

CHAPTER I  
METEOROLOGY IN EUROPEAN CULTURE

Babylonian, Egyptian, Cretan civilisation	18000–1800 B.C.
Hebrew, Greco-Roman civilisation	1800 B.C.–A.D. 400
The Northmen	A.D. 400–1200
The Mediterranean revival	A.D. 1200–1600
The North-Western intrusion	A.D. 1600–

METEOROLOGY is the science of the atmosphere, or, with a certain limitation of meaning, the study of weather. The word is sometimes used as being synonymous with weather itself. It has been stated that meteorology is of great importance to armies and to navies, to ships and to farmers, although when the statement is made the seafaring man, the husbandman, and the soldier may have little interest in the science of the atmosphere. It is indeed true that weather is of urgent and vital importance for every section of the human race, it always has been so and always will be; but whether those who study the atmosphere can put their experience, and the knowledge derived from it, in such a form that practical folk like sailors or soldiers will regard it as important is quite another question; and whether it can be so represented as to challenge attention from those who are interested in science is again something quite different.

Many books have been devoted to expounding the importance of meteorology in its practical applications. This book is concerned with the possibilities of its importance as a science, as a subject of study for its own sake, interesting to those who are interested in the study of their own environment.

Hitherto the interest in meteorology has been dependent mainly upon the extent to which the community felt itself unprotected against the weather; and on that account has been subject to notable fluctuations, especially in recent times when protection has been found in buildings, clothes and new means of transport and communication. At the beginning of the nineteenth century when sea-travel was still by sailing-ships and land-travel was on horseback or by coach, attention had to be paid to the study of weather; every sailor was a practical meteorologist, all professors of natural philosophy regarded meteorology as part of their province and the subject engaged the unremitting personal attention of such influential persons as John Dalton and Luke Howard.

The interest culminated in the establishment of official meteorological departments in the early sixties and the evolution of the weather-map. But changes had already come in: sea-travel was by steamer and land-travel by rail. The community found itself more or less immune. Meteorology lost its place in the universities and was left to official organisations and special societies.

The position is most clearly expressed by noting that the Government grant for meteorology in this country which had increased fivefold between 1854 and 1882, remained quite stationary for a quarter of a century thereafter, though the

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operations were under the highest scientific direction. In 1899 the Royal Society when asked to obtain funds for pensions gave expression to the almost inhuman sentiment that there ought to be pensions but the funds should be provided by sacrificing activity.

Fluctuations on a smaller scale are easily remarked. When the art of flying began, all phases of weather were important; but by the time the war was over the aviator's interest was mainly confined to fog and wind above clouds.

Conditions have however changed again, the development of travel by air over long distances and the spread of wireless facilities have almost restored the enthusiasm of sixty years ago. The Government spends on meteorology eight times as much as it did before the war. The fact however remains that all along from the earliest times the importance of meteorology has been conditioned by the utility of its applications, particularly in the anticipation of future weather. The claims for interest in the subject for its own sake as giving an insight into nature have been recognised only by a comparatively few devoted observers. But these are the claims which are connoted by meteorology as a science and which are the subject of this book.

THE PRACTICAL IMPORTANCE OF WEATHER

What is it moulds the life of man?  
The weather.  
What makes some black and others tan?  
The weather.  
What makes the Zulu live in trees,  
The Congo natives dress in leaves  
While others go in furs and freeze?  
The weather.  
(W. J. Humphreys, *Weather Proverbs and Paradoxes*.)

Enthusiasm for meteorology is perhaps a peculiar experience; but it is not difficult to become enthusiastic, and, in favourable circumstances, even eloquent, about the importance to mankind of the atmosphere and its changes. If meteorologists have failed to interest their fellow-men therein it is not for lack of importance in the subject of their study, for the atmosphere is the chief element in man's physical environment. It is the breath of his life. With less than enough within him or about him he feels stifled; under the genial influence of the sun it provides his food and drink, and against its changes he is careful to provide himself with shelter; it is indispensable alike for his bodily warmth, for all his own physical energy and for that of his transport, his camels, his horses, his sailing-ships, his steamers and his motor-cars. The larger part of man's life-history consists in his endeavour to adjust himself to the ways of the atmosphere, to its habits in respect of wind and weather. His interest in the air has been vivid and unremitting. It is altogether insufficient to say that with some nations the study of weather has been connected with religion. The religions of mankind have been in large part formed out of the ideas which prolonged experience has engendered about the control of the atmosphere. Human lives have been sacrificed in order to propitiate or conciliate the powers that rule the air<sup>1</sup>. Perhaps even

<sup>1</sup> Mexico, *Hibbert Journal*, October 1923.

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at the present day the greater part of mankind, following the examples of Greek and Hebrew poets, regard weather as under the personal control of the supreme deity into which it would be impious to inquire. In English law “the act of God” is still a legitimate plea for exoneration of damages for injuries to person or property if the circumstances are so exceptional as to be unforeseen. Small indeed is the fraction of mankind who are like-minded with the Greek philosophers and regard the vagaries of the atmosphere as subject to natural laws, and are unwilling to believe them to be past finding out.

This diversity of attitude was as conspicuous in the ancients as it is in the moderns; we shall deal with it more fully in the sequel when we glance at the references to weather and its control which are to be found in the poets and the philosophers of the ancient world. It has had some important consequences for the study because the idea of the personal control of weather by a major or minor deity has led to the confusion of those who pursue the scientific study of the atmosphere with its worst enemies—the rain-maker, the magician, and the temple-minder who accepts sacrifices in order to propitiate a deity.

CIVILISATION AND THE STUDY OF WEATHER

We may regard the religious practice of a people as the expression of their relationship to their environment, which includes inanimate nature on the one hand and living beings on the other, and therefore we might fairly expect the story of the weather to be coeval with that of civilisation, and intertwined with its records, its legends and its religions. This aspect of history is not without interest for students of weather.

According to the teaching of the new anthropology<sup>1</sup>, human civilisation was autochthonous in ancient Egypt, and spread from there over the world with subsequent subcentres of diffusion in Babylonia and India. This view may not be accepted but it arrests attention by the circumstance that Egypt, and especially the Egypt of the early Egyptians, the Thebaid, is that part of the world which is most nearly independent of what we understand by weather. It draws its water-supplies from the river and takes nothing but dew from the sky. It has winds generally so arranged as to temper and mollify the burning effect of the sun’s rays, seldom strong enough to raise a dust-storm and practically free from the terrible visitation known as simoom. At the same time it is wonderfully fertile with very little effort on the part of the husbandman.

They take the flow o’ the Nile  
By certain scales i’ the pyramid; they know  
By the height, the lowness, or the mean, if dearth  
Or foison follow. The higher Nilus swells  
The more it promises; as it ebbs, the seedsman  
Upon the slime and ooze scatters his grain,  
And shortly comes to harvest<sup>2</sup>.  
(*Antony and Cleopatra*, II, vii, 20.)

<sup>1</sup> *Nature*, vol. CXII, 1923, p. 611.  
<sup>2</sup> Measures of the height of the Nile go back to 3600 B.C. H. G. Lyons, *The Physiography of the River Nile and its Basin*, Cairo, 1906.

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If then our civilisation began in Egypt, we are faced with the conclusion that primitive man found the line of least resistance to his advance towards civilisation in a country which has no weather, and yet enjoys a plentiful supply of water, with a sky so serene and genial as to make clothing a matter of little importance and the indispensable shelter beyond that of black pigment an easy artifice.

Professor Elliot Smith, in his work on the ancient Egyptians and the origin of civilisation, writes as though at the dawn of civilisation the world in every part was full of human beings, or “saturated” with humanity as well as with other forms of life, and that the spread of civilisation meant the replacement of autochthonous practices by Egyptian practices. The idea is very suggestive as expressing in the most simple terms by a physical analogy the relation of man to his environment. The possible density of population of any region has always been dependent on the capacity of production of the necessities of life. That capacity has been increased by the arts of civilisation to many times the original productivity of the soil. It is capable of still further increase; but whenever the population increases beyond the productivity of its own area it must either restrain its numbers or extend its area. The density of population necessary to “saturate” a particular locality would vary greatly with the available means of subsistence. It is however difficult to imagine a density of population in a region of primeval forest in any way like that which would be possible in a country like irrigated Egypt. A pastoral people might be to some extent gregarious because they had to tend their flocks, but forest-dwellers must have been comparatively isolated families.

Civilisation ... began when the early Egyptians invented the art of irrigation to extend artificially the area of cultivation of barley. The irrigation-engineer of early Egypt was the first man to organise the labour of his fellows. He conferred the benefits of security and prosperity upon the community and upon every individual member of it. He personified every subsequent idea of kingship. The life of the community flowed from him in a sense as real and actual as that in which the Nile was subject to his control. To identify him with these subtle forces was less an act of metaphysical ingenuity than one of unsophisticated realism. He became the incarnation of the life-giving powers which he bestowed upon his people. He became a god, assimilating to himself attributes of the shadowy Great Mother, and was apotheosised after death as Osiris. Eventually his powers were extended and transferred to his successor, Horus, himself credited with the immortalisation of the dead king.

(*Nature*, vol. CXII, 1923, p. 611.)

If this kind of experience is the condition for, or specially favourable to, the development of civilisation, the selection of Egypt is singularly apposite because no other place on the earth can be found with conditions more nearly perfect or even exactly parallel. Mesopotamia and Chaldaea give the nearest approach to the conditions, Palestine and Greece show a complete contrast. The valley of the Indus is also suitable for irrigation; but the flow of the river is irregular, and its overflow for irrigation “sporadic and fluctuating.” Commencement has now been made of the construction of a dam at Sukkur in the Province of Sind which will bring  $5\frac{1}{3}$  million acres under irrigation.

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“The total cultivated area in Egypt is thus exceeded by half a million acres in this one scheme<sup>1</sup>.”

The types of civilisation where there is no irrigation are quite different. People, such as those of Egypt or in a less degree of Babylon, who have no weather and grow their crops by irrigation, must naturally take a view of life entirely different from that of a people whose chance of continued existence, as in Palestine or Greece, depends upon “the former and the latter rain,” perhaps better expressed as the beginning and the end of the rains. The meaning and importance of the river was well-known both to Egyptians and Greeks, as the following quotation from Herodotus will show :

One fact which I learnt of the priests is to me a strong evidence of the origin of the country. They said that when Moeris was king, the Nile overflowed all Egypt below Memphis, as soon as it rose so little as eight cubits. Now Moeris had not been dead 900 years at the time when I heard this of the priests; yet at the present day, unless the river rise sixteen, or, at the very least, fifteen cubits, it does not overflow the lands. It seems to me, therefore, that if the land goes on rising and growing at this rate, the Egyptians who dwell below lake Moeris, in the Delta (as it is called) and elsewhere, will one day, by the stoppage of the inundations, suffer permanently the fate which they told me they expected would some time or other befall the Greeks. On hearing that the whole land of Greece is watered by rain from heaven, and not, like their own, inundated by rivers, they observed—“Some day the Greeks will be disappointed of their grand hope, and then they will be wretchedly hungry”; which was as much as to say, “If God shall some day see fit not to grant the Greeks rain, but shall afflict them with a long drought, the Greeks will be swept away by a famine, since they have nothing to rely on but rain from Jove, and have no other resource for water.”

(The *History* of Herodotus, translated by Rawlinson, Book II, chap. 13.)

But the independence of weather, which has been accepted as characteristic of early Egyptian civilisation, could not have represented the experience of the Egyptians of the Delta, who according to Elliot Smith and others initiated and developed the art of navigation, by which they established communication with all parts of Europe, Asia and Africa and perhaps America. The Delta appears indeed to have evolved a goddess whose worship was carried to Greece, through Crete. “The Minoan 8-shaped shield is itself the outcome of that which formed part of the emblem of the Egypto-Libyan Delta goddess Neith. A Minoan goddess holding this shield seen at Mycenae seems to have been the prehistoric forerunner of Athena<sup>2</sup>.”

When the Hebrews migrated from Egypt they cut themselves adrift from the security of the great river and actually entrusted their whole future to the permanence of meteorological conditions of which they could have only the vaguest assurance. Moses must indeed have been not only a great law-giver but a very competent meteorologist because the land of his choice is at best semi-arid and forms a tongue, with no adequate rivers, lying between two deserts. It depends for its seasonal rainfall upon the nearness of the Mediterranean and the suitability of the prevailing winds. It would be ruled

<sup>1</sup> *Nature*, vol. CXII, 1923, p. 699.  
<sup>2</sup> Sir Arthur Evans, *Nature*, vol. CXII, 1923, p. 660.



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out of consideration at first sight, by a meteorologist of to-day, as one of those semi-arid lands which are subject to famine.

While he accepted the change of his sources of sustenance from the river to the air, he very strongly deprecated at the same time the repetition of the Egyptian precedent of personifying and deifying the agencies of fertility or of failure. He trustfully anticipated natural conditions and had no patience with people who would placate a minor deity instead.

But the Greeks had no such scruples. Their prosperity was not based upon a single element such as the river Nile. It must have been evident to all that they were dependent upon the sky and sea as well as upon Mother Earth and, with the same idea of deifying experience, the mythological religion of Greece expresses most clearly the difference of meteorological conditions from those of Egypt. Instead of the custodian of the perennial river they imagined the control and government of the Universe entrusted in course of time to three sons of Kronos and the earth: Zeus (Jupiter) who was in charge of the sky, Poseidon (Neptune) who ruled the sea and shores, and Hades or Pluto, who ruled the under-world with its hollows and caves as well as its mines and minerals. On the human analogy the ruler of the sky, Zeus, the thunderer, the lord of rain, the cloud-gatherer, the lord of the aegis, surrounded himself on Mount Olympus with a numerous assembly of auxiliary deities, Apollo, the far-striker, and Artemis, twin-controllers of the sun, with all its life-giving power, and of the moon with her periodical changes. "Action at a distance" seems to have been included in their attributes and therewith the control of pestilences, sudden and irresistible, together with recurring ailments equally incomprehensible; it was to the benevolence of the controllers that appeal might be made for deliverance or recovery. The hierarchy of Olympus is not the subject of our study, but as our natural philosophy was born in Athens we are concerned to remark that Ruskin wrote of the patron-goddess Athene as the Queen of the Air, the personification of wisdom, who was derived directly from the brain of Zeus fully equipped with shield and spear. The mythological view is explicit testimony to the complications of the atmospheric conditions of Greece, very greatly in contrast with the simplicity of Egypt, as may be gathered from a study of the tables of chapter II. It is peculiarly significant that the patroness of Athens should have been evolved as the goddess of the atmosphere.

Besides the principal Olympian deities there were a host of mythical personifications of the controlling agencies of various aspects of weather, which are familiar enough, not only in ancient but in modern literature. Personification went to great lengths. Elsewhere I have noted that the harpies are a very apt personification of the line-squall, characterised by its propensities for snatching and fouling with dust<sup>1</sup>; and that Medusa, or Gorgon, is equally an apt personification of the winter cyclone of the Mediterranean. The coil of a snake, which is embodied in the very word cyclone, describes her hair; and the frigid north wind, the final expression of Mediterranean cyclonic energy, turns limpid water into stony ice.

<sup>1</sup> Ruskin, *Queen of the Air*.

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This elaborate personification seems to have been attributable more to the poetic and aesthetic sense of the Greeks than to actual religion or to the exercise of the powers of reasoning which are their legacy in the culture of Europe. Here is a curious juxtaposition taken from Herodotus:

The storm lasted three days. At length the Magians, by offering victims to the Winds, and charming them with the help of conjurers, while at the same time they sacrificed to Thetis and the Nereids, succeeded in laying the storm four days after it first began; or perhaps it ceased of itself.

If civilisation began in Egypt, the dawn of meteorology came some time after the dawn of civilisation; and there is this further point of interest, that although the localities of genial climate, plenty of water and no weather, are the easiest for human beings to live together in, they are apparently not the best in the long run. The civilisations that spread out from the original centres, carrying with them the contrivances for their own protection and enrichment that had been invented in the favourable locality, developed faster when they faced successfully the vagaries of a weather-climate, and, coming back from the bitter North to the mild South, actually drove out the successors of their own progenitors, who seem to have become effeminate in comparison; and their own fate was to be driven out by still more hardy invaders from the North, later on. So much so that, though we may trace the dawn of civilisation to the country where cyclonic depressions are practically unknown, we must look upon the region of the maximum number of cyclonic depressions as the most favourable for the development of human energy<sup>1</sup>.

It is useless to expect much information about weather-study from the records of the dawn of civilisation outside the range of changes of weather. We can only expect notes about weather from those countries where there is weather to be noted.

### THE CONTRIBUTIONS OF METEOROLOGY TO ANCIENT CULTURE

Turning from these mythological questions to consider the real services which the study of weather had already rendered to mankind in the time of the ancients, we may call to mind all that is embodied in the kalendar, the division of the year into seasons, the selection of times for ploughing, sowing, reaping and harvesting, the arrangement of the work of husbandmen and pastoral folk, the suitable times for making voyages with ships, the contrivance of buildings for protection against the natural severity of the seasons, the drainage of lands and roads. All these imply the ability to profit by past experience, the benefit of which the great mass of mankind now take for granted; although they owe their present immunity, at least from the ordinary effects of weather and season, to the collective experience of their predecessors, who were in their own way practical students of weather. Thus, besides those who have put their ideas about the weather into words, there has been a vast body of students of weather whose only memorial is to be found in common

<sup>1</sup> Ellsworth Huntington, *Civilisation and Climate*, Yale University Press, 1915.

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practice. The classification of the work of understanding the ways of the air from the earliest times to the present day is in itself a subject of some interest. As we survey the progress in this department of knowledge, we can discern three collateral aspects: first, the preservation of the memory of the events of past weather and their sequence, and its embodiment in common agricultural or navigational practice; second, speculations upon the relations of those events and upon their proximate and ultimate causes such as are to be found in the writings of philosophers; and, thirdly, the endeavours to use existing knowledge for the anticipation of future weather expressed from time immemorial in weather-lore. To-day we recognise the corresponding division of labour in modified forms as between the observer, who makes regular contributions to the recorded memory, the natural philosopher or knowledge-lover, who endeavours to trace the connexions of events as the relation of effects to causes, and the practical meteorologist, a government official, who draws such conclusions as he can with regard to future weather for the benefit of the general public.

To these must be added, as the result originally of the belief in personal weather-control and magic, a fourth class to which we have already referred. From very hoary antiquity there has always existed in some form or other a class of persons whose profession has been to exercise some form of control over the weather, either by appealing to the deities to whose influence the course of nature might be supposed to be entrusted, or, in more recent times, by the direct application of incantations or of physical forces to the atmosphere itself.

### BEFORE AND AFTER THE WEATHER-MAP

Since the middle of the nineteenth century, the first and third classes have been co-ordinated to form a novel and very important class of persons, or groups of persons, whose business it is to organise the general public memory of the events of weather, to collect all the available information on the subject and to apply it to the needs of the community. This is the primary function of the meteorological offices of modern days which, beginning with departments of naval or military establishments, have now become a recognised part of all civilised governments; the care of these is generally entrusted to persons who are qualified also as scientific investigators. Since the middle of the nineteenth century the collection of facts has been operated not only by personal memory or by written records but also by electric telegraph and now by radio-telegraphy. With the development of this method of collecting facts there began a new era in the science of meteorology, quite different from anything with which the ancients were acquainted. The history of meteorology in its present sense begins with the weather-map.

Still, the primary classification into recording observations, discussing them from the philosophical point of view, and applying them to the use of the community, is evident throughout the ages and remains to this day.

The change in the amount of attention devoted to the different aspects of the subject is also somewhat remarkable. In the earlier days speculation and



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philosophical discussion were active, when the facts were wholly inadequate and records hardly existed; to-day we have a multitude of facts and records, though even now they are insufficient, but philosophers are less disposed to regard their exposition as part of their ordinary duty than they were before the introduction of the weather-map.

*The place of forecasting in modern meteorology*

This most recent development leads us to remark upon another misconception in the public mind with regard to meteorology, and that is that meteorology means forecasting the weather and nothing else. It is a great misfortune for the subject. A curious sense of depression for some meteorologists arises from the question which their friends, without exception, ask on the mention of any new scientific advance in meteorology: "Will it be useful in forecasting?" It is hardly an exaggeration to say that meteorologists have a natural aversion from the iteration of the duty of forecasting. No student of physical science in any of the recognised institutes, however sure he might feel about the result of a scientific calculation, with the exception of such well-tryed predictions as those of the *Nautical Almanac*, would dream of announcing it in the public press without waiting for its verification, if waiting were the only avenue to verification. This feeling of premature disclosure is deep-seated in the scientific student. When Admiral FitzRoy, overpowered by the glamour of a telegraphic synoptic map, published his anticipations of coming weather as forecasts in the newspapers, his colleagues of the Royal Society were shocked and gave expression to their feelings; so much so that, after FitzRoy's death in 1865, when the Royal Society took over the administration of his office, no forecasts were allowed. In 1879 the controlling body, with full scientific authority, had arrived at the conclusion that the primary problems were solved, and forecasts have been issued day by day since that date. But the problems were not really solved with the degree of precision necessary for unfailing accuracy. It is a fair question whether forecasts would not really have been better to-day if meteorologists had not been compelled to issue a series of 50,000 sets of forecasts, only more or less correct. They might have given their attention to more purely scientific aspects, with some assurance of useful results, because the scientific aspect is the aspect from which true knowledge is derived. But any such question is *chose jugée* from the first. The universal desire for information about future weather opens the main artery of communication between the science and the public and is the chief vindication of an appeal for public funds; and when once a scientific subject enjoys public money it is difficult to persuade anybody that it is not provided for in all particulars. Public money is not always an unmixed blessing; science sometimes prospers in what appears to the outsider as poverty or adversity.

In the meantime forecasting is an invaluable touchstone, or test, of the reality of the scientific conclusions that are reached in the study of the atmosphere. If the general conclusions are correct, the inferences fairly

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drawn from them in particular cases must necessarily be correct too, and the comparison between inference and fact is an indispensable part of scientific reasoning which depends partly upon inductive principles and partly upon deductive calculations.

It is from that point of view that we propose to treat the subject in this book. We shall survey the methods and results of observation, we shall set out the inductive principles which have been established by their aid, and illustrate the application of physical and dynamical reasoning, with the understanding that the final test of the conclusions is their agreement with the facts of observation.

### THE EARLIEST RECORDS

Reverting after this digression to the main purpose of this chapter, we note that the civilisations from which our own culture is derived include those of Egypt, Crete, Babylonia, Phoenicia, Chaldaea, Palestine and Greece; also that for satisfactory evidence of the dawn of meteorology we must not look to those civilisations which were independent of weather. We naturally look to the documents that remain of the civilisations which took their sustenance from the sky for the earliest indications of the nature and progress of meteorological study. The indications which have survived are only fragmentary until we come to the time of Aristotle, who wrote the first formal treatise with the title *Meteorologica*; but such fragments as there are, are not without interest.

There are still a considerable number of popular superstitions about the weather. In a lecture before the Royal Meteorological Society in 1908 on *The Dawn of Meteorology*<sup>1</sup>, Dr G. Hellmann of Berlin traced some of them back to very early times. For example, the widespread belief in the first twelve days of the year as prophetic of the weather of the ensuing twelve months is traceable in the old Indian or Vedic texts, and the *signa tonitruī*, the forecasts of weather and fertility deduced from the thunder heard in each of the twelve months, contained in mediaeval almanacs, though attributed to the Persian prophet Zoroaster, are in fact of Chaldaic or Babylonian origin and date back to some thousands of years before the Christian era. From the astrological cuneiform library of Assurbanipal, now in the British Museum, we learn that predictions authorised with the forecaster's name were addressed to the king; for example: "When it thunders in the day of the moon's disappearance, the crops will prosper and the market will be steady. From Ašaridu."

The Babylonians had the wind-rose of eight rhumbs, and used already the names of the four cardinal points to denominate the intermediate directions; whereas it was till now generally supposed that we owe to Charles the Great, or perhaps to his learned monk Alcuin, who came from Yorkshire, this progress of the combination of the four principal winds to denote all others. That was indeed a great advance, for it is well-known that in the Greek and Roman periods each wind had its peculiar name, a practice still in use amongst the Italian mariners in the Mediterranean.

<sup>1</sup> *Q. J. Roy. Met. Soc.* vol. xxxiv, 1908, p. 221, revised and extended in *Met. Z.* 1908, Bd. xxv, p. 482.