CLOUD TYPES.

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The first classification of clouds was proposed by Lamarck, a French naturalist, in 1801. His classification, which consisted of six types to which French names were given, was not well received. Two years later Luke Howard proposed seven cloud types which have formed the basis of all later attempts at classification. His seven types consisted of four primary types and three combined types. His four primary types were cirrus, cumulus, stratus and nimbus. The cirrus cloud he defines as a thin, fleecy, hair-like cloud; the cumulus as a lumpy, piled-up cloud; the stratus as a layer or sheet cloud; and the nimbus as a cloud from which precipitation is falling. In 1891 the International Meteorological Conference in session at Munich adopted a classification which was proposed by Hildebrandsson and Abercromby, Scandinavian and English meteorologists, respectively. This classification has been almost universally used since that time. It consists of 13 types whose names are derived from Howard's four types except for the introduction of two terms, "fracto" meaning broken and "alto" meaning high. The 13 types according to this classification are cirrus, cumulus, stratus, nimbus, cirro-stratus, cirro-cumulus, strato-cumulus, cumulus-nimbus, alto-stratus, alto-cumulus, fracto-stratus, fracto-cumulus and fracto-nimbus.

Milham¹ in commenting on this classification suggests 11 other possible combination names among which is strato-nimbus, but states that they are all impossible combinations, redundant or unnecessary. It seems that there should be a question as to whether the strato-nimbus should be omitted. Milham states that this type name is unnecessary because the nimbus cloud is in the form of a layer. However, he defines the nimbus cloud as "a dense, dark sheet of formless cloud from which precipitation is falling. It is widely extended and when breaks occur an upper cloud area is usually seen."² In the same discussion of the nimbus cloud he states the methods of formation which he lists as (1), (2) and (3). In a discussion of these methods³ he explains method (1) as a case in which layers of air within two miles of the earth surface move laterally from a warmer to a cooler region and states that the stratus or nimbus type of cloud is formed. Method (2) he explains as a case in which convection causes air-cooling thus causing condensation. He cites the thunderstorm of summer afternoons and thunderstorms over small islands as examples and states that the cloud form is always some form of cumulus. He does not refer to the nimbus cloud except that he uses the term "thundershower." Method (3) is explained as a case in which air is cooled by being forced to rise and he cites the two

¹ Meteorology by W. I. Milham, 1921, p. 219.

² Idem, p. 222.

³ Idem, pp. 233-37.

circumstances of air passing over mountain areas and of air ascending at the cyclonic centers as examples. He does not mention the cumulus cloud in this discussion but does mention the nimbus and stratus.

Thus there seems to be some inconsistency in Milham's discussion of the nimbus cloud. He states that it is a sheet but formless. He also states that the term strato-nimbus is unnecessary because the nimbus is always in the form of a layer. Again, he says that the nimbus cloud may be formed by convection but that convection always forms the cumulus type of cloud. By careful reading it seems that he has a nimbus cloud sheet underlying the cumulus cloud base and that the rain is falling from the nimbus cloud. Alexander McAdie in his Cloud Atlas⁴ defines the nimbus cloud in almost the same language as Milham but uses the expression "dense masses of dark formless cloud" instead of "dense, dark sheet of formless cloud". He also seems to have the idea of a formless form of cloud which is neither cirrus, cumulus nor stratus from which the rain falls. He accepts and defines the 13 types adopted by the International Meteorological Conference except that he includes the three fracto types under the main type form⁵ thus reducing 13 types to 10. Willis L. Moore in his Descriptive Meteorology⁵ ignores the nimbus cloud entirely and lists the three type forms of Howard and four combined forms. J. Warren Smith in his Agricultural Meteorology ⁶ ignores the nimbus cloud in his discussion of cloud types but defines it at the end of the discussion as any cloud from which rain is falling and says that it is sometimes considered as a fourth type. McFall Kerby in his semi-popular article, "Toilers of the Sky" recognizes the nimbus cloud and defines it much as McAdie has done.

Charles F. Brooks, in his article "Cloud Nomenclature" first quotes verbatum the definition of the nimbus cloud from the International Cloud Atlas and then discusses this definition at length. This definition follows very closely the definition of McAdie and Milham but varies by calling it "a thick layer of dark clouds, without shape and with ragged edges". Brooks then expresses his opinion that the test of the nimbus cloud is not that precipitation is falling from it but that it is dense and ragged. This is an entirely new conception except that it is hinted in Milham's treatment and later in McAdies's, both later publications than Brooks'. Brooks says that steady rain or snow may be falling from a cloud which is not nimbus and that there may be rainless nimbus.

This apparent inconsistency on the part of authorities is confusing to the elementary student and to the layman. In no discussion has the basis of classification been distinctly stated but is usually intimated to be the basis of form. There is no question that the cirrus, cumulus and stratus types could be considered as differing in form although there may be other differences. Some authorities seem to consider the nimbus cloud as a formless form of cloud which means that it has form but so

⁴ McAdie, Alexander, A Cloud Atlas, 1923, p. 11.

⁵ Moore, Willis L., Descriptive Meteorology, 1910, p. 193.

⁶ Smith, John Warren, Agricultural Meteorology, 1920, p. 11.

⁷ Kerby, McFall, Toilers of the Sky, National Geographic Magazine, August, 1925, pp. 163-89.

⁸ Brooks, Charles F., Cloud Nomenclature, Monthly Weather Review, September, 1920, pp. 513-19.

indefinite that it cannot be designated. Brooks seems to undertake to clear up this matter by stressing the raggedness and density. The idea that a nimbus cloud underlies the usual stratus and that the rain comes from it does not seem feasible. If a cyclonic center is over Ohio and the southern edge of the cyclonic area reaches over the Gulf of Mexico the winds blow from the gulf toward the center and are cooled by passing into a cooler region. These winds may be clear in Alabama but by cooling below the dew point in Tennessee become cloudy. The cloud particles carried onward by the wind grow larger and in Kentucky, become large enough to fall, first in small quantity, but as the cooling continues, in copious and continuous rain at Cincinnati. If the wind is brisk this cloud mass becomes the typical rain cloud which in Tennessee was a typical stratus cloud and the only difference seems to be that the particles became larger, large enough to fall. However there is another difference, that the falling water tends to drag the cloud mass downward with it and makes the lower surface appear ragged while in the stratus cloud of Tennessee the under side seems to be smooth.

This tendency to drag the cloud mass downward is also noticeable in the typical cumulus or thunder cloud when rain begins to fall. In this case the friction of the falling water is sufficient to reverse the rising air currents and cause the movement to be downward where the copious rain is falling. This destroys the typical flat base of the cumulus cloud and makes it appear ragged. However, the idea that the rain originates in this ragged undercloud in either case seems absurd for the raggedness is caused by the rain which started falling from the typical stratus or cumulus and continues to fall therefrom. Nevertheless, this ragged undercloud seems to be the typical nimbus of certain authorities and is simply the lower surface of the cumulus or stratus which has been distorted by falling rain, which has caused sinking air currents where the rainfall is heaviest. The reason this depressed cloud material does not descend to the surface of the earth in the case of most clouds is that the relative humidity is usually far below 100 per cent while it is raining and the tenuous cloud material evaporates as it descends, and since the rate of evaporation is unequal at different points this adds to the irregularity produced by the downward air movement. In some cases it does descend to the earth and envelopes it in so called fog, through which the rain still falls.

In view of the foregoing discussion it seems that the basis for cloud classification should be form which is dependent on air movement and altitude. On this basis there should be three or four type forms, stratus, cumulus, cirrus and probably nimbus. Stratus cloud is formed in sheets or layers at comparatively low altitudes by lateral air movements or by air radiating heat without movement. Cumulus cloud is formed in domes, columns or towers at comparatively low or middle altitudes by vertical upward movements of air. Cirrus cloud is formed into a great variety of forms by mixing of air at high altitudes. Nimbus cloud, if considered as a type form, is formed by downward movements of air where rain is falling at low altitudes.

After these type forms are familiar to the observer he can begin to recognize combined forms and should be free to coin his own names

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according to the importance of the types in the combination. The type on which emphasis is desired should be named last and end in "us" and the less important should precede and end in "o". Thus if a cirrus cloud has a dome shape it should be designated as a cumulo-cirrus cloud and a thundercloud which has cirrus about its crest should be designated as a cirro-cumulus cloud.

If the nimbus cloud be considered as a cloud from which precipitation is falling, as it seems to be considered by most authorities, then it is necessary to classify clouds on the basis of whether or not precipitation is occurring. On this basis there will be two types, one from which precipitation is occurring and one from which precipitation is not occurring. The former has been suitably named "nimbus" from the Latin "nimbi" meaning rainstorm or cloud. The latter has never been named but should be because a partial classification is unscientific. It would seem to be appropriate to call this cloud "aridus" from the Latin "aridus" meaning to be dry.