does the first-mentioned *Quercus alba* formation.

E. Talus slopes, at the foot of which are the flood plains of the modern larger rivers and tributaries; soil largely derived from other habitats by landslides, thus usually deep and more or less mixed with rock fragments. The upper part of this habitat, and often the newer or more unstable portions down to the base, is chiefly characterized by what may be termed the *Sambucus pubens* talus thicket formation; facies, the red-berried elder. In the lower portion of the habitat and in the more stable portions this formation is displaced, often plainly *succeeded,* by the next forest formation to be characterized.

F. The present flood plain of the modern rivers and larger tributaries; altitude of about 750–775 feet A.T.; soil a deep, sandy, moist, fertile alluvium. So far as can now be determined this habitat was formerly occupied by a climax *Acer-Ulmus* forest formation; facies—*Acer saccharinum, Acer rubrum, Ulmus americana.* This formation, as indicated by a few isolated remnants, was characterized by a greater number of tree species than any of the other forests of the region. Many large sycamores in this forest are to be regarded as relicts of the next formation.

G. The river banks and low islands subject to inundation during times of floods, especially in winter and spring. This habitat is characterized by the *Platanus-Salix* river-bank forest formation; facies—*Platanus occidentalis* L., and *Salix nigra* Marsh. With the meandering of the stream the habitat often is occupied by the *Acer-Ulmus* forest formation but the sycamores remain as relicts even after the succeeding forest has reached maturity.

H. The sand bars in the rivers, ordinarily covered by shallow water. This habitat is pre-eminently characterized by the *Dianthera americana* sand-bar formation; facies, *Dianthera americana* L. With the upbuilding of the bar this formation is succeeded by the *Platanus-Salix* river-bank formation.

Besides the above-mentioned formations there are several less conspicuous formations and no mention has been made of various successional formations, especially those of secondary successions incidental to the march of civilization, the purpose of this note being merely to designate the more important plant formations and to point out their correlation with certain conspicuous habitat-structures evolved in the physiographic development of the region.

Otto E. Jennings

Carnegie Museum

THE "PERMANENT PHASE"

For some time it has been generally admitted that all substances are capable of existing in the three phases, solid, liquid, vapor, and some substances, as sulphur, in four phases. We believe that all substances are capable of existing in four phases, and some in more.

To show this notion, we will use the common text-book phase-diagram for water shown in Fig. 1, in which, for the sake of clearness,

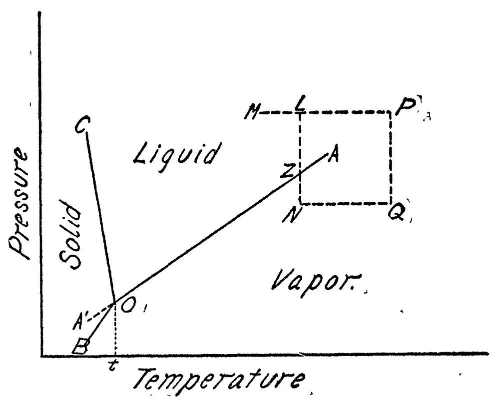

Fig. 1

the curves have been drawn as straight lines, and only the substance in a stable condition is considered. It will at once be seen that OA is the curve of vapor pressure that separates the region of liquid from the region of vapor. However, there is a limiting pressure beyond which the vapor pressure of the liquid can not rise, and therefore at the value of critical temperature and critical pressure A the curve OA abruptly ceases. It is commonly admitted that "for temperatures and pressures beyond A there is no distinction between the liquid and vapor phase, the phases having become identical."

Let us take any value M in the region of liquid, and pass to any value N in the region of vapor; this may be done in a variety of ways and may therefore be represented by straight or curved lines in the figure. However, let us choose to pass from M to N by changing either pressure or temperature, keeping the other constant meanwhile.

First let us change the temperature to that indicated by the value N (which is value L). Now the pressure at L is greater than vapor pressure at constant temperature, therefore at L the substance is a liquid only. Then let us decrease the pressure to that of N. At the pressure and temperature Z where the line LN (LN being any line cutting OA), indicating the drop in pressure, intersects OA, the curve of vapor-pressure, there is a discontinuity in the passage, the phenomenon of "boiling" will ensue, and no further drop in pressure can take place until all of the substance is vaporized. Then the pressure can be lowered till the value N is reached.

If, on the other hand, we follow the line $MPQN$, which does not cut the line OA, we can pass from the state of liquid at M to the state of vapor at N, without any discontinuity whatever. We first increase the temperature, following the line MLP to a value above the critical value. This takes us into the region where there is no distinction between liquid and vapor, so that by first reducing the pressure and then lowering the temperature, we pass without any break, to a substance in the truly vaporous state at N, the substance at no time having been in the state of two distinct phases.

To this last clause we take exception on the ground that we started with the substance a liquid at M, and ended with substance as a vapor at N, and therefore there must be a place in the transition where the substance ceases to be a liquid and begins to be a vapor. This follows just as naturally as it follows that when a ball is thrown into the air it reaches a point where it ceases going up and begins coming down.

By hypothesis, A was the critical value, which means that any further increase in temperature or pressure acting either singly or together can not produce any change in the state of the substance, and it also follows that any decrease of pressure or temperature acting either singly or in unison will place the resultant condition in the liquid or vapor region or on OA. If, as in Fig. 2, we draw

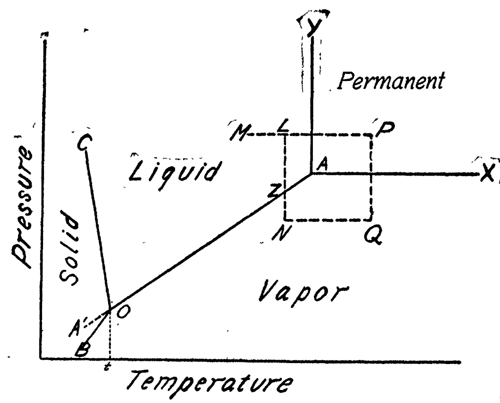

FIG. 2

the limits at which the critical condition can exist, we have YA and AX, because, taking the lowest temperature, that of A, and keeping it constant, and increasing the pressure, we get AY of infinite extent, any value to the left of which, as M, is liquid, and any value to the right, as P, resembles the critical condition at A. Now if we take the minimum pressure, that of A, keep it constant, and increase the temperature, we have AX, any presso-temperature P above AX resembling the substance when at A, while any value below AX, as Q, is vapor.

It is seen, then, that any value within the region YAX is in a special condition, which, for want of a better name, I propose the name "permanent phase."

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CURRENT NOTES ON METEOROLOGY AND CLIMATOLOGY

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