dispersion of aggregated virus particles, by a mechanism as yet not understood, or whether it represented actual multiplication of a living agent. The same problem has arisen in connection with the increase in potency of vaccine virus in a lifeless medium.

In view of the outcome of the experiments, we have concluded that the results of our tests can not with certainty be referred to a true multiplication of the mosaic virus.

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GEOMORPHOLOGICAL EVIDENCE OF A CLIMATIC BOUNDARY

ONE of the most significant climatic boundaries across the United States separates the territory experiencing effective winter cold from warmer regions on the south. Within humid climates the northern region is often called the cool temperate and the southern, warm temperate climate. In the terminology of the Köppen[1] system of climatology the two are designated microthermal and mesothermal, respectively. Within the realm of the dry climates the distinction becomes that between hot and cold steppes and deserts.

In a recent paper the writer[2] has presented arguments in favor of using one and the same boundary whether climates are humid or arid and has suggested that in the United States the January isotherm of 32° F. appears more satisfactory than any other proposal thus far made.[3] Certain contrasts were pointed out in vegetational, soil, geomorphological and cultural forms on the two sides of that isotherm. Since the publication of that paper he has observed a very interesting and fundamental condition that lends additional support in favor of the January 32° F. thesis.

The January isotherm of 32° F. enters the Atlantic Seaboard approximately at New York City, swings southward through New Jersey and across the Appalachian region, west of which it approximates the positions of the Ohio and Missouri rivers as far as the eastern boundary of the dry climates

[1] W. Köppen, "Die Klimate der Erde" (Berlin, W. de Gruyter Co., 1923).

[2] R. J. Russell, "Dry Climates of the United States: I, Climatic Map," *Univ. Calif. Publ. Geog.*, 5: 1–41, 1931.

[3] W. Köppen (1923) uses the mean annual isotherm of 18° C. (64.4° F.) in dry climates and the January isotherm of −3° C. (26.6° F.) in humid climates. On the more recent Köppen-Geiger "Klimakarte der Erde" (1: 20,000,000), (Gotha, Justus Perthes, 1928), he uses the value of eight or more months above 1° C. (33.8° F.) in humid climates. Van Royen, *Monthly Weather Review*, 55: 319 (1927) suggests, for the dry climates, the cold month isotherm of 50° F.

In the Trenton Folio of the United States Geological Survey Florence Bascom[4] calls attention to the fact that in the Coastal Plain of New Jersey topography sloping toward the north is notably steeper than that toward the south. The writer is not only able to confirm this observation but finds that it applies with equal force in landscapes of southern Ohio. South of both of these regions it disappears, thus appearing to be related to the position of the January 32° F. isotherm both east and west of the Appalachians.

In both cases the nature of the underlying bedrock is such that it could not possibly account for the observed slope asymmetry, as it is very nearly flat-lying. It is obvious that the details of sculpture must be ascribed to denudational processes now taking place.

While contrasted angles of incidence of sunlight on north and south slopes condition processes of weathering, evaporation rates, vegetational cover, and other denudational elements, it seems apparent that the greatest single effect is with reference to snow cover. On the borderlands of the region effectively blanketed by snow for considerable periods during the winter months, slight differences in slope direction produce enormous contrasts in the length of time snow actually remains on the ground. The relatively sunny southward slopes are barren for long periods during which northward slopes lie beneath thin sheets of snow. The snow protects the ground beneath from denudation during much of the critical winter period. Thus a contrast arises in the rate at which denudation takes place on the banks of any rills or streams flowing in directions approaching east or west. The northern bank, being the more rapidly attacked, has its gradient lessened in comparison to the southern bank, hence arises the topographic contrasts observed.

It is notable that in the southeastern United States erosion and denudation take place very rapidly, particularly as the result of the absence of frozen soil or snow cover during the winter season of vegetational dormancy, whereas in the northeastern and north central regions these processes are comparatively slow. Agricultural occupation aggravates conditions to such an extent that the loss of soil from the fields of the southern states has become recognized as a major national problem, and one recently receiving much attention as a result of the studies of H. H. Bennett and others. From the standpoint of climatology the contrasted regions may be considered mesothermal and microthermal climates.

Recognizing that all climatic boundaries are attempts to indicate mean positions within zones of gradual change, the asymmetrical slopes of New Jer-

[4] Folio 167: 2, (1909).

sey and southern Ohio have unusual interest in respect to the climatic boundary under consideration. The snow-covered northward slopes are effectively microthermal as regards snow cover and the southward slopes are mesothermal. Thus, from the geomorphological standpoint, in the vicinity of the isotherm of January 32° F., we find an ideal expression of climatic borderline conditions, innumerable islands of one climate within the realm of another. Whereas climatic contrasts may take place within comparatively short distances in areas of considerable relief, it is unusual to find them so strikingly displayed in such comparatively flat regions as those under discussion and hence of all the greater significance.

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CHLORATES AS HERBICIDES

THE persistent spread of the more noxious perennial weeds has recently focused the attention of many experimental workers on the problem of a cheap, safe and effective chemical method for the eradication of these plants. Sodium chlorate has proved in many trials to be the most generally effective herbicide now in use. With proper methods, such weeds as Canada thistle (*Cirsium arvense*), European bindweed (*Convolvulus arvensis*), quack grass (*Agropyron repens*) and similar plants can be controlled with one or more applications of this chemical. The cost ranges from twenty-five to one hundred dollars an acre and the fire hazard may be very serious with the usual methods of application in which a chlorate spray is applied to a heavy growth of foliage.

A three-year study of the herbicidal action of sodium chlorate in the botany department of the Iowa State College indicates that this compound may be more effective when applied to the roots rather than to the aerial portions of the plant, and suggests that under humid conditions the elimination of perennial plants by spraying with chlorates is dependent upon a portion of the spray residue reaching the soil. By applying the chemical, either crystalline or in solution, directly to the moist soil it is possible to reduce the quantities applied, and if the top growth of the plants is removed before treating, the principal fire hazard is eliminated. The apparently unchanged chlorate salt persists in the soil for a period varying with the conditions from a few weeks to two or more years. The herbicidal action consists of both a direct killing of the underground portions of the plants and of translocation to and slow killing of any new sprouts which may be formed. The importance of the two effects probably varies with the plant and the conditions. Quack grass or Canada thistle rhizomes and roots may be killed in the dormant stage, so that the effects of ultra-violet light are not required for the toxic action of chlorates. We have been unable to obtain any appreciable translocation of the toxin except in the transpiration stream, and any generalized action seems to be dependent upon the ability of the salt to persist in the soil solution, where, as stated, it may either penetrate and kill the roots and rhizomes, or be absorbed and translocated to transpiring regions of the top. The continued killing of the tops adds starvation to the direct action on the underground organs and explains the effectiveness of the treatment.

The tendency of the chlorate to persist in the soil may become seriously objectionable under some conditions. In our field tests we find that heavy applications which result in a large quantity of the salt reaching the sub-soil are particularly persistent. Temperature and leaching seem to be the most important factors concerned in the disappearance of chlorates. At temperatures of 25 to 30° C. treated soil loses its toxic properties in a few weeks, while in the sub-soils mentioned (three to five feet) the chlorate concentration is still too high to permit crop growth nearly two years after the initial application. The surface foot of these same plots which received chlorate at the rate of 1,000 pounds per acre is normal. The use of lighter applications under more favorable conditions should reduce the deep penetration and persistence of chlorates.

The recognition of the fact that chlorates are effective when used as root absorption poisons will permit the use of the sodium salt instead of the more expensive calcium chlorate. It will make it possible to eliminate the fire danger, now a very serious factor, avoid the destruction of chlorates exposed on the leaves of sprayed plants and help to reduce the after-effects of chlorate applications by avoiding excessive applications in cool soils not subject to leaching.

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THE CAUSATIVE ORGANISM OF A PAPULAR TYPE OF APPLE MEASLES[1]

THE disease known as apple measles, reported first by Hewitt and Truax[2] in 1912 as an obscure apple disease, has recently attracted especial attention in certain sections. This disease has been reported under various names which include "measles," "pimple

[1] Approved by the director of the West Virginia Agricultural Experiment Station, as Scientific Paper No. 97.

[2] J. L. Hewitt and H. E. Truax, "An Unknown Apple Tree Disease," Arkansas Agric. Exp. Sta. Bull. 112: 481–491, 14 figs, 1912.