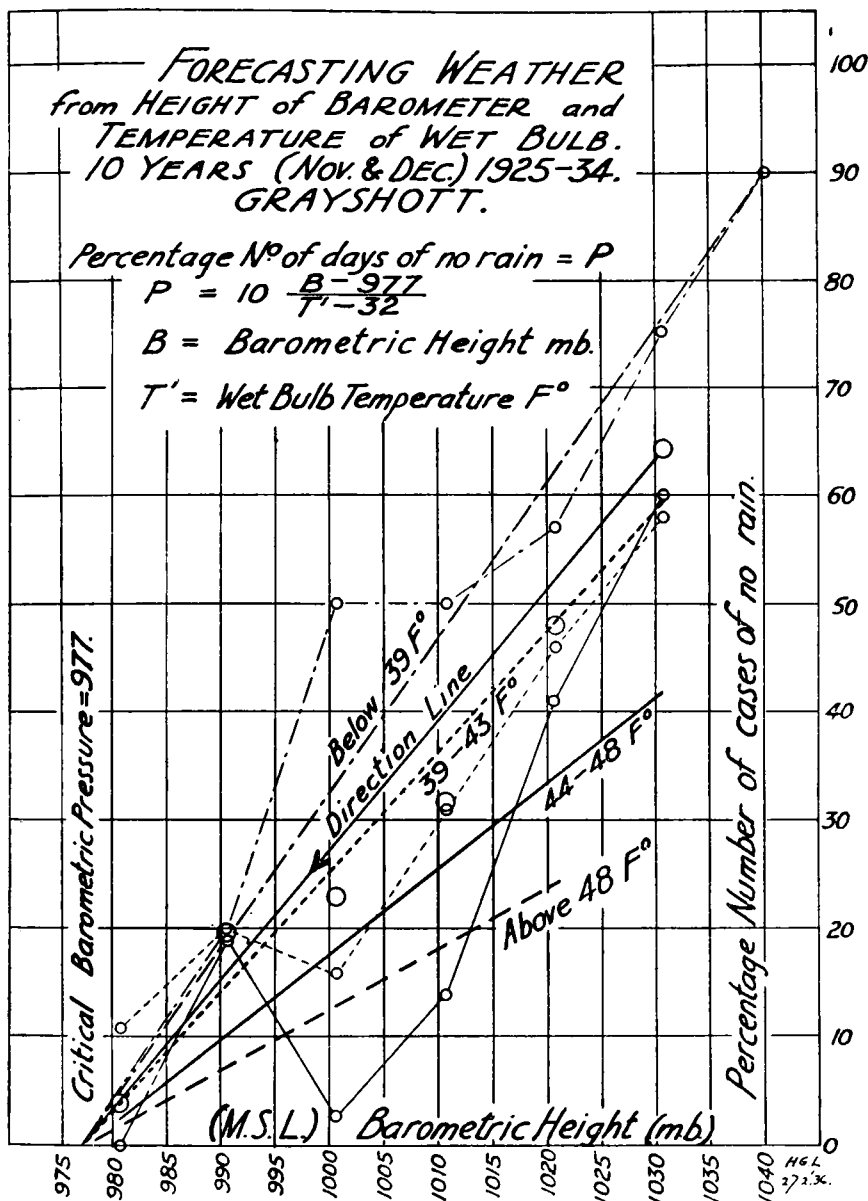
By courtesy of the Royal Meteorological Society the barometric and wet bulb observations for Edgbaston, Birmingham, for January and February from 1923 to 1932 inclusive have been abstracted by me from the records and a table and diagram prepared which show that the "critical barometric pressure" there is 976 mb. (reduced to M.S.L. for barometer at 542 ft.). The results vary little with humidity and the number of cases of no rain at 24 hours only justify an approximate formula of $P = 1.3 (B - 976)$ from the data. This may indicate also that the constant 1.3 or a which applies to B does not apply to the wet bulb temperature T' .

In the case of Grayshott if this were so then the constant for the averages (plotted for the direction line) would be

$$b = \frac{64.3}{1,030.5 - 977} = 1.20; \text{ but } a = \frac{b}{c} \text{ where } b = 1.2 \text{ and } c = 0.12$$

therefore the formula becomes:—

$$P = \frac{b (B - K)}{c (T' - 32)}$$



but as the formula is for the "man in the street" it is more conveniently written

$$P = a \frac{B - K}{T' - 32}$$

Perhaps the method for obtaining the "critical barometer pressure," and these remarks may be a help to others to obtain the corresponding results at other stations for the winter months and more especially January and February.

H. G. LLOYD.

REVIEWS

The Analysis of Weather Charts. By Dr. E. Kidson. (Reprinted from *The Australian Geographer*, Vol. II, No. 5.)

This paper gives a detailed analysis of a series of depressions which moved south-east from eastern Australia to the New Zealand area. The general principles illustrated were similar to those in our own area, but their detailed application was modified by local topographical features, especially near the Australian coast.

India Meteorological Department, Scientific Notes, Vol. VI, No. 66.—
Normal monthly percentage frequencies of upper winds at 4, 6, 8
and 10 Km. above sea-level obtained from pilot balloon ascents.

In Scientific Notes No. 17, the India Meteorological Department published (in the form recommended by the International Commission for Air Navigation) tables of monthly percentage frequencies of upper winds in India for heights up to 3 Km. In the publication under review the tables have been extended from 4 Km. to 10 Km. at 2 Km. intervals, although the limits adopted for grouping the wind speeds have been reclassified according to forces ranging from below 5 m/s to above 40 m/s. The tables have been prepared from all the available data of morning ascents up to the end of 1931—covering an area from Peshawar, Lat. $34^{\circ} 2' N.$, to Trivandrum, Lat. $8^{\circ} 31' N.$, and from Aden, Long. $45^{\circ} 3' E.$, to Rangoon, Long. $96^{\circ} 13' N.$

With the rapid development of new air routes in India, increasing demands will be made for information concerning upper winds. This publication will help the meteorologist to meet these demands. It will also provide valuable material for upper air investigation.

R. G. VERYARD.

On the colours of distant objects, and the visual range of coloured objects.
By W. E. Knowles Middleton. (Trans. Roy. Soc. Can. (Toronto),
XXIX, 1935.)

The author first outlines two usual methods of colour description—the monochromatic, and the Commission Internationale de l'Eclairage (C.I.E.) system; the paper has been carried through using the latter, with occasional transformation of results into terms of the former. He obtains the relation of the mean extinction coefficient, involving integration of brightness terms over the whole range of wave-length. Relations for the three components of colour for black, white and coloured objects at a distance are briefly described, and a considerable part of the paper is devoted to the method of computation of the apparent colours at several distances for a range of colour, together with black and white. He quotes results in an instructive table which gives apparent colour for black, white, red, yellow, green and blue at distances ranging from 10 to 300 Km. Assumptions and the necessary measurements are clearly stated. Visual range of coloured objects is briefly considered, and it

is shown that at distances of the order of the visual range, all objects appear grey. Finally, the problems of the colour of shadows, and the illumination of an object seen at a small angle from the setting sun are suggested for further consideration. It is an interesting paper, but in common with all work on visual range, the sky has necessarily to be considered either as clear or overcast, which constitutes a great restriction.

GEO. W. HURST.

BOOK RECEIVED

On forecasting weather over north-east Baluchistan during the monsoon months, July and August. By A. K. Roy, B.A., B.Sc., and R. C. Bhattacharva, M.Sc., India Meteor. Dept., Sci. Notes, **5**, No. 58.

OBITUARY

We regret to learn of the death on April 9th in Berlin-Friedenau, after a short illness, of Konteradmiral a. D. Alfred Herz. Konteradmiral a. D. Herz was born on April 29th, 1850, and was Director of the Deutsche Seewarte from 1903 to 1911.

Erratum

MAY, 1936, p. 94, Table I, *for* "Range of relative humidity at 3h." *read* "Range of relative humidity at 5h."

The Weather of May, 1936

Pressure was above normal over northern Europe, north-west Siberia, the North Atlantic, the eastern United States and central Canada, the greatest excess being 8·3 mb. at 50° N., 30° W. but below normal over southern and central Europe, Greenland, Alaska, western and eastern Canada and western United States, the greatest deficits being 10·1 mb. at Point Barrow and 3·9 mb. at Cairo. Temperature was above normal in Sweden, but considerably below normal in central and south-east Europe while rainfall was mainly below normal in Sweden and central and south-east Europe except Austria and Hungary where it was much above normal. For the first time monthly climatological broadcasts for Europe have been used in preparing this summary.

The outstanding features of the weather of May over the British Isles were the deficiency of rainfall and the north-easterly winds, and also in England generally the deficiency of sunshine*. An "absolute drought" occurred in several parts of south and east England during the first half of the month. From the 1st to 4th anticyclonic conditions prevailed with rather low temperatures but generally good sunshine records, 13·6 hrs. bright sunshine were registered at Spurn Head on the 1st and 13·5 hrs. at Bath on the 2nd. On the 4th the anticyclone was receding in a north-easterly direction, and on

* see p. 116.

the 5th and 6th a small area of low pressure passed across the south-western districts giving thunderstorms locally over the whole country on those two days; in the north the thunderstorms were accompanied by hail or sleet and in the south and west by moderate to heavy rain especially in Bedfordshire*. Mist or fog were also prevalent during these days but sunshine records were good locally and temperature was high. From the 7th to 9th the winds were light from between east and north and temperature fell considerably in the south. Local mist or fog occurred in the east and south but bright sunshine in the west and north. From the 10th to 14th a "col" extended over the country, day temperatures were generally about or above normal though there were local ground frosts at night and the weather was mainly dry and frequently sunny, 14·6 hrs. at Aberdeen on the 11th, but some local mist or fog occurred on the 11th and 12th. On the 14th a depression approached from the west and temperature rose generally, the 18th being the warmest day of the month in the south, 80° F. at Camden Square, and the 19th, in the north and west, 71° F. at Abbotsinch. Gales were recorded in north Ireland on the 14th and 15th and in north Scotland on the 16th, while thunderstorms were experienced on the 16th in the north and west and on the 17th and 18th in the south and east, 1·49 in. of rain fell at Rothesay on the 16th, 1·45 in. at Dunmanway (Co. Cork) on the 14th and 1·11 in. at Pondsmead (Somerset) on the 18th. By the 17th rain had fallen in most parts of the country breaking the "absolute droughts" which had prevailed in many parts of the south and east from April 26th or 27th. At Selbourne (Hants) the drought, however, was not broken until the 21st and at Oxford and Lexden (Essex) not until the 22nd making a total of 25 days "absolute drought" at Selbourne and Oxford and of 26 days at Lexden. The 18th and 19th were the sunniest days of the period in eastern England, 14·5 hrs. bright sunshine being recorded at York, Cranwell, Mildenhall, Oxford, Hastings and Lympne on the 19th. Except for the 22nd when a shallow depression moved south across the country the winds were between north and east from the 20th to 28th mainly light or moderate but strong on the east coast on the 21st and 27th and in the south-west on the 24th. Temperature was generally low with ground frosts during this period but rose above normal on the 25th to 27th. Rain fell in most parts from the 21st to 24th, while sunshine records were variable on most days but consistently good on the 20th and 21st. Fog occurred locally on the 25th to 26th. From the 28th to 31st a depression moved in a southerly direction to south Scandinavia and cold northerly winds prevailed with occasional rain but sunny periods; hail was reported from many places on the 30th and 31st. Thunderstorms occurred at Guernsey on the 24th, Valentia on the 26th and in the eastern districts on the 30th and 31st. The distribution of bright sunshine for the month was as follows:—

* see p. 115.

	Total	Diff. from		Total	Diff. from
	(hrs.)	normal		(hrs.)	normal
	(hrs.)	(hrs.)		(hrs.)	(hrs.)
Stornoway ...	212	+31	Chester ...	176	+14
Aberdeen ...	200	+27	Ross-on-Wye ...	168	-25
Dublin ...	193	+6	Falmouth ...	213	-2
Birr Castle ...	196	+22	Gorleston ...	164	-65
Valentia... ..	233	+44	Kew	199	-4

Miscellaneous notes on weather abroad culled from various sources

Thick fog was reported in the neighbourhood of Lugano about the 9th and a violent thunderstorm swept over central Switzerland on the evening of the 10th; this was accompanied by hail, and rail and road communications were interrupted for several hours owing to floods—the fruit trees then in blossom were much damaged. Serious floods occurred in many parts of Spain after torrential rains causing much material damage. Northerly gales were experienced over Syria from the 19th–21st. A violent thunderstorm occurred at Siena on the 21st. During a sudden squall on Lake Neuchatel on the 21st, 3 students were drowned. A violent storm in the Gulf of Lions, on the 22nd, delayed inward shipping to Marseilles for 10 hours. Seven gypsies were drowned at Pakratz (Croatia) on the 30th when a sudden cloudburst caused a stream to overflow. (*The Times*, May 11th–30th.)

Snow, which has not been seen in May for many years, occurred on the mountains of Talarna (near Algiers) about the 10th and much damage was done to fruit trees in the same district by sharp frosts at night. Two aeroplanes were wrecked in a fog in Morocco about the 11th. Sixteen people were killed on the 24th when two houses collapsed in Fez (Morocco) as the result of undermining caused by recent heavy rains. Westerly gales occurred near Alexandria on the 29th. (*The Times*, May 11th–30th.)

A severe storm passed over the Kyaukpyu district of Burma on April 25th followed by floods—1,000 people were reported killed. The unusually heavy “little monsoon” reported on the 29th, though very welcome in famine-stricken western Bengal, caused anxiety in Assam where the level of the Brahmaputra was dangerously high. Bombay had several showers of rain and heavy rain was reported from Malabar. A severe storm occurred at Tura (Assam) on the 30th destroying many buildings. (*The Times*, May 4th–June 1st.)

Light and scattered showers prevailed generally in Australia during the middle of the month except along the north coast of Queensland and the north coast of New South Wales, where there were moderate to heavy rains. Light rains and mild sunny weather prevailed generally in New Zealand during the month. (*The Times*, May 27th–30th.)

An unusually early heat wave occurred in central Canada towards the middle of the month and heavy rains about the same time caused floods in the eastern provinces. About the 20th, however,

(continued on p. 128)

Rainfall : May, 1936 : England and Wales

Co.	STATION.	In.	Per cent of Av.	Co.	STATION.	In.	Per cent of Av.
<i>Lond</i>	Camden Square.....	·48	27	<i>Leics</i>	Thornton Reservoir ...	·79	39
<i>Sur</i>	Reigate, Wray Pk. Rd..	·55	30	"	Belvoir Castle.....	1·40	66
<i>Kent</i>	Tenterden, Ashenden...	·34	22	<i>Rut</i>	Ridlington	1·71	85
"	Folkestone, Boro. San.	·15	...	<i>Lincs</i>	Boston, Skirbeck.....	·68	39
"	Margate, Cliftonville...	·23	15	"	Cranwell Aerodrome...	·73	40
"	Eden'bdg., Falconhurst	·61	33	"	Skegness, Marine Gdns.	1·18	69
<i>Sus</i>	Compton, Compton Ho.	·40	18	"	Louth, Westgate.....	2·07	102
"	Patching Farm.....	·59	32	"	Brigg, Wrawby St.....	1·63	...
"	Eastbourne, Wil. Sq....	·21	13	<i>Notts</i>	Worksop, Hodsock.....	·67	34
"	Heathfield, Barklye...	...	...	<i>Derby</i>	Derby, L. M. & S. Rly.	·42	22
<i>Hants</i>	Ventnor, Roy. Nat. Hos.	·22	13	"	Buxton, Terr. Slopes...	·51	16
"	Fordingbridge, Oaklands	1·49	72	<i>Ches</i>	Runcorn, Weston Pt....	1·65	71
"	Ovington Rectory.....	·64	29	<i>Lancs</i>	Manchester, Whit. Pk.	·57	27
"	Sherborne St. John.....	·41	21	"	Stonyhurst College.....	1·74	61
<i>Herts</i>	Royston, Thetfield Rec.	·84	43	"	Southport, Bedford Pk.	·97	46
<i>Bucks</i>	Slough, Upton.....	·43	26	"	Lancaster, Greg Obsy.	1·35	55
"	H. Wycombe, Flackwell	·48	26	<i>Yorks</i>	Wath-upon-Deerne.....	·79	39
<i>Oxf</i>	Oxford, Mag. College...	·42	23	"	Wakefield, Clarence Pk.	1·33	68
<i>N'hant</i>	Wellingboro, Swanspool	1·15	59	"	Oughtershaw Hall.....	1·77	...
"	Oundle	1·17	...	"	Wetherby, Ribston H..	...	...
<i>Beds</i>	Woburn, Exptl. Farm...	1·25	64	"	Hull, Pearson Park.....	1·38	72
<i>Cam</i>	Cambridge, Bot. Gdns.	1·07	61	"	Holme-on-Spalding.....	1·56	77
<i>Essex</i>	Chelmsford, County Gdns	·78	54	"	West Witton, Ivy Ho.	1·99	88
"	Lexden Hill House.....	·72	...	"	Felixkirk, Mt. St. John.	1·26	67
<i>Suff</i>	Haughley House.....	·48	...	"	York, Museum Gdns....	1·31	66
"	Campsea Ashe.....	·70	47	"	Pickering, Hungate.....	1·49	76
"	Lowestoft Sec. School...	·74	46	"	Scarborough.....	2·04	107
"	Bury St. Ed., Westley H.	2·09	115	"	Middlesbrough.....	1·70	89
<i>Norfol.</i>	Wells, Holkham Hall...	2·02	125	"	Baldersdale, Hury Res.	1·99	77
<i>Wilts</i>	Calne, Castle Walk.....	1·14	...	<i>Durh</i>	Ushaw College.....	2·25	104
"	Porton, W.D. Exp'l. Stn.	·66	38	<i>Nor</i>	Newcastle, D. & D. Inst.	1·80	98
<i>Dor</i>	Evershot, Melbury Ho.	·61	30	"	Bellingham, Highgreen	2·00	83
"	Weymouth, Westham.	·51	31	"	Lilburn Tower Gdns....	1·47	64
"	Shaftesbury, Abbey Ho.	·51	24	<i>Cumb</i>	Carlisle, Scaleby Hall...	·76	32
<i>Devon</i>	Plymouth, The Hoe.....	·60	29	"	Borrowdale, Seathwaite	2·00	29
"	Holne, Church Pk. Cott.	1·28	40	"	Borrowdale, Moraine...	1·18	21
"	Teignmouth, Den Gdns.	·76	42	"	Keswick, High Hill.....	1·12	35
"	Cullompton	·65	30	<i>West</i>	Appleby, Castle Bank...	·70	32
"	Sidmouth, U.D.C.....	·78	...	<i>Mon</i>	Abergavenny, Larchf'd	1·43	54
"	Barnstaple, N. Dev. Ath	·67	33	<i>Glam</i>	Ystalyfera, Wern Ho....	1·53	44
"	Dartm'r, Cranmere Pool	1·40	...	"	Cardiff, Ely P. Stn.....	1·94	78
"	Okehampton, Uplands.	·89	33	"	Treherbert, Tynywaun.	1·92	...
<i>Corn</i>	Redruth, Trewirgie.....	1·50	65	<i>Carm</i>	Carmarthen, Coll. Rd.	2·00	73
"	Penzance, Morrab Gdns.	·89	40	<i>Pemb</i>	St. Ann's Hd. C. Gd. Stn.	1·35	71
"	St. Austell, Trevarna...	1·25	52	<i>Card</i>	Aberystwyth	1·86	...
<i>Soms</i>	Chewton Mendip.....	1·08	39	<i>Rad</i>	Birm'W. W. Tyrmynydd	2·23	65
"	Long Ashton.....	1·13	54	<i>Mont</i>	Lake Vyrnwy	1·76	56
"	Street, Millfield.....	1·41	...	<i>Flint</i>	Sealand Aerodrome.....	1·10	...
<i>Glos</i>	Blockley	·72	...	<i>Mer</i>	Dolgelley, Bontddu.....	2·14	65
"	Cirencester, Gwynfa....	1·27	62	<i>Carn</i>	Llandudno	3·03	170
<i>Here</i>	Ross, Birchlea.....	·76	36	"	Snowdon, L. Llydaw 9..	3·46	...
<i>Salop</i>	Church Stretton.....	1·12	43	<i>Ang</i>	Holyhead, Salt Island...	1·22	62
"	Shifnal, Hatton Grange	1·70	82	"	Lligwy	1·87	...
<i>Staffs</i>	Market Drayt'n, Old Sp.	·70	32	<i>Isle of Man</i>			
<i>Worc</i>	Ombersley, Holt Lock.	1·09	53		Douglas, Boro' Cem....	3·11	124
<i>War</i>	Alcester, Ragley Hall...	·99	48	<i>Guernsey</i>			
"	Birmingham, Edgbaston	·99	46		St. Peter P't. Grange Rd.	·72	42

Rainfall: May, 1936: Scotland and Ireland

Co.	STATION.	In.	Per cent of Av.	Co.	STATION.	In.	Per cent of Av.
<i>Wig</i>	Pt. William, Monreith.	3.56	152	<i>Suth</i>	Tongue	1.26	53
	New Luce School.....	4.14	145		Melvich.....	1.26	61
<i>Kirk</i>	Dalry, Glendarroch.....	1.86	59		Loch More, Achfary....	1.44	33
	Carsphairn, Shiel.....	...	...	<i>Caith</i>	Wick	1.96	95
<i>Dumf.</i>	Dumfries, Crichton R.I.	1.35	52	<i>Ork</i>	Deerness	1.23	61
	Eskdalemuir Obs.....	.60	18	<i>Shet</i>	Lerwick .....	.91	44
<i>Roxb</i>	Hawick, Wolfelee.....	.86	38	<i>Cork</i>	Dunmanway Rectory...	2.04	60
<i>Selk</i>	Ettrick Manse.....	.59	16		Cork, University Coll...	1.38	61
<i>Peeb</i>	West Linton.....	.67	...		Ballinacurra.....	1.29	54
<i>Berw</i>	Marchmont House.....	1.56	63		Mallow, Longueville....	1.72	77
<i>E.Lot</i>	North Berwick Res.....	1.98	100	<i>Kerry</i>	Valentia Obsy.....	2.09	66
<i>Midl</i>	Edinburgh, Blackfd. H.	.83	40		Gearhameen.....	2.80	53
<i>Lan</i>	Auchtyfardle	1.25	...		Bally McElligott Rec...	1.68	...
<i>Ayr</i>	Kilmarnock, Kay Pk....	1.76	...		Darrynane Abbey.....	1.34	45
	Girvan, Pinmore.....	3.23	108	<i>Wat</i>	Waterford, Gortmore...	1.45	63
<i>Renf</i>	Glasgow, Queen's Pk....	1.66	68	<i>Tip</i>	Nenagh, Cas. Lough....	1.24	50
	Greenock, Prospect H...	2.73	79		Roscrea, Timoney Park	.91	...
<i>Bute</i>	Rothsay, Ardenraig...	3.08	...		Cashel, Ballinamona....	1.18	50
	Dougarie Lodge.....	3.34	...	<i>Lim</i>	Foynes, Coolnanes.....	1.10	47
<i>Arg</i>	Ardgour House.....	3.34	...		Castleconnel Rec.....	.78	...
	Oban.....	2.93	...	<i>Clare</i>	Inagh, Mount Callan....	2.12	...
	Poltalloch.....	5.87	186		Broadford, Hurdlest'n.	1.17	...
	Inveraray Castle.....	3.65	93	<i>Wexf</i>	Gorey, Courtown Ho....	1.33	60
	Islay, Eallabus.....	2.49	94	<i>Wick</i>	Rathnew, Clonmannon.	1.52	...
	Mull, Benmore.....	6.55	88	<i>Carl</i>	Hacketstown Rectory...	.98	38
	Tiree	2.30	92	<i>Leix</i>	Blandsfort House.....	1.08	44
<i>Kinr</i>	Loch Leven Sluice.....	.57	23	<i>Offaly</i>	Birr Castle.....	2.50	112
<i>Fife</i>	Leuchars Aerodrome...	...	...	<i>Dublin</i>	Dublin, FitzWm. Sq....	1.18	58
<i>Perth</i>	Loch Dhu.....	2.60	58		Balbriggan, Ardgillan...	...	...
	Balquhidder, Stronvar.	2.33	...	<i>Meath</i>	Beauparc, St. Cloud....	1.67	...
	Crieff, Strathearn Hyd.	1.45	58		Kells, Headfort.....	1.78	66
	Blair Castle Gardens...	.87	43	<i>W.M</i>	Moate, Coolatore.....	1.33	...
<i>Angus</i>	Kettins School.....	.46	17		Mullingar, Belvedere...	1.28	52
	Pearsie House.....	.96	...	<i>Long</i>	Castle Forbes Gdns.....	1.24	48
	Montrose, Sunnyside...	1.04	51	<i>Gal</i>	Galway, Grammar Sch.	1.12	...
<i>Aber</i>	Braemar, Bank.....	2.43	102		Ballynahinch Castle...	2.11	59
	Logie Coldstone Sch....	1.47	59		Ahascragh, Clonbrock.	1.21	44
	Aberdeen, Observatory.	1.18	51	<i>Mayo</i>	Blacksod Point.....	2.39	85
	Fyvie Castle.....	1.26	49		Mallaranny	1.85	...
<i>Moray</i>	Gordon Castle.....	.82	39		Westport House.....	2.08	73
	Grantown-on-Spey .....	...	...		Delphi Lodge.....	4.09	68
<i>Nairn</i>	Nairn	1.17	65	<i>Sligo</i>	Markree Castle.....	1.75	64
<i>Inw's</i>	Ben Alder Lodge.....	1.19	...	<i>Cavan</i>	Crossdoney, Kevit Cas.	1.92	...
	Kingussie, The Birches.	1.77	...	<i>Ferm</i>	Enniskillen, Portora...	1.66	...
	Loch Ness, Foyers	1.14	47	<i>Arm</i>	Ernagh Obsy.....	1.56	66
	Inverness, Culduthel R.	.83	...	<i>Down</i>	Fofanny Reservoir.....	2.97	...
	Loch Quoich, Loan.....	2.65	...		Seaforde	1.71	65
	Glenquoich.....	2.57	47		Donaghadee, C. G. Stn.	1.89	84
	Glenleven, Corrour	2.28	59		Banbridge, Milltown...	...	...
	Fort William, Glasdrum	2.45	...	<i>Antr</i>	Belfast, Cavehill Rd....	1.58	...
	Skye, Dunvegan.....	2.32	...		Aldergrove Aerodrome.	1.30	57
	Barra, Skallary.....	2.30	...		Ballymena, Harryville.	1.91	67
<i>R&C</i>	Alness, Ardrross Castle.	1.35	52	<i>Lon</i>	Garvagh, Moneydig....	1.29	...
	Ullapool	1.13	44		Londonberry, Creggan.	1.62	62
	Achnashellach	1.80	40	<i>Tyr</i>	Omagh, Edenfel.....	2.16	83
	Stornoway, Matheson...	1.10	43	<i>Don</i>	Malin Head.....	.85	...
<i>Suth</i>	Lairg.....	1.07	42		Killybegs, Rockmount.	.89	...

Climatological Table for the British Empire, December, 1935

STATIONS.	PRESSURE.		TEMPERATURE.							Relative Humidity.	Mean Cloud Am't	PRECIPITATION.		BRIGHT SUNSHINE.	
	Mean of Day M.S.L.	Diff. from Normal.	Absolute.			Mean Values.						Am't.	Diff. from Normal.		
			Max.	Min.	°F.	Max.	Min.	°F.	Max. 1 and 2 Min.						Diff. from Normal
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	%	0-10	In.	In.	Days.	Hours per age of day.	Per cent. of possible.
London, Kew Obsy....	1003.9	- 9.8	51	25	43.0	35.8	39.4	- 0.9	88	8.4	2.15	- 0.14	21	1.1	14
Gibraltar.....	1017.5	- 2.8	65	42	58.9	50.6	54.7	...	78	5.7	4.48	...	9	...	...
Malta.....	1012.5	- 3.7	68	49	61.6	53.9	57.7	- 0.2	75	6.7	3.70	0.01	18	5.0	52
St. Helena	1013.1	- 0.2	69	55	64.5	56.6	60.5	- 1.2	93	9.4	0.80	...	18	...	...
Freetown, Sierra Leone	1012.3	+ 3.1	89	69	83.2	72.7	79.5	- 1.9	77	4.1	1.35	0.07	3	...	...
Lagos, Nigeria	1010.7	+ 0.7	90	74	87.4	75.9	81.7	- 0.1	89	5.7	0.43	- 0.38	2	6.8	53
Kaduna, Nigeria	1009.5	...	96	52	91.3	56.1	73.7	+ 0.4	48	2.5	0.00	0.00	0	9.0	78
Zomba, Nyasaland	1009.1	+ 0.8	88	56	81.1	63.7	72.4	- 0.7	75	6.7	8.01	- 2.86	13	...	...
Salisbury, Rhodesia...	1010.2	- 0.2	89	49	81.0	58.7	69.9	+ 0.3	58	5.0	3.39	- 2.70	12	7.4	56
Cape Town	1015.0	+ 0.7	101	50	79.5	57.7	68.6	+ 0.7	61	3.1	0.33	- 0.48	6	...	...
Johannesburg	1011.3	+ 1.0	87	42	77.4	54.0	65.7	+ 0.2	61	4.7	5.85	+ 0.42	18	7.9	58
Mauritius	1013.5	- 0.5	91	64	87.4	73.4	80.4	+ 2.1	69	5.9	3.82	- 0.91	17	8.4	63
Bombay	1012.8	- 0.7	91	65	86.4	70.0	78.2	+ 0.8	75	2.1	0.00	- 0.05	0*	...	...
Calcutta, Alipore Obsy.	1015.3	- 0.4	83	50	80.2	56.6	68.4	+ 1.9	83	2.1	0.21	- 0.03	1*	...	...
Madras	1013.0	- 0.5	85	66	83.4	70.0	76.7	0.0	84	6.0	2.35	- 3.00	3*	...	...
Colombo, Ceylon	1010.8	+ 0.5	89	71	85.1	73.3	79.2	- 0.3	75	6.6	9.93	4.81	13	5.9	50
Singapore	1009.8	+ 0.1	89	72	84.8	74.5	79.7	- 0.2	81	7.0	9.39	1.17	19	4.9	41
Hongkong	1020.0	+ 0.3	78	47	65.1	56.3	60.7	- 2.3	74	6.9	1.04	0.01	7	4.2	39
Sandakan	1010.0	...	91	73	86.9	74.5	80.7	+ 0.5	82	8.3	9.68	8.96	21	...	...
Sydney, N.S.W.	1012.5	+ 0.6	89	54	74.4	62.7	68.5	- 1.6	70	7.7	4.70	1.84	18	6.4	45
Melbourne	1014.2	+ 1.5	98	47	76.9	55.1	65.0	+ 1.2	56	6.8	1.33	0.74	12	7.2	48
Adelaide	1014.5	+ 1.3	102	49	83.0	59.0	71.0	- 0.1	35	5.1	1.16	0.16	6	9.6	67
Perth, W. Australia	1012.7	+ 1.5	102	44	87.0	58.8	72.9	- 2.8	61	4.4	0.39	- 0.30	2	...	...
Coolgardie	1011.9	- 0.1	97	61	84.5	67.8	76.1	- 0.3	62	5.2	3.63	1.26	9	8.8	64
Brisbane	1014.1	+ 4.4	91	47	66.9	52.2	59.5	- 0.7	66	6.8	3.25	1.26	14	5.8	38
Hobart, Tasmania.	1021.3	+ 9.1	74	48	68.3	55.9	62.1	+ 1.9	77	7.9	3.09	0.13	8	7.3	48
Wellington, N.Z.	1009.8	+ 1.2	88	71	84.1	73.0	79.1	+ 0.1	82	7.6	14.92	2.40	24	4.9	37
Suva, Fiji	1007.7	- 0.6	87	71	85.3	74.2	79.7	+ 0.4	79	6.9	16.40	2.51	18	5.2	40
Apia, Samoa	1013.7	- 0.3	91	66	85.9	68.9	77.4	- 0.3	84	2.6	0.74	0.85	4	6.3	57
Kingston, Jamaica	1011.1	- 0.7	89	70	85	73	79	+ 0.8	74	4	4.97	2.23	22	...	...
Grenada, W.I.	1019.9	+ 2.3	44	-6	27.9	17.4	22.7	- 4.4	77	8.2	0.60	1.87	8	1.8	20
Toronto	1021.9	+ 3.2	32	-24	14.7	0.0	7.3	+ 1.5	...	6.1	0.96	0.02	13	1.7	21
Winnipeg	1010.3	- 3.7	40	-2	26.5	16.6	21.5	+ 2.9	81	7.0	1.98	2.19	3	2.8	32
St. John, N.B.	1015.4	- 1.3	52	35	47.5	41.3	44.4	+ 3.3	91	6.8	1.67	4.07	22	2.8	33
Victoria, B.C.	1015.4	- 1.3	52	35	47.5	41.3	44.4	+ 3.3	91	6.8	1.67	4.07	22	2.8	33

(continued from p. 123)

the weather turned cold in Ontario—snow fell in many parts and frost did much damage to crops and orchards. Unseasonably high temperatures and strong winds were experienced in western Canada at the end of the month. In the United States temperature was considerably above normal during the first half of the month, becoming about or somewhat above normal during the later half, while rainfall was mainly below normal. (*The Times*, May 12th–June 3rd, and *Washington, D.C., U.S. Dept. Agric. Weekly Weather and Crop Bulletin*.)

Daily Readings at Kew Observatory, May, 1936

Date	Pressure, M.S.L. 13h.	Wind, Dir., Force 13h.	Temp.		Rel. Hum. 13h.	Rain.	Sun.	REMARKS. (see vol. 69, 1934, p. 1).
			Min.	Max.				
	mb.		°F	°F	%	in.	hrs.	
1	1027.8	ENE.3	41	54	62	—	2.6	
2	1028.5	E.3	39	55	60	—	4.1	
3	1026.4	ENE.3	43	57	61	—	5.4	
4	1015.3	ENE.4	47	62	56	—	7.8	
5	1007.6	E.4	48	68	57	—	7.5	m early.
6	1007.9	WSW.2	48	72	56	—	10.2	mw early., t 17h.
7	1013.1	N.4	51	61	77	—	8.0	
8	1014.2	N.4	48	55	69	—	0.0	
9	1014.5	NNW.2	46	55	79	—	0.0	
10	1015.6	WNW.2	48	62	70	—	2.0	
11	1017.9	N.2	45	67	48	—	9.4	
12	1018.0	N.1	45	62	63	—	0.8	w early.
13	1018.9	SSW.2	52	68	57	—	6.3	w early.
14	1020.5	WSW.2	48	68	58	—	8.9	
15	1013.9	S.4	44	73	53	—	8.6	
16	1008.5	ESE.4	55	77	35	—	12.4	
17	1012.0	E.2	55	72	57	0.07	4.2	tlr 15h.–17h., F 22h.
18	1017.5	ENE.4	52	75	52	—	12.9	Fw early.
19	1018.7	ENE.4	52	71	43	—	14.2	
20	1017.6	N.5	46	62	59	—	9.6	
21	1017.4	N.5	41	54	49	0.08	9.3	pr 14h., 16h. & 18h.
22	1012.6	N.2	37	69	47	0.17	7.2	t 15h., r-r ₀ 18h.–24h.
23	1010.0	ENE.4	48	55	59	0.11	2.1	r-r ₀ 0h.–9h.
24	1010.7	NE.3	45	61	48	—	5.8	
25	1016.1	E.2	49	68	53	—	6.1	
26	1019.5	NE.3	47	64	66	—	7.6	
27	1019.2	NNE.3	53	64	70	—	4.0	d ₀ early.
28	1021.6	N.3	46	52	60	—	0.3	
29	1010.9	WSW.3	38	63	42	—	8.1	
30	1002.8	SSW.2	48	57	72	0.09	1.9	r 10h.–11h. & 15h.–16h.
31	1013.2	W.3	40	56	40	—	11.3	pr ₀ 20h.
*	1015.8	—	47	63	57	0.51	6.4	* Means or totals.

General Rainfall for May, 1936

England and Wales	...	53	} per cent. of the average 1881–1915
Scotland	...	65	
Ireland	...	61	
British Isles	...	58	



FIG. 1 (a).—WIND VANE MAST WITH
10 FT. AND 20 FT. THERMOMETERS

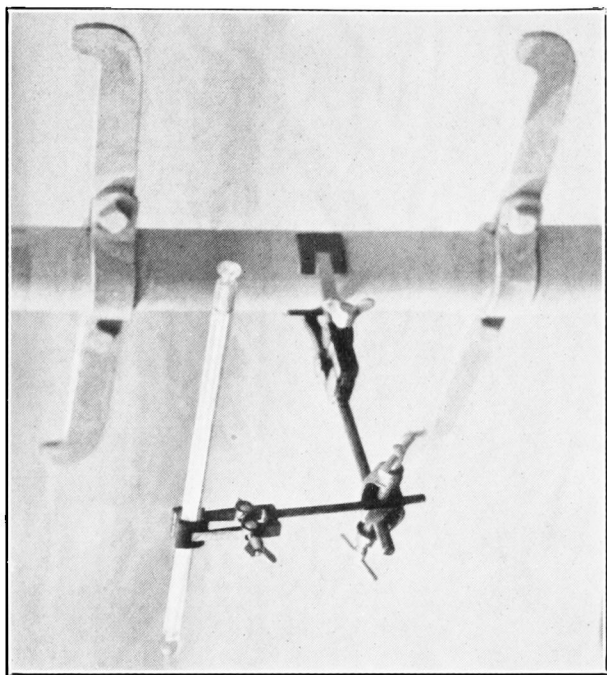


FIG. 1 (b).—DETAILS OF FIXING OF THERMOMETERS TO MAST