to see to what extent the pharmacognosist and pharmaceutical chemists have contributed to make the microchemistry of plants an important branch of phytochemical investigation, pure as well as applied.

It ought to be possible in the future to supplement the macrochemical investigation of plants in a manner that should prove productive of the very best results. If the microscope, supplemented by accessories and chemical reagents, is going to enable the phytochemist of the future to extend the macroscopic examination carried out on one or several species to all members of a genus or even family with a minimum of material and possibly of time, the boundaries of plant chemistry ought to be extended farther in a decade than they have been during a century.

E. K.

THE ORIGIN OF CLIMATIC CHANGES[1]

The discussion of meteorological observations shows clearly that climates undergo variations of short duration, but such records as the presence of old lake beaches and the existence of well-marked glacial moraines, and other geological evidence distinctly point to climate changes covering long intervals of time. The evidence is not sufficient to characterize the variations as periodic, but the ice ages are sufficient to point to times when the conditions reached were extreme.

What may reasonably be assumed to be the chief established facts about such extensive changes may be summed up briefly as follows: Climatic changes were several, and probably many. Similar simultaneous changes occurred over the whole earth, or, in other words, it was warmer or colder over the whole earth simultaneously. These times of warmth or coldness were unequal in intensity and duration, and of irregular occurrence, and, lastly, they have taken place from very early, if not from the earliest geological age down to the present. Numerous theories, both probable and improbable, have been suggested from time to time to account for the origin of such world-wide changes, and while each has its advocates, perhaps only three may be said to claim attention to-day. These may be briefly stated as the eccentricity theory (Croll), depending on the eccentricity of the earth's orbit; the carbon dioxide theory (Tyndall), based on the selective absorption and variation in amount of carbon dioxide; and thirdly, the solar variation theory, on the assumption of solar changes of long duration. A new theory, which may be called "the volcanic dust and solar variation theory," has recently been put forward by Professor W. J. Humphreys,[2] under the guarded heading, "Volcanic Dust and Other Factors in the Production of Climatic Changes, and Their Possible Relation to Ice Ages."

The author carefully points out that the idea that volcanic dust may be an important factor in the production of climatic changes is not new, but "though just how it can be so apparently has not been explained, nor has the idea been specifically supported by direct observation." He remarks also that while the pioneers regarded the presence of volcanic dust in the atmosphere as an absorbent of radiation, and so lowered the earth's temperature, modern observation suggests the opposite effect, namely, the warming of the earth's surface.

In putting forward his views of the action of dust, Professor Humphreys proceeds first to indicate that the dust that is effective is that which is situated in the atmosphere in the isothermal region or stratosphere. He then enters into the question of the size of the particles and probable time of fall, and concludes that particles of the size of 1.85 microns in diameter would take from one to three years to get back to the earth if they originally had been thrown up by a volcanic eruption.

Considering next the action of the finest and therefore most persistent dust on solar radiation, he finds that the "interception of outgoing radiation is wholly negligible in com-

[1] From *Nature*.

[2] *Journal of the Franklin Institute,* August, 1913, Vol. CLXXVI., No. 2, p. 131; also *Bulletin of the Mount Weather Observatory,* August, 1913, Vol. VI., Part 1, p. 1.

parison with the interception of incoming solar radiation."

Professor Humphreys now turns his attention to the observational evidence of pyrheliometric records, such readings being functions of, among other things, both the solar atmosphere and the terrestrial atmosphere. He thus introduces a curve showing smoothed values of the annual average pyrheliometric values, and compares this with sun-spot frequency values (representing solar atmospheric changes) and number of volcanic eruptions (representing terrestrial atmospheric changes). The similarity of the last-mentioned with the pyrheliometric curve leads him to write as follows: "Hence it appears that the dust in our own atmosphere, and not the condition of the sun, is the controlling factor in determining the magnitudes and times of occurrence of great and abrupt changes of insolation intensity at the surface of the earth."

The action of the dust intercepting at times as much as one fifth of the direct solar radiation leads him to inspect earth surface temperature values to inquire whether they are below normal on such occasions. The pyrheliometric and temperature curves suggest a relationship, but, as he states, "the agreement is so far from perfect as to force the conclusion that the pyrheliograph values constitute only one factor in the determination of world temperatures." A better agreement is secured when the combined effect of insolation intensity and sun-spot influence is considered.

The author then discusses the temperature variations since 1750 as influenced by sun-spots and volcanic eruptions, and indicates that the disagreement in the curves of temperatures and sun-spots is in every important instance simultaneous with violent volcanic eruptions.

Limitations of space will not permit us to remark on his references to the action of carbon dioxide in slightly decreasing the temperature or to probable great changes in level. Enough perhaps has been said to show that Professor Humphreys, in his interesting attempt to show "that volcanic dust must have been a factor, possibly a very important one, in the production of many, perhaps all, past climatic changes . . .," has restarted a topic which will no doubt call for criticisms and discussions from many quarters.

SPECIAL ARTICLES

THE EFFECT OF COLD UPON THE LARVÆ OF TRICHINELLA SPIRALIS

IN the course of an investigation relative to *Trichinella spiralis,* it has been determined that cold has a decided destructive effect upon the encysted larvæ of this parasite. Heretofore it has been accepted as an established fact, upon the basis, however, of insufficient evidence, that low temperatures have no considerable influence upon the vitality of the larvæ of *Trichinella.* Although the results of only a single series of the writer's experiments are available at present, these results have been so definite that there can be little doubt as to the lethal action of cold upon *Trichinella* larvæ. The writer's experimental work thus far has shown that most of the parasites survive when exposed for as long as six days to a temperature ranging between 11° and 15° F. (= —11.70° to —9.4° C.). On the other hand, when exposed to a temperature in the neighborhood of 0° F. (= —17.8° C.) the larvæ of *Trichinella* quickly succumb. Only one out of over 1,000 larvæ examined has been found to survive an exposure of six days to this temperature. This was one among 275 isolated from a piece of trichinous meat which had been kept at a temperature of about 0° F. from September 27 to 30, allowed to thaw, and then again kept at the same low temperature, October 1 to 4, a total of six days' exposure. None was found alive among 498 larvæ from a piece of trichinous meat kept at about 0° F. September 27 to 30, allowed to thaw, then exposed again to the same low temperature October 1 to 3, and thus exposed five days in all, nor was any found alive among 233 larvæ from a piece of trichinous meat kept continuously at about 0° F. for five days. Out of 301 larvæ from trichinous meat kept at about 0° F. for three days only 5 showed signs of life. 225 out of 366 larvæ exposed for two days to a