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DR. J. M. STAGG, C.B., O.B.E., F.R.S.E.

By the DIRECTOR-GENERAL

On 7 September of this year the Meteorological Office lost the services of Dr. J. M. Stagg, the Director of Services. He has given 36 years of his life to the service of his country in the fields of meteorology and geomagnetism.

Dr. Stagg, as everyone knows, is a Scot; he comes from Dalkeith, Midlothian, and was educated at Broughton School, Edinburgh, and afterwards at Edinburgh University. After a brief spell as Science Master at George Heriot's School, Edinburgh, he entered the Meteorological Office in 1924 as a Professional Assistant. In 1932 he was chosen to lead the British Polar Year Expedition to Fort Rae, in arctic Canada. This expedition played a conspicuous part in the 1932–33 Polar Year, a forerunner of the International Geophysical Year, and its results have now become part of the classical literature of geophysics. The field covered was wide, including meteorology, terrestrial magnetism, auroral activity and atmospheric electricity, and those who know Dr. Stagg will see in this list an early indication of his wide knowledge of the earth sciences. His work soon began to be well known, especially his studies in geomagnetism, and his appointment in 1939 as Superintendent of Kew Observatory was a natural consequence of his interests in geophysics generally. At Kew he did some notable work in radiation, but with the outbreak of war, it soon became evident that his knowledge and experience had to be used more directly to assist the national effort.

What followed has now become history. In 1943 Dr. Stagg was made Chief Meteorological Adviser to the Supreme Commander, Allied Forces, Europe, and on D-Day 1944 he carried out the famous briefings of General Eisenhower which led to the successful assault on the beaches of Normandy. Never before had so much depended upon a meteorological forecast, and the conditions could hardly have been more difficult, but the job was done, with results that are now familiar to all. For his services to the Allies, Dr. Stagg was made an Officer of the Legion of Merit by the President of the United States of America.

After the war Dr. Stagg was made Principal Deputy Director of the Meteorological Office and later, following the report of Lord Brabazon's Committee, became the Director of Services. In this capacity he has been responsible for the "operational" side of the Office. His keen physical insight and long experience, coupled with an outstanding devotion to duty, have made him conspicuously successful in directing those aspects of the work of the national meteorological service which bring the Office into direct contact with the users, be they military or civil. It is fitting that this part of his life as a Civil Servant should also see his election to the Presidency of the Royal Meteorological Society.

He is, however, much more than a meteorologist, and for many years he has been closely associated with the International Union of Geodesy and Geophysics, of which he was for a time General Secretary, an arduous duty which he carried out with outstanding success. In 1954 he was created C.B., and his contributions to geomagnetism were recognized internationally in 1955 by the award of the Gauss-Weber Medal at Göttingen.

Throughout the whole of his career as a Civil Servant Dr. Stagg has maintained a high standard of scientific and professional integrity and has not spared himself in his efforts to maintain the traditions of the Office, both as a public service and as a scientific institution. His deep knowledge of atmospheric processes and his clear, rigorous thinking, especially in synoptic work, are known and valued throughout the world of meteorology. He has always given of himself more than he has asked of others, and with his departure the Office loses one whose technical judgement in the most difficult of all branches of physics is unexcelled. We wish him and Mrs. Stagg, whose work with the Royal Meteorological Society will always be remembered with appreciation, a serene and happy future, secure in the knowledge of a distinguished career and a task well done.

THE USE OF 1000–500 MB THICKNESS TO DETERMINE THE FREEZING LEVEL

By G. J. JEFFERSON, M.Sc.

Forecasts of freezing level are usually made with the use of upper air soundings plotted on the tephigram or other upper air diagram. Over areas where no soundings are available some estimate can usually be made from the synoptic situation, type of air mass, surface air temperature and estimated lapse rate near the surface.

Murray[1] has considered the relationship between the 1000–700 mb thickness and the height of the freezing level in polar air over the British Isles during a five-day period of unsettled weather. He has shown that in this rather limited case there was a correlation coefficient of 0·945 between the two variables. This note will endeavour to show that some use can also be made of the more readily available 1000–500 mb thickness charts over wide areas under any conditions. It should be especially useful over areas such as the oceans where soundings are sparse. Maximum and minimum as well as mean values of freezing level obtained by this method can be a useful confirmation of heights already estimated as well as giving a guide over areas where even surface temperatures are not available.

In discussing the relationship between freezing level and 1000–500 mb thickness it is convenient to consider the range of thickness which can occur with given freezing levels. In the first instance, only a simple freezing level is considered with all the air below it at a temperature above 0°C. Average values can be obtained from soundings which follow the saturated adiabatic lapse rate through the whole 1000–500 mb layer (for example, KJ in Figure 1). The relation between thickness and freezing level (above the 1000 mb level) of such soundings is shown in Figure 2. Thickness values are given in geopotential metres but, as in most forecasts, feet are used for freezing levels.

There are, however, maximum and minimum possible values of thickness for any given freezing level. Two hypothetical soundings shown on a tephigram in Figure 1 illustrate this. Discounting super-adiabatic lapse rates, and freezing layers at lower levels, ABC represents the smallest possible thickness having the same freezing level as KJ. AB is an isothermal at a little above 0°C (taken at 0·5°C) and BC is a dry adiabatic from the top of this layer to 500 mb. DEF represents the maximum possible thickness with the same freezing level, DE being a dry adiabatic from 1000 mb to a temperature just below 0°C (taken at − 0·5°C) and EF an isothermal at − 0·5°C from the top of this dry adiabatic layer to 500 mb.

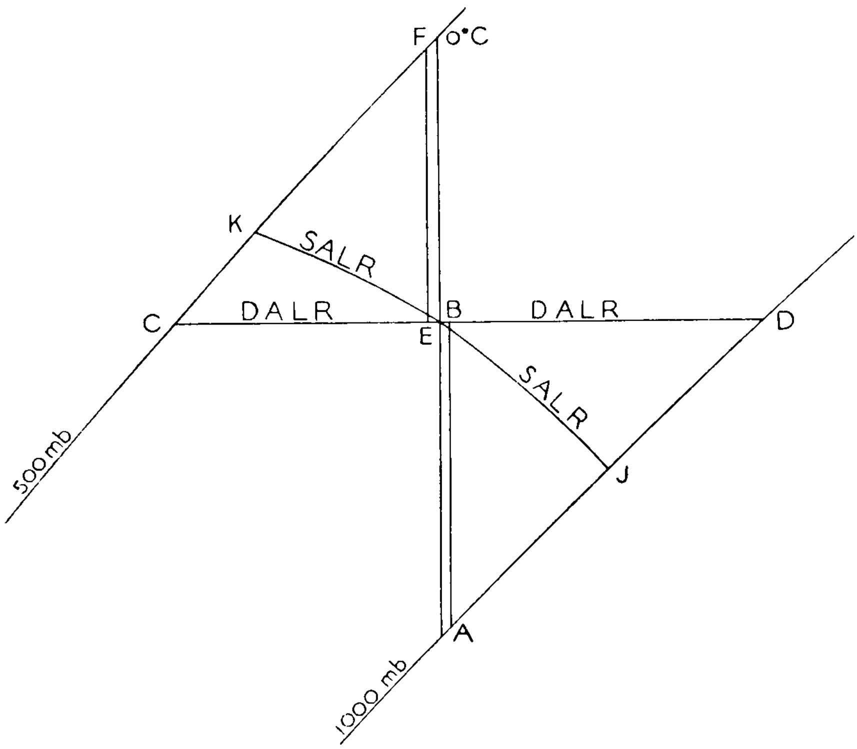


FIGURE 1—TEPHIGRAM ILLUSTRATING MAXIMUM AND MINIMUM POSSIBLE THICKNESS FOR A GIVEN FREEZING LEVEL

Values of absolute minimum and absolute maximum thicknesses computed in this way for freezing levels from the surface up to near the 500 mb level are shown on Figure 2 as pecked lines. An examination of Figure 2 reveals that the possible range of freezing level for any given value of thickness is in most cases much too great for practical use in forecasting. With a thickness of 5550 geopotential metres the average freezing level would be at 10,000 feet, the maximum at 16,600 feet and the minimum at 3200 feet. At any thickness below about 5520 geopotential metres a freezing level at the surface is possible, while at this thickness the maximum freezing level is 13,700 feet.

A consideration of the hypothetical maximum and minimum thickness soundings reveals that some are very far from being realized in practice. With a freezing level of 1000 feet the sounding for an absolute maximum thickness shows a dry adiabatic from 1000 to about 960 mb and an isothermal layer at − 0·5°C through the entire layer between 960 and 500 mb. Such an assumption is obviously quite unrealistic as soundings of this type are clearly unknown. Experience would

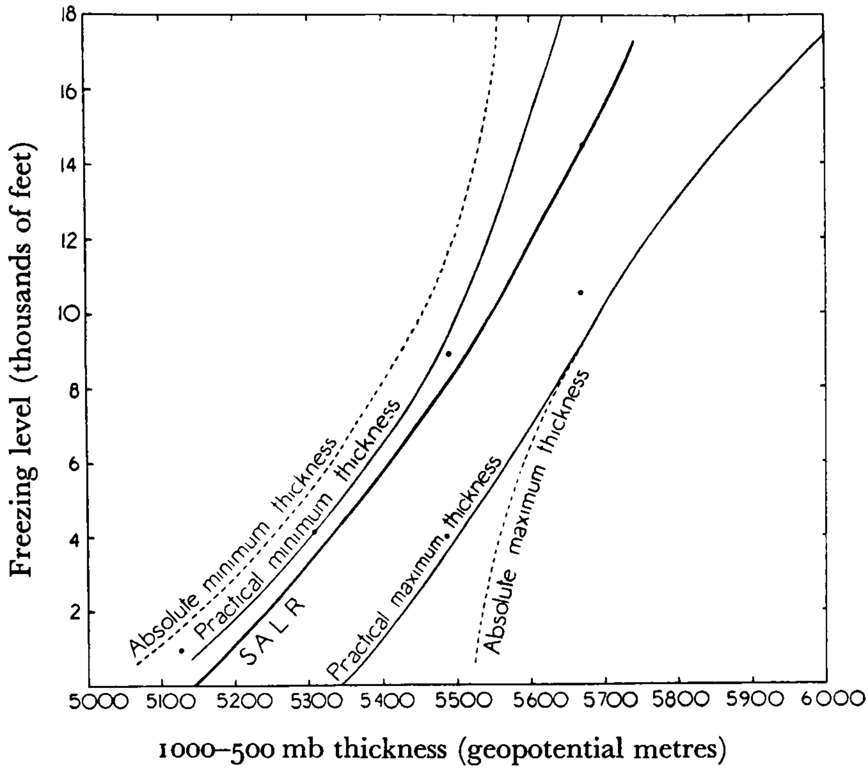
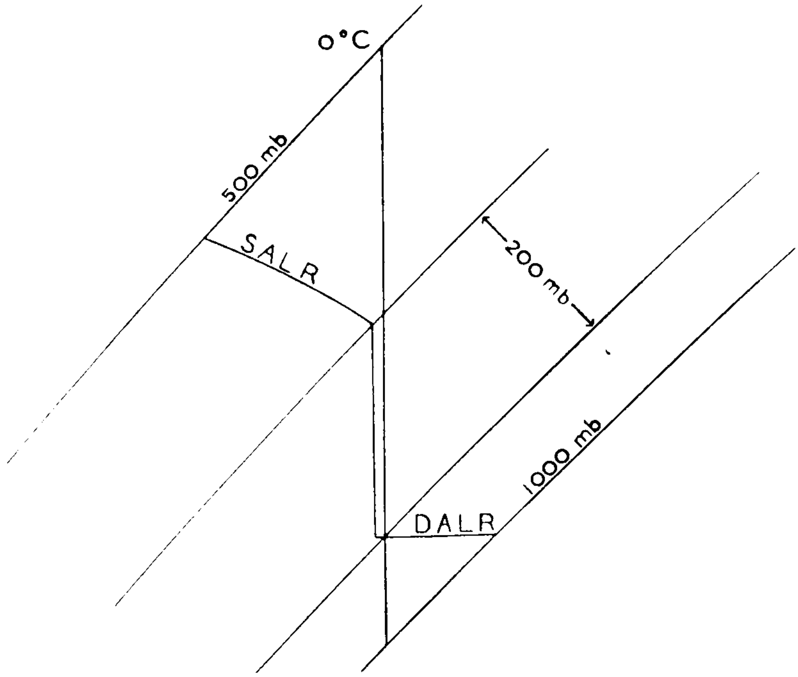


FIGURE 2—CALCULATED RELATION BETWEEN THICKNESS AND FREEZING LEVEL

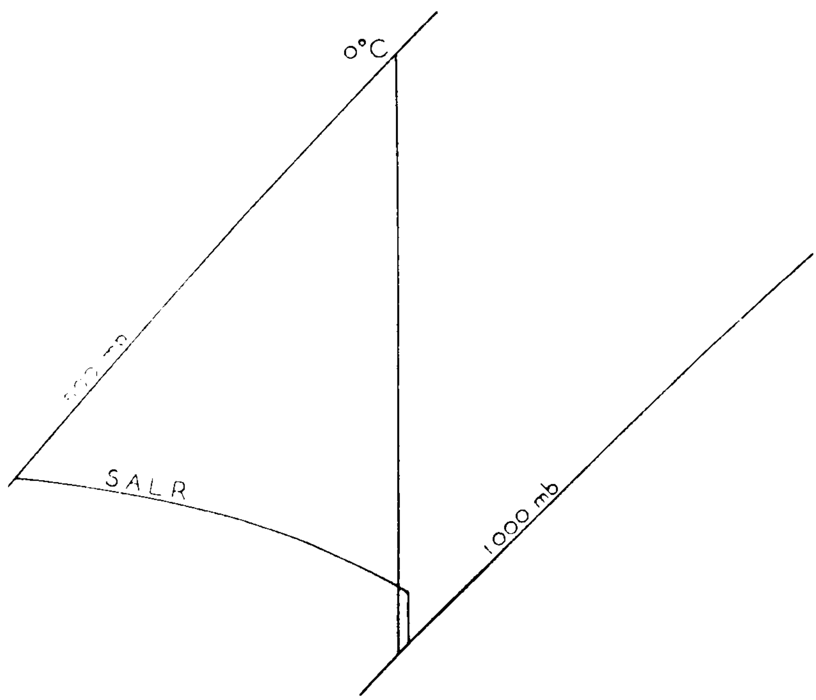
The dots are highest and lowest freezing levels observed by Lamb.[2]

suggest that such an isothermal layer would be limited to not more than 200 mb. A new "practical maximum thickness" sounding has therefore been assumed as shown in Figure 3(*a*) with a dry adiabatic from 1000 mb to the level of $-0{\cdot}5$°C, an isothermal for 200 mb above this and a saturated adiabatic from the top of this layer to 500 mb. A new series of thicknesses have been calculated for various freezing levels and are shown in Figure 2 as the "practical maximum". This is of course tangential to the absolute maximum curve at a freezing level which occurs when the top of the dry adiabatic layer is at 700 mb.

Similarly, a sounding which gives a hypothetical minimum thickness for a freezing level of only a little below 500 mb would involve an isothermal a little above 0°C through most of the 1000–500 mb layer which is again quite unrealistic. Experience and theory again suggest limiting factors. Especially with low freezing levels it is rare to find a deep dry adiabatic layer surmounting an isothermal (or stable or inversion) layer at the surface. The dry adiabatic has therefore been replaced by a saturated adiabatic as shown in Figure 3(*b*). As the freezing level gets higher the curve resembles the anticyclonic subsidence type but experience suggests an upper limit of about 700 mb for the stable layer. At higher levels, therefore, the saturated adiabatic has been carried down to 700 mb in each case. Below this a useful working minimum thickness is provided by an inversion drawn as a straight line from 700 mb to 1000 mb at 0°C, as shown by LST in Figure 4. A succession of such profiles was used to complete the upper part of the "practical minimum thickness" line in Figure 2. Since in most cases the anticyclonic inversion will be well below 700 mb, a thickness value much nearer the mean is probable. LXW in Figure 4 illustrates this.



(*a*)



(*b*)

FIGURE 3—TEPHIGRAM ILLUSTRATING PRACTICAL MAXIMUM AND MINIMUM THICKNESS

The curves of Figure 2 show that below about 10,000 feet the maximum height of freezing level is not far above the average height but that the lowest freezing level is some way below. In many cases knowledge of the synoptic situation can help to decide whether the freezing level is nearer to the highest or lowest values. While these practical upper and lower limits of freezing level for any thickness are occasionally exceeded in an air mass with a very unusual tephigram profile they serve as useful working limits.

Figures given by Lamb[2] of the highest and lowest freezing levels on 293 ascents at upper air stations over Europe and the North Atlantic in 1951 lie, with one exception, within the practical minimum and practical maximum lines on Figure 2. These values, taken from Table 4 of Lamb's paper and converted into feet, are shown in Figure 2.

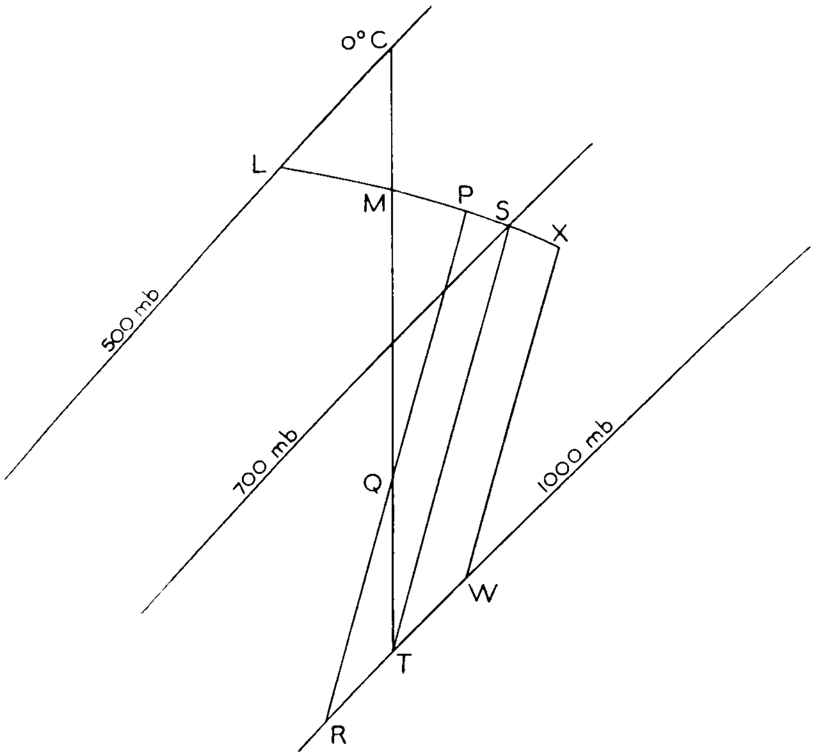


FIGURE 4—TEPHIGRAM SHOWING THE EFFECT OF AN INVERSION

In order to further investigate the validity of the "practical maximum" and "practical minimum" curves of Figure 2 an examination was made of 2751 upper air soundings from stations for which data were readily available. They were chosen to cover as wide an area and variety of climatic régime as possible, where the radio-sonde network is not dense and where thickness charts are normally available. Stations from the dense networks of north-west Europe were deliberately omitted. Those chosen were Gibraltar and Malta, representing western Mediterranean conditions, and Ocean Weather Stations "J" and "I" to represent the eastern North Atlantic. In each case all available ascents for January, April, July and October in 1958 and 1959 were used. The data for four Arctic and sub-Arctic stations for the same four months in one year (1959) were also used. These were Danmarkshavn in north-east Greenland, Jan Mayen, Bear Island and Ocean Weather Station "M".

Taking the stations of each of the three areas together, freezing level (in feet) was plotted against 1000–500 mb thickness (in geopotential metres). When there was a multiple freezing level the highest one was used. Since there can be no minimum thickness when the freezing level is at the surface, ascents in which this occurred were omitted, but the greatest thickness which occurred with a surface freezing level is shown for each station in Table I. The number of occurrences of freezing levels at the surface is also shown in Table I.

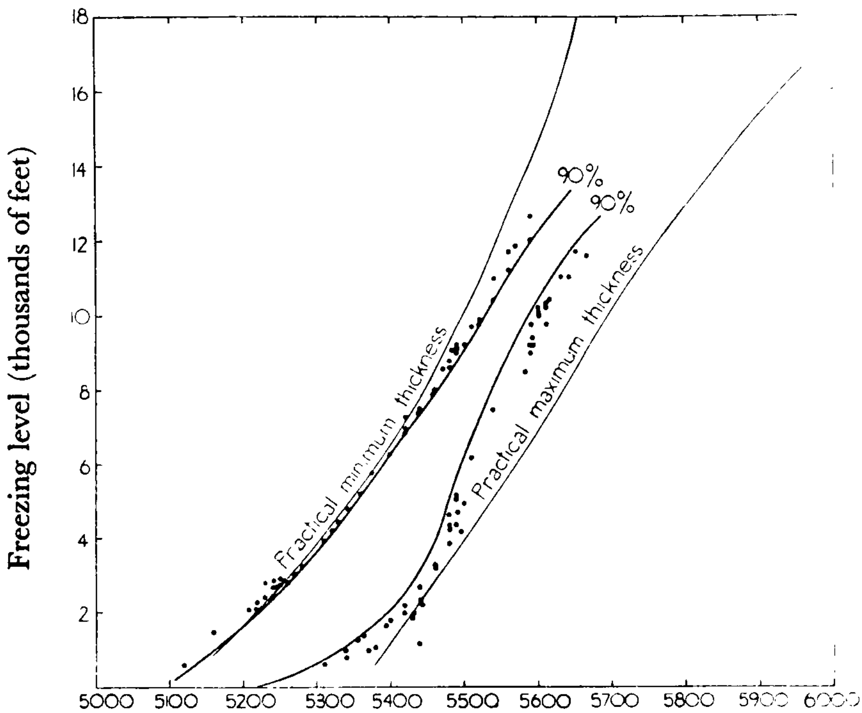
TABLE I

		Gibraltar	Malta	Station "J"	Station "I"	Jan Mayen	Danmarkshavn	Bear Island	Station "M"
					number of occasions				
January	(*a*)	0	0	0	7	52	49	12	19
	(*b*)	2	6	4	3	0	0	0	0
	No. of obs.	123	124	124	124	52	49	50	57
April	(*a*)	0	0	0	0	43	36	33	8
	(*b*)	8	1	7	2	0	0	0	0
	No. of obs.	120	120	120	114	47	36	35	60
July	(*a*)	0	0	0	0	3	3	0	0
	(*b*)	0	0	2	2	8	5	3	1
	No. of obs.	124	124	122	122	60	30	59	60
October	(*a*)	0	0	0	0	10	21	29	0
	(*b*)	1	3	5	7	2	2	8	1
	No. of obs.	120	120	124	124	58	24	59	62
Total	(*a*)	0	0	0	7	108	109	74	27
	(*b*)	11	10	18	14	10	7	11	2
	No. of obs.	487	488	490	487	216	141	203	239
					per cent				
Total	(*a*)	0	0	0	1·4	50·4	77·3	36·4	11·3
	(*b*)	2·2	2·0	3·6	2·8	4·1	4·9	5·4	1·2
					metres				
Maximum thickness with freezing level at surface		—	—	—	5130	5370	5440	5400	5300

(*a*), freezing level at surface; (*b*), multiple freezing level.

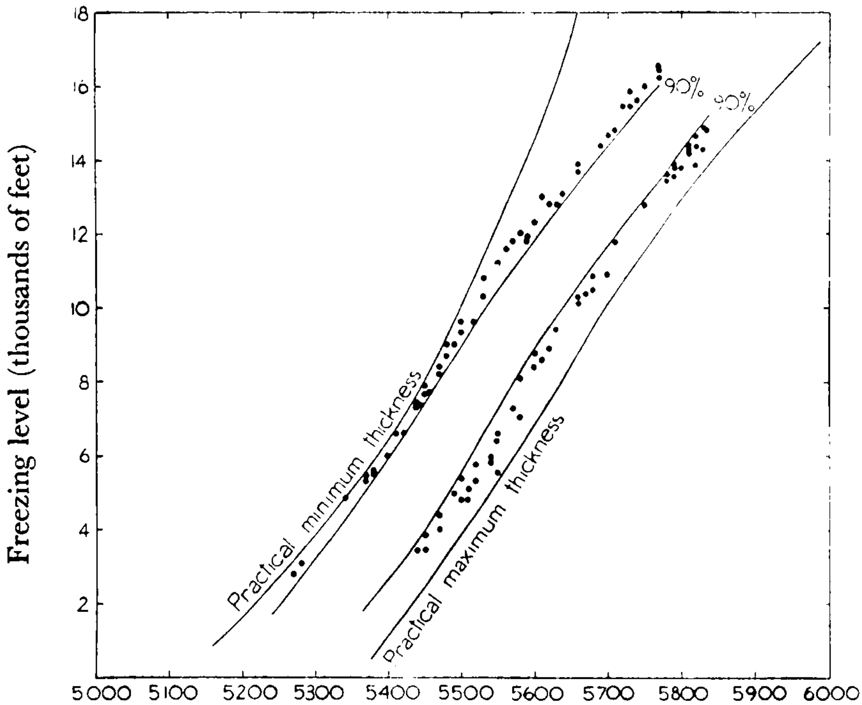
In each case two lines were drawn enclosing 90 per cent of the plots, leaving 5 per cent above the upper and 5 per cent below the lower line. Figures 5(*a*)–5(*c*) show these lines for each of the three areas together with the "practical minimum" and "practical maximum" lines of Figure 2. The individual plots outside the 90 per cent lines are also shown. It will be seen that with very few exceptions all points lie within the "practical maximum" and "practical minimum" thickness lines of Figure 2. All these areas show that when the freezing level is high its range of values for any thickness is appreciably smaller than that given by the "practical minimum" and "practical maximum" lines.

The Atlantic and Arctic stations show notably smaller thicknesses at high freezing levels than those given by the "practical maximum" value. This is probably due to the fact that deep isothermal (or stable or inversion) layers are rare at high levels. With Malta and Gibraltar (Figure 5(*b*)), however, the lower 90 per cent line approaches the "practical maximum" much more closely. This is probably due to the character of warm subtropical anticyclonic air of the Mediterranean summer. The Atlantic and Arctic stations show a range of thickness values when freezing levels are low, nearly as great as the "practical minimum"–"practical maximum" range. The two Mediterranean stations experienced no really low freezing levels in the months surveyed.



1000–500 mb thickness (geopotential metres)

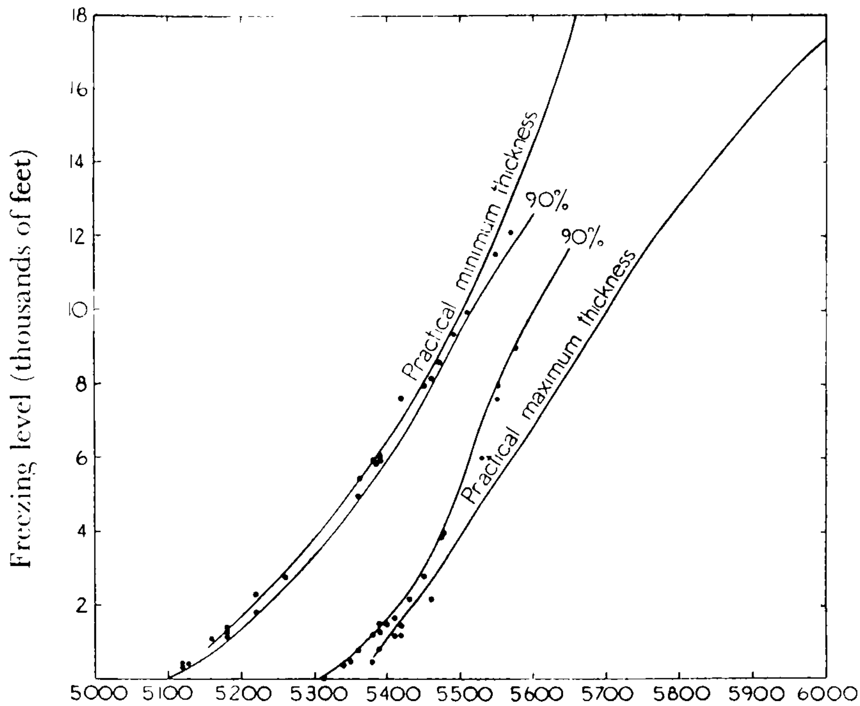
(*a*) Ocean Weather Stations "I" and "J", 1958–59



1000–500 mb thickness (geopotential metres)

(*b*) Malta and Gibraltar, 1958–59

FIGURE 5—PRACTICAL MAXIMUM AND MINIMUM THICKNESS LINES COMPARED WITH OBSERVATIONS



1000–500 mb thickness (geopotential metres)

(*c*) Danmarkshavn, Jan Mayen, Bear Island and Ocean Weather Station "M", 1959

FIGURE 5—PRACTICAL MAXIMUM AND MINIMUM THICKNESS LINES COMPARED WITH OBSERVATIONS

The small cluster of points at freezing levels about 3000 feet above the 90 per cent and "practical minimum" lines in Figure 5 (*a*) occurred at Ocean Weather Station "I" and was investigated separately. It was found that these points occurred during a period in which the air had a lapse rate near the dry adiabatic through the whole 1000–500 mb layer. It occurred in air of cold origin carried quickly round a stationary depression near Iceland from the ice area near the coast of south-west Greenland across a steep gradient of sea temperature. Rapid warming and convection produced this effect. When a sounding shows a low freezing level with a lapse rate near the dry adiabatic through most of the 1000–500 mb layer, its thickness value can be less than that used to compute the "practical minimum" line which has a shallow isothermal layer at the bottom surmounted by a deep layer with a saturated adiabatic lapse rate. Similar conditions often occur in the North Atlantic with cold northerly outbursts. In such conditions the freezing level should be forecast near the "practical minimum" line.

The single point of Figure 5(*a*) well below the "practical maximum" line occurred at Ocean Weather Station "J" with a sounding of a somewhat unusual type. A nearly isothermal layer with a temperature a little below 0°C extended through more than 200 mb with a stable lapse rate above that to 500 mb. The thickness was, in this case, actually above the value of the "practical maximum".

The points below the "practical maximum" lines of Figure 5(*c*) occurred at Danmarkshavn and Jan Mayen and were associated with very deep layers in which the air had temperatures not far below 0°C and a very small lapse rate.

A freezing level above the surface was produced by surface heating, and the points therefore came into consideration for plotting on the diagram.

TABLE II—TABLE OF FREEZING LEVELS TO BE EXPECTED WITH VALUES OF 1000–500 MB THICKNESS

1000–500mb thickness in gp metres	average	lowest	highest	North Atlantic lowest	North Atlantic highest	West Mediterranean lowest	West Mediterranean highest	Arctic and sub-Arctic lowest	Arctic and sub-Arctic highest
				freezing level in feet					
5100	0	0	0	0	200	—	—	0	0
5160	300	0	1000	0	1000	—	—	0	700
5220	1500	0	2100	0	2000	—	—	0	1700
5280	2800	0	3400	400	3200	—	2600	0	2900
5340	4300	0	5000	1100	4600	1400	4200	500	4300
5400	5800	1200	6500	2100	6300	2600	5900	1700	5900
5460	6400	2800	8300	3900	7900	4300	7700	3400	7900
5520	9200	4500	10,800	7200	9700	6200	9600	6400	10,100
5580	11,100	6300	14,200	9800	11,700	8300	11,200	9200	12,000
5640	13,300	8100	17,560	11,600	13,200	10,000	12,800	11,800	—
5700	15,600	10,200	over 500 mb	—	—	11,700	14,400	—	—
5760	18,000	12,000	over 500 mb	—	—	13,200	15,800	—	—

Table II shows the average, "practical maximum" and "practical minimum" values taken from Figure 2, as well as the 90 per cent maximum and minimum values for the three areas investigated for the standard thicknesses used on British charts. In using Table II when sea-level pressure is appreciably different from 1000 mb, a height correction must be made of about 100 feet for each 3 mb.

Only simple freezing levels have so far been discussed. As shown in Table I, multiple freezing levels are not of common occurrence. LPQR in Figure 4 illustrates the occurrence of a freezing layer below Q with a main freezing level higher up. In cases where a multiple freezing level is likely, as much use of other data must be made as possible. Where the air mass is thought to be of an

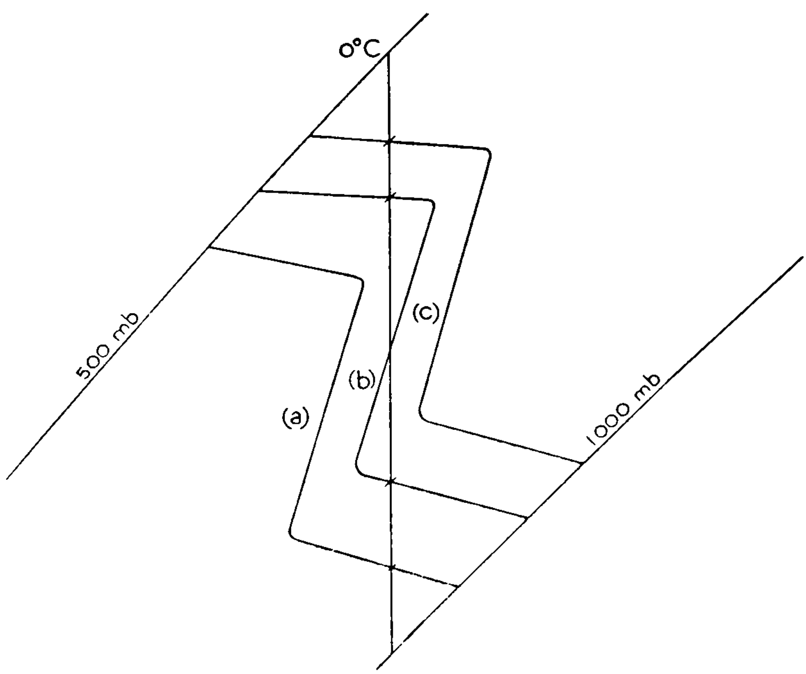


FIGURE 6—POSITION OF THE INVERSION IN RELATION TO THE 0°C ISOTHERM

anti-cyclonic type the freezing level will be high or low in relation to the thickness according to whether the stable layer or inversion lies above or below 0°C. Figure 6 illustrates this. When this stable layer lies below 0°C, as in (*a*) in Figure 6, the freezing level will be near the minimum value of Table II and estimation of the height can be assisted by the use of the surface temperature and the lapse rate below the stable layer. When the stable layer or inversion is above 0°C the freezing level will be near maximum height, (*c*) in Figure 6, that is, the thickness will be between the "practical minimum" and average curves of Figure 2. Multiple freezing levels occur with a profile such as (*b*) intermediate between (*a*) and (*c*). The lower freezing level can be evaluated from surface data and the thickness used to find the upper freezing level which can be expected to lie near the "practical minimum" line. The question of whether there is an upper freezing level will depend on whether there is any air above the inversion at a temperature higher than 0°C. Any available temperatures for the standard levels of 850 or 700 mb may enable a decision to be made on this point even though a complete plotted ascent is not available.

The author wishes to acknowledge advice given by Mr. H. H. Lamb in the preparation of this paper.

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WEATHER CENTRES

By N. B. MARSHALL, B.Sc.

The opening of the London Weather Centre in August 1959, marking the beginning of a new development in the provision of meteorological services to the general public, has created widespread interest, especially amongst professional meteorologists both at home and abroad. It may, therefore, be not inappropriate to outline here the background to the new experiment and to indicate briefly the methods used, not only in London, but also in Glasgow and Manchester where further centres have been established.

For many years the London Forecasting Office (one of the many names by which it has been known) in Kingsway has been the main channel through which has flowed information from the Central Forecasting Office (at one time, indeed, actually located there) to the outside world, the teleprinter link between Dunstable and Broadcasting House being an exception to this generalization. Between World Wars I and II the weather window of Adastral House, then situated at the corner of Kingsway and Aldwych, was a well known feature and always attracted interested passers-by. The emphasis there was, perhaps, rather on the aviation aspect of meteorology, naturally enough since at that time the Air Ministry controlled both Military and Civil Aviation. That particular display fell a victim of Hitler's war and its later revival was made difficult as a result of the location of the London Forecasting Office on the eighth floor of Victory House.

The great success of the model meteorological office set up in the Dome of Discovery during the Festival of Britain in 1951, and the subsequent Meteorological Office Centenary Exhibition which was sent round the principal cities of the country, clearly indicated the public interest in "Weather", while the growing demands of industry for precise meteorological information suggested that the time was ripe for a new approach on the part of the Office towards meeting the challenge.

These considerations, together with the necessity of finding, owing to the impending move of Meteorological Office Headquarters to Bracknell, a new home for the London Forecasting Office, encouraged the Meteorological Committee, under the Chairmanship of Lord Hurcomb, to recommend using the ground-floor accommodation in Princes House, opposite the Stoll Theatre and only a few doors from Her Majesty's Stationery Office shop, for the pilot scheme of a combined operational forecasting unit and weather information centre. Generous window space made it possible to reintroduce, in a new form, the old Weather Map (using up-to-date display methods so that hourly instead of twice-daily changes could be made) and to show: recent, present and future barometric charts, topically housed in mock television cabinets so convincingly illuminated that many onlookers have believed that they were viewing actual television transmissions; moving text (FLOSIGN) based on the current Automatic Telephone Weather Service forecasts—a most popular feature; and a distant-reading thermograph and anenometer. In addition, with the help of Air Ministry Publicity and certain outside users, small displays illustrating the co-operation between the Meteorological Office and public utilities—the General Post Office, broadcasting, the Central Electricity Board, etc.—have been set up and have attracted much interest. From time to time charts or diagrams of topical weather—the dry summer of 1959, the chance of a "white" Christmas, etc.—have with the help of the Climatological Services Division been added to the window, often at short notice. The window has undoubtedly been a great popular success, as the size of the crowd round it at lunch time will confirm. Two to four dozen people can often be counted at one time gazing at the exhibits, and the flow of spectators is sometimes at the rate of one every five seconds. But passers-by are also welcome inside the Centre where, in "contemporary-style" surroundings, their weather enquiries may be answered by a team of Senior Assistants at a counter well supplied with a wealth of actual and forecast weather data and the wherewithal to give "off-the-cuff" replies of a climatological nature. Visitors requiring weightier replies are referred to a forecaster, or to the meteorological office at Harrow. Telephone inquiries answered, of course, from the forecast bench behind the scenes, have noticeably increased in number since the opening of the Centre and at times have a peak density of about twelve a minute with a maximum of nearly 2,000 in a day.

Broadcasting has been catered for, the consultation room adjacent to the public part of the Centre having been, with the advice of BBC engineers, acoustically treated and turned into a studio from which "Your Holiday Weather" broadcasts are made.

The Centre was opened to the public on Monday, 31 August 1959, following a Press Conference conducted by Mr. Airey Neave, M.P., then Parliamentary Under-Secretary of State for Air. The newspapers, radio (both sound and television) and film units gave the new venture encouraging publicity.

Whilst the planning of this London Weather Centre was under way, pressure of public service inquiries at Renfrew and at Ringway was brought to the attention of the Meteorological Committee and in due course instructions were received to open suitable offices in Glasgow and Manchester to take over growing commitments, it being understood that the scheme be entirely experimental. For a

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PLATE I—WINDOW OF THE LONDON WEATHER CENTRE

PLATE II—FORECAST ROOM IN THE LONDON WEATHER CENTRE

Reproduced by courtesy of Park Pictures Ltd.

PLATE III—WINDOW OF THE MANCHESTER WEATHER CENTRE

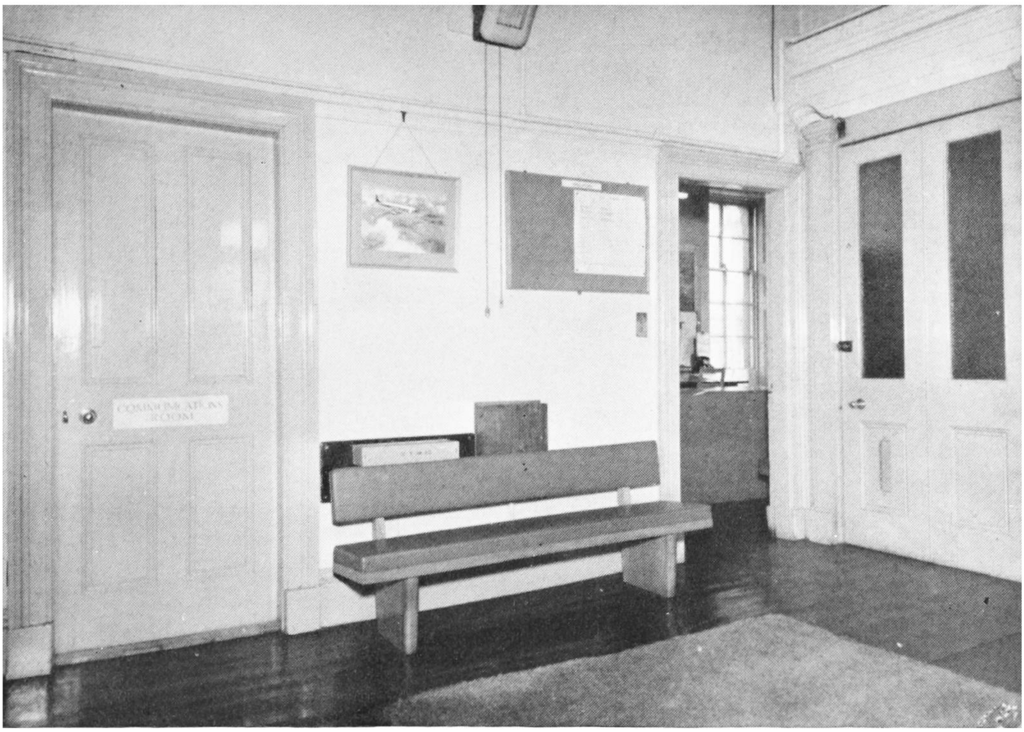

PLATE IV—ENTRANCE TO THE GLASGOW WEATHER CENTRE variety of reasons plans for these two offices have gone on rather different lines. That in Glasgow is located on the first floor of a block of offices on the fringe of the business quarter of the city, perhaps not an ideal site. There is no "shop" but the forecast room and general offices have been extremely well furnished by the Ministry of Works and the general impression of the Centre, once an unfortunate flight of stairs has been surmounted, is most attractive. It was opened at a Press Conference on 14 December 1959 and, as in London, the BBC and ITV gave good coverage.

In Manchester a central site became available in the Royal Exchange Building. Forecast and administration offices on the first floor are connected to instruments with an excellent exposure on the roof. For the public a well designed "shop" has been built at street level near the opening to an arcade which carries very heavy pedestrian traffic in the centre of the city. Windows with a display similar to that in London are likely to attract even larger crowds than in the capital. Industrial concerns with suites in the same building will in the future, it is hoped, also find it worthwhile to use the facilities available in our office on the first floor.

At the time of writing there is no firm project for any additional weather centres but nevertheless the claims of certain provincial cities have already been considered. If London, Glasgow and Manchester between them prove the usefulness of such amenities, the experiment can very easily be extended to include other places.

NOTES AND NEWS

Meteorological Office awards to captains and navigators of civil aircraft

The Meteorological Office awards for 1960 to captains and navigators of civil aircraft for long and meritorious service in the provision of reports of weather observations made in flight were presented on 28 June 1960 by Mr. B. C. V. Oddie, Deputy Director for Outstations of the Meteorological Office. The presentation was made at a small ceremony held under the auspices of the Guild of Air Pilots and Air Navigators with the Master of the Guild, Dr. K. G. Bergin, in the Chair.

Before making the presentations Mr. Oddie spoke of the great help the in-flight observations were to forecasters. Necessary as surface observations were, they were no substitute for observations made in the air at flying heights. About 1000 in-flight observations a day were received from over the North Atlantic but from over Europe, largely because of overstressed communications, the number was much less. Mr. Oddie assured aircrews that the reports which they made despite all their many other occupations were needed and used by forecasters.

He then presented briefcases to Captain D. F. Redrup and Captain G. P. Lace, both of the British Overseas Airways Corporation.

Awards of suitably inscribed books will be sent later to the following officers:

Navigator G. F. Andrews	B.O.A.C.	Navigator D. Kaye	B.O.A.C.
Navigator B. L. Baldwin	B.O.A.C.	Navigator R. C. Langdon	B.O.A.C.
Navigator C. H. Ball	B.O.A.C.	Navigator H. F. Musker	B.O.A.C.
Navigator C. H. Bancroft	B.O.A.C.	Captain R. H. Payne	B.E.A.
Captain G. R. Buxton	B.O.A.C.	Captain A. V. Rix	B.O.A.C.
Navigator J. Ellington	B.O.A.C.	Captain R. H. Rose	B.E.A.
Navigator E. E. Freeth	B.O.A.C.	Captain I. R. Stephens	B.O.A.C.
Navigator R. L. York	B.O.A.C.		

One hundred voyages as a weather ship

In April 1960 *Weather Observer* had the distinction of being the first British weather ship to complete 100 patrols at a North Atlantic Ocean station. She was formerly the "Flower" Class corvette *Marguerite*.

During the war, together with other vessels of her class, she did a strenuous and very useful job on convoy escort duties. It was largely their reputation for seaworthiness which they had built up during the war, that influenced the British decision to convert these corvettes to weather ships in 1947.[1] The Norwegian authorities followed the British example. The conversion of *Weather Observer* to an ocean weather ship was done at Sheerness and took about 12 months. When the conversion was complete she came up to the London Docks and was re-named there by the Secretary of State for Air at an official ceremony.[2] She sailed direct from London for Ocean Station "Juliett", which she occupied for the first time on 4 August 1947. All four of the British ocean weather ships were in operation by February 1948.

When the North Atlantic Ocean Station Agreement came into force, as a result of an agreement signed in September 1946, 13 stations were established. By June 1949 all 13 stations were in operation, the operating countries being the United States of America (7 stations), United Kingdom (2), Canada and the United States (1), France (1), the Netherlands and Belgium (1), Norway and Sweden (1). For reasons of economy the number of stations was reduced to eleven in 1949 and to nine in 1954. Since 1954 the four western stations, "B", "C", "D" and "E" have been manned by vessels of the United States Coast Guard and the five eastern stations, "A", "I", "J", "K" and "M" have been the joint responsibility of France, the Netherlands, Norway and Sweden and the United Kingdom. Up till 1954 the period of duty on station of the European ocean weather ships each voyage was 21 days, but owing to a re-adjustment of responsibility in 1954, whereby the European authorities became responsible for Station "A" (which had formerly been a United States responsibility) the number of days on station had to be increased to 24.

Following upon her strenuous war service, much of which was spent in the Atlantic, *Weather Observer's* successful career as an ocean weather ship amply justifies the choice of these ships for this important job. Admittedly, the accommodation aboard these "Flower" Class vessels is rather cramped and antiquated, but all these ships have shown themselves to be surprisingly "comfortable" in heavy weather and their sea-keeping qualities have been fully up to expectation.

Captain H. Sobey, who is now Master of *Weather Observer*, has served continuously since the inception of the Ocean Weather Ship Service, having transferred from *Weather Watcher* to take command of *Weather Observer* in August 1952 on the resignation of Captain N. F. Israel.

Some of the present members of her ship's company have served in *Weather Observer* for long periods, particular note being made of

Mr. M. Dunning, Chief Radio Technician ...	99 voyages
Mr. L. Lambert, Radio Overseer	96 voyages
Mr. W. Bremner, Radio Operator	89 voyages
Mr. M. V. Dunphy, Senior Assistant Scientific ...	75 voyages

Most of the rest of the present-day meteorological staff have served in the ship for more than one tour of duty of eight voyages; the Meteorological Officer-in-Charge, Mr. A. R. J. Jones, is in his sixth tour.

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Interesting observation of lightning

An interesting lightning display was observed at Mahe, Seychelles, on Sunday, 3 January 1960 at 1032 GMT. A huge thundercloud was situated in the south-east and a comparatively smaller one in the north. A line of distant cumulonimbus clouds ran right from the south-eastern to the northern horizon. Sheet lightning associated with thunder occurred in the thunderclouds situated in the south-east and north from 0954 GMT. At 1032 GMT a very brilliant flash occurred on the south-eastern cumulonimbus and instantaneously took the form of "a diagram of a radio wave" with small balls on it. This was classified as "pearl-necklace" lightning. The "pearl-necklace" lightning produced a long "wave" of small bright balls running from the south-east to the north and was visible for $1\frac{1}{2}$ seconds. It looked as if the "pearl-necklace" lightning travelled from the south-eastern cumulonimbus to the northern cumulonimbus. Can this be so? The distance between the two clouds was approximately 15 miles. Calculating the distance of the huge cumulonimbus in the south-east from the interval which elapsed between the time the "pearl-necklace" lightning became visible and the time that thunder was heard from the cloud, by the formula $t/5$ (sec) $= d$ (miles), it was estimated that the huge thundercloud was at a distance of 5·2 miles from the station.

The accompanying rough diagram shows the display.

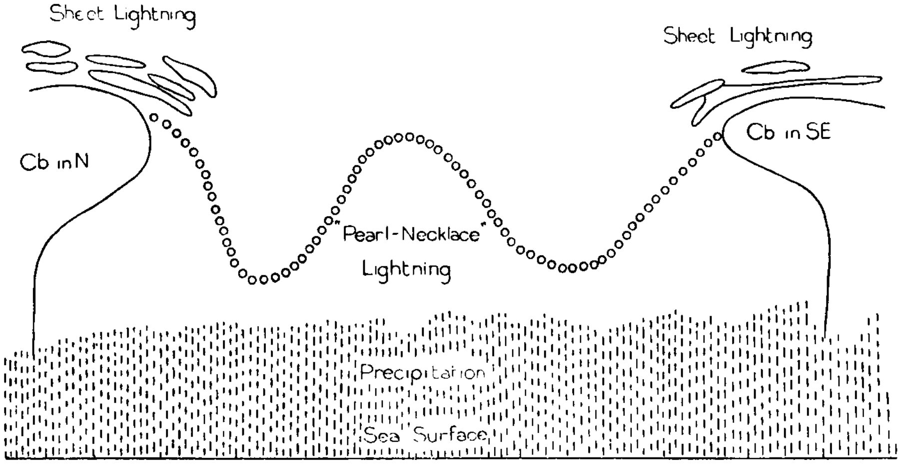

DIAGRAM OF LIGHTNING DISPLAY AT MAHE, SEYCHELLES, ON 3 JANUARY 1960

[According to W. J. Humphreys[1] the "pearls" represent end-on views of the irregular portions of the lightning path; B. F. J. Schonland[2] states that a meandering flash thirty miles long has been reported.—Ed.]

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2. SCHONLAND, B. F. J.; The flight of thunderbolts. Oxford, 1950, p. 39.

Mr. L. P. Smith—Special Merit Promotion to Senior Principal Scientific Officer

Mr. L. P. Smith's promotion to the grade of Senior Principal Scientific Officer will be welcomed not only by his colleagues and fellow meteorologists but also by those workers in the agricultural field with whom Mr. Smith has collaborated in recent years. The promotion has been made in recognition of "Special Merit" by the Interdepartmental Scientific Panel. On behalf of the Director-General and staff of the Meteorological Office I am very glad to offer our hearty congratulations to the recipient of this well merited promotion.

Mr. Smith's claim to distinction rests on his success in applying the results of research in both micro- and large-scale climatology in a practical form to the problems of workers in other fields, and most notably to the problems of those who can profit by the assistance of the meteorologist in their occupations. In this sense he has largely "created" the agricultural services of the Meteorological Office by seeking out those points of the somewhat esoteric studies of the micrometeorologists, interpreting them in terms of easily measured or estimated entities and finally, by personal contact, persuading others to use the results of his work. As a result of the special attention he has given to the planning and application of irrigation, the effects of weather on the incidence of plant and animal diseases and on crop and milk yields he is well known to the farmer and the agricultural scientist. In short he has carried out operational research of a high order in a field of the greatest economic importance.

A.C.B.

AWARD

International Meteorological Organization Prize for 1960

Every year since 1955 the Executive Committee of the World Meteorological Organization has had the pleasant but exacting task of awarding the International Meteorological Organization Prize. The recipient is chosen from names submitted by the nations which belong to the Organization, and in making the selection the Committee takes into account both scientific eminence and the record of work done in the field of international meteorological organizations. The Prize has been awarded so far to Dr. T. H. Hesselberg, the late Professor C.-G. Rossby, Mr. E. Gold and Dr. J. Bjerknes. This year the Executive Committee selected Professor J. Van Mieghem, of the Royal Meteorological Institute of Belgium, as the winner.

Professor Van Mieghem is well known to British meteorologists and, indeed, all over the world for his outstanding contributions to dynamic meteorology. He is a mathematician of the first order who has devoted his life to unravelling the intricacies of the complex physical processes which cause weather. In addition, he has been very active in international work, both in the World Meteorological Organization and in the Union of Geodesy and Geophysics.

We congratulate Professor Van Mieghem most heartily on this well earned distinction.

LETTER TO THE EDITOR

Blocking action

I have read the recent article on blocking by Mr. E. J. Sumner in the Nov. 1959 issue of the *Meteorological Magazine*[1] as well as its predecessor in the *Quarterly Journal* in 1954[2] and find them both very interesting. They constitute a significant contribution to the climatology of this important phenomenon.

In particular the statement that well-developed blocks are almost non-existent over North America arrested my attention. This conclusion probably arises from the definition of blocking used, namely the high pressure cell itself. Mr. Sumner states that for the British Isles and European area "This is the most important pivotal system". However, for purposes of studying this phenomenon in our area, it has been found useful to apply a somewhat different criterion. For example, if we define blocking in terms of centers of large positive anomaly at the 700-mb level a somewhat different longitudinal distribution from that shown in Table III of Mr. Sumner's article emerges. To illustrate, I have tabulated in Figure 1 the frequency of occurrence of 5-day mean 700-mb departure from normal values greater than +500 ft at various

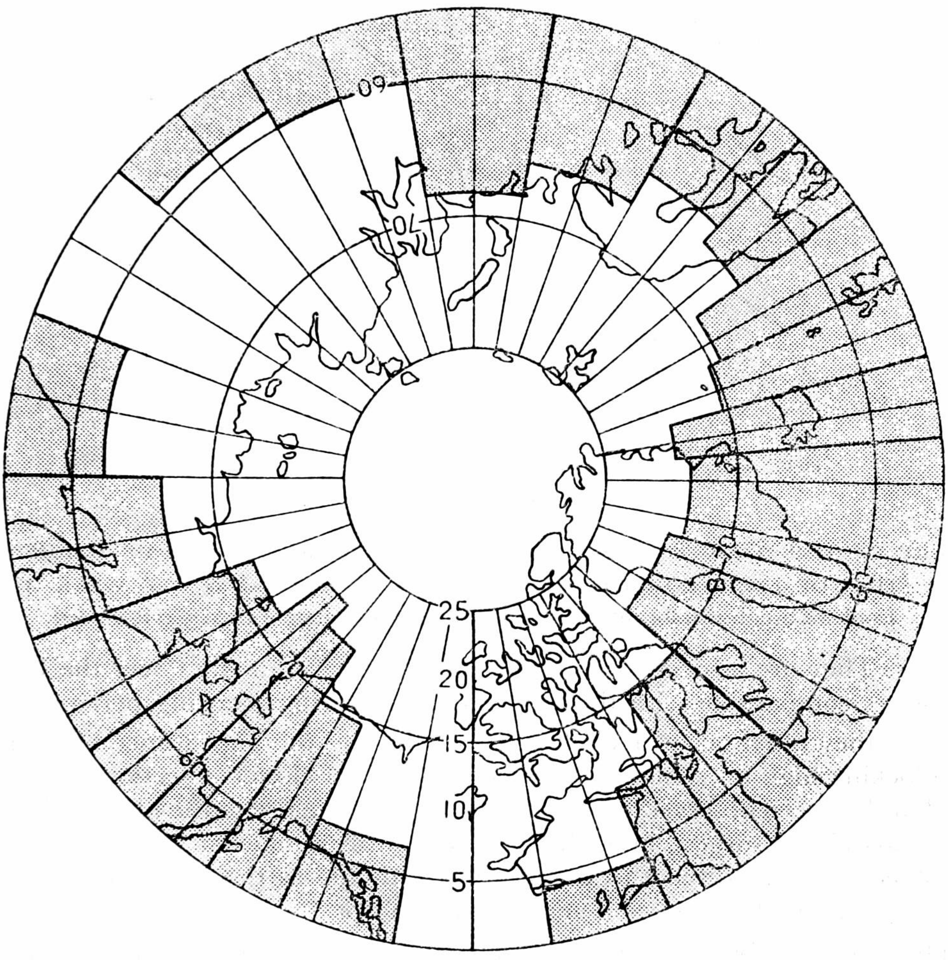


FIGURE 1—NUMBER OF OCCURRENCES OF 5-DAY MEAN 700-MB HEIGHT DEPARTURE FROM NORMAL VALUES GREATER THAN +500 FT ALONG THE 60TH PARALLEL FOR THE TEN WINTERS 1948–1957

longitudes along 60°N for the 10 winters 1948–1957. It is noteworthy that such aberrations appear more frequently over the Bering Sea and the Davis Strait than over Northern Europe. To some extent this reflects the fact that normal troughs appear in these regions. However, there seem to me to be two cogent reasons why such large positive anomaly centers at high latitudes should be linked to the term blocking.

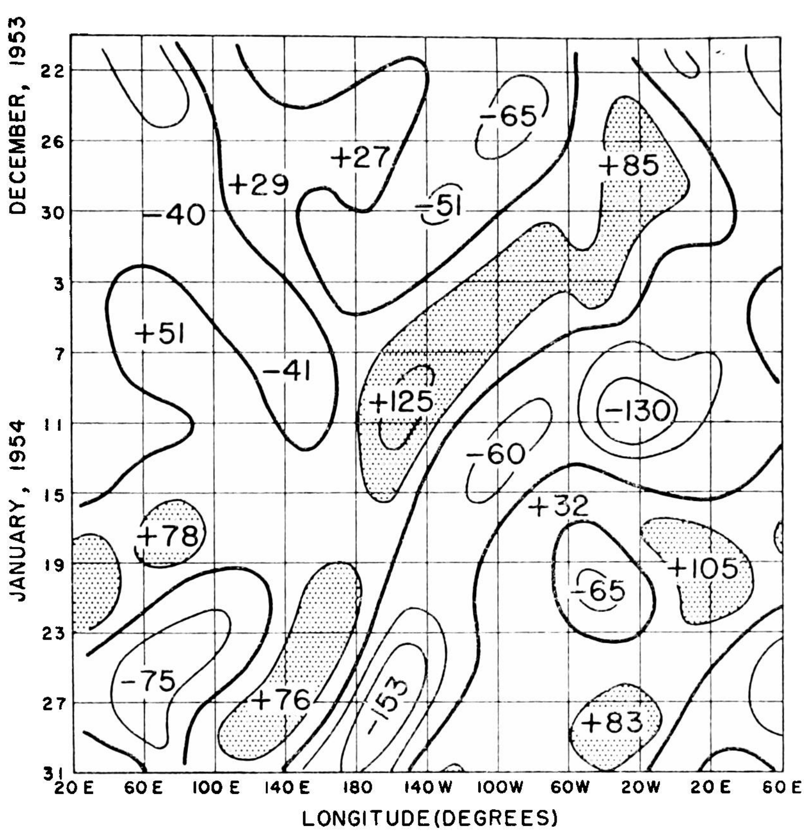


FIGURE 2—TIME–LONGITUDE SECTION SHOWING CHANGES IN 700-MB HEIGHTS AT 60°N (TENS OF FEET) COMPUTED FROM 5-DAY MEAN CHARTS ONE WEEK APART

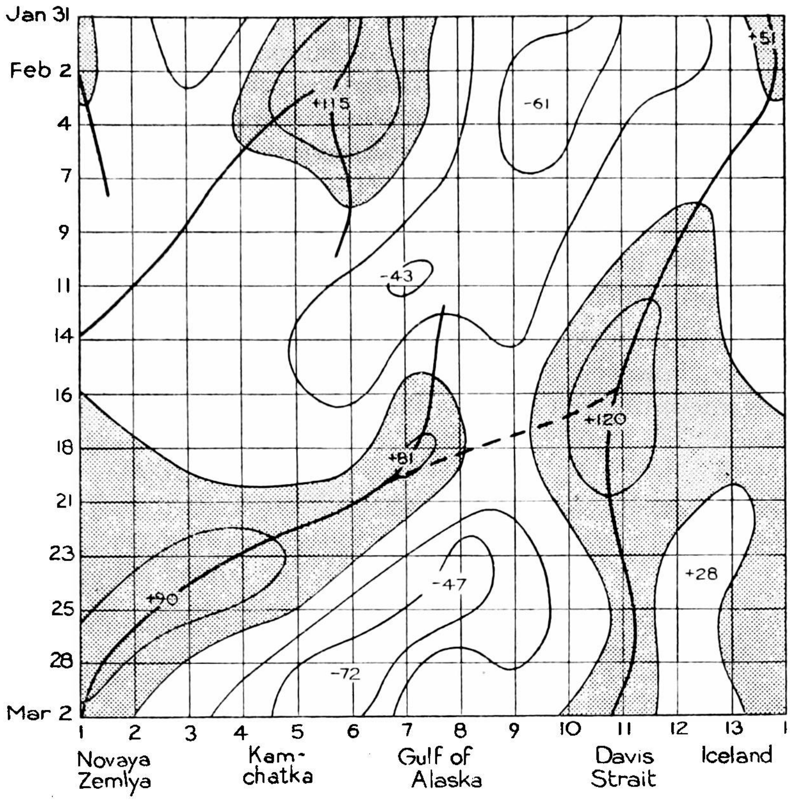
Isopleths are drawn for intervals of 500 ft with rises greater than 500 ft shaded.

1. They are associated with extreme weather anomalies over the United States comparable with those over Europe during blocking periods and

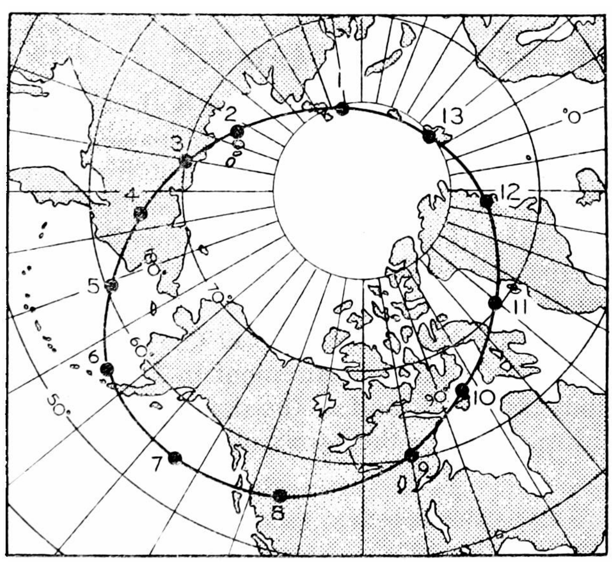
2. they often occur a week or two following the appearance of a strong blocking high over Europe and seem to have a close connection therewith. This has been observed frequently enough to give rise to the idea of blocking "waves" or "surges" and, though the term is somewhat vague and not as objective or as subject to quantitative estimate as the "blocking high", it has none-the-less proved a very useful concept.

This idea has been described in terms of a "westward displacement of a minimal zonal index" by several authors, notably Namias and Clapp,[3] Hawkins[4] and Krueger.[5] Krueger's paper also depicts this effect in a time-longitude cross section showing changes in 700-mb heights at 60°N during January 1954 as computed from 5-day mean charts one week apart. A copy of this chart is shown here as Figure 2. To be noted is the "channel" of rises originating about 20°W in late December and spreading westward during January. An inspection of the individual 5-day mean 700-mb charts indicates that these rises, though sizeable, were insufficient to result in a closed mean high over the Davis Strait so that, although Mr. Sumner's definition would not apply, an influence of a blocking type definitely affected North America.

Similarly in Figure 3, which refers to Feb. 1957, a positive anomaly band (not changes as in the previous example) can be followed westward around the



(*a*)



(*b*)

FIGURE 3—(*a*) TIME VARIATION OF 700-MB 5-DAY MEAN HEIGHT DEPARTURE FROM NORMAL ALONG THE LINE SHOWN IN (*b*)

The numbers forming the abscissa of (*a*) refer to the positions shown in (*b*) and the ordinates are the central day of the 5-day mean period. Lines are drawn for 400 ft intervals with the zero line heavier and values greater than 400 ft stippled.

Pole. The axis of positive anomaly can be traced from the 510-ft center at position 1 (Novaya Zemla) near the end of January, first westward to strongly influence the Davis Strait about mid-February, thence to the Gulf of Alaska (dashed line) and finally on around to Novaya Zemla. In this instance strong blocking highs did appear over North America on the 5-day mean 700-mb charts centered Feb. 14, 16, 19, 21, and 24.

Thus in the two examples cited, and in numerous other instances in our synoptic experience, it has been apparent that some form of blocking "wave" or "impulse" has proceeded upstream against the westerly current.

This letter is in no way intended as a criticism of Mr. Sumner's interesting articles. It does, however, appear to me that the discontinuous, retrogressive aspect of this interesting but often baffling phenomenon, should receive greater stress.

CHARLES M. WOFFINDEN

U.S. Weather Bureau, Washington 25, D.C.

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3. NAMIAS, J. and CLAPP, P. F.; Studies of the motion and development of long waves in the westerlies. *J. Met., Lancaster, Pa.*, **1**, Nos. 3 and 4, 1944, pp. 57–66.
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5. KRUEGER, A. F.; The weather and circulation of January 1954—A low index month with a pronounced blocking wave. *Mon. Weath. Rev., Washington, D.C.*, **82**, No. 1, 1954, pp. 29–34.

OBITUARIES

Miss Rose Ellen Smith.—With the death of Miss R. E. Smith on 18 July 1960, at the advanced age of 94, we regret to record the passing of the oldest remaining member of the Victoria Street staff. After a liberal education, which included a period of study in Germany, Miss Smith entered the Office in January 1891 in the computing section of the Marine Branch, dealing with the collation of material from ships' meteorological logs. For many years this section consisted of the only female staff of the Office. In 1915 she was transferred to the library, where her knowledge of German was naturally a great asset, and remained there until her retirement in March 1931. Her work was of a most meticulous character, and as the doyen of the later female staff she had a very kindly disposition for their welfare.

A. T. BENCH

Mr. Gilbert Allen Williams.—The sudden death of Mr. G. A. Williams on 26 July 1960, following a coronary thrombosis, came as a great shock to his many friends and colleagues. He was aged 30 when, after service in the Royal Air Force, he joined the Meteorological Office in August 1934 as an Observer II at Leuchars. He served, as an Assistant III, at Fighter Command airfields in Kent and Surrey during the Battle of Britain, after which, in June 1942, he was promoted Assistant II and transferred to administrative duties at various Fighter Group Headquarters. Early in 1944 he went to the Air Ministry to serve with the Royal Air Force (Home Commands) Branch until the end of hostilities when, in the Personnel and General Services Branch he did a useful job of work dealing with the demobilization of many thousand Assistant personnel. He became an Assistant Experimental Officer in the 1946 re-organization but, at his own request, was regraded Senior Scientific Assistant in 1947. He continued at Headquarters on administrative work for the Royal Air Force from September 1946 for nine years until October 1955 when he was transferred to the Civil Aviation Division. For two months prior to his tragic death he acted as Personal Assistant to the Director of Services of the Meteorological Office (Dr. Stagg) in such a manner as to merit temporary promotion to Experimental Officer.

Amongst his colleagues, Gilbert was well known for his intelligent anticipation, his dry sense of humour, which on occasion could be perverse, and for his meticulousness. If there was one thing he hated it was a loose end.

His like, who were old fashioned enough to enjoy work, formed the backbone of the pre-war Office and by precept and example gave much encouragement to recruits during the fateful war years.

Gilbert Williams was held in high esteem by his colleagues and he will be sadly missed by all. He leaves a widow and two grown-up sons to whom we tender our heartfelt and comforting sympathy.

BEN G. BRAME

OFFICIAL PUBLICATION

The following publication has recently been issued:

GEOPHYSICAL MEMOIRS

No. 104—*The exchange of energy between the atmosphere and the oceans of the southern hemisphere.* By D. W. Privett, M.Sc., The National Institute of Oceanography.

Seasonal estimates have been obtained of the rate of evaporation from five-degree squares of the oceans of the southern hemisphere, the exchange of sensible heat, the net radiation received, the total heat made available to the atmosphere by the condensation of water vapour and the flux of sensible heat from the sea surface, and the surplus energy available to the atmosphere in the latent form of water vapour. These estimates are presented in a tabulated form.

As the main purpose of this investigation was to obtain these values the remainder of this paper is restricted to an account of the methods used, and to brief comments on the distributions. The latter are illustrated by maps and profiles showing respectively the annual distributions and the latitudinal variations.

The estimates were obtained by using accepted empirical formulae. The rate of evaporation was computed from Jacob's equation, but modified by a change in the value of the constant consistent with the use of British climatic data. Kimball's figures were used for the incoming radiation at the sea surface and Brunt's equation was used to compute the back radiation. The meteorological data used in this investigation, with the exception of precipitation, consisted of surface observations recorded aboard British selected ships during the period 1921–50.