cooperated in the production of *The American Journal of Botany,* in accordance with an agreement executed in 1913. The society had charge of the editing and the garden had charge of the business management and assumed certain financial responsibility. In harmony with a provision in this agreement, the Botanic Garden suggested to the society last June that the cooperation be terminated at the earliest convenience of the society. The society has now notified the Botanic Garden naming January 1, 1936 as the date for the termination of the agreement. After that date, the Brooklyn Botanic Garden will have no official connection with *The American Journal of Botany.*

AN expedition of nine men has left England to spend fourteen months in North-East Land. It is supported, according to the London *Times,* by Oxford University and the Royal Geographical Society, and will be under the leadership of A. R. Glen, leader of the 1933 expedition. The objects of the expedition are to map the unknown north and east coast of North-East Land, and also to explore the islands to the north and east. It is hoped to continue the survey of Victoria Island during the summer of 1936. Investigations on the ionosphere will be carried out, in continuation of the work of the British Polar Year Expedition, 1932–33, and research will also be made on cosmic rays, ozone and the *aurora borealis.* Two winter stations will be established on the western ice-sheet; each will be maintained by two men through the winter in order to examine the present balance of glacial conditions. The base hut is being built in Rijps Bay. The motor-ship Polar of Tromsö has been chartered to take the expedition to North-East Land, where no expedition has yet wintered.

DISCUSSION

POWER TO MOVE CONTINENTS

THE subject of continental drift seems to be still very much alive. This is evidenced by the fact that the International Astronomical Union[1] has been engaged in checking gross movements of earth crust since 1926 to determine the existence of systematic drift and by the very adequate discussion of the geological aspects of the case by Dr. W. W. Watts[2] in his presidential address before the British Association for the Advancement of Science in September, 1935.

It is notable that in all the discussion of the subject, the fact that "no plausible explanation of the mechanics involved has been offered" appears to be the final reason for not accepting the drift theory. This paper is an attempt to present a reasonable, understandable process of drift and is proposed for such consideration as it may deserve.

If continental drift occurred, if Malasia, Australia and Antarctica were moved from the Indian Ocean area, the problem is one of transportation; if the Americas were swung away from the Eurasia-Africa land body, transportation is again the central problem. The thing accomplished is a great engineering feat, done by recognized engineering methods. When inquiry is made regarding an adequate source of power to separate two continents by two thousand miles, the engineer answers without hesitation that only one such is conceivable—the heat engine.

What, then, are the geologically possible conditions under which a great natural heat engine may be created and so function as to separate continental masses?

The first requirement is that solid ocean bottoms shall not present an effective barrier to continental movement. This in turn demands a liquid substratum in the earth structure. Since the publication of Joly's[3] work on the geological effect of radioactivity the idea of a periodical liquid phase in a subsurface zone appears to be gaining favor. The engineer may then proceed on the basis that there are periods when the solid shell of rock is underlain by a liquid zone of like material. Moreover, that portion under the continental mass will be in a highly superheated condition; *i.e.,* dissolved gases will be exerting high pressure and the more volatile constituents of the complex liquid will be ready to vaporize with the slightest release of confining pressure. This condition of high temperature and high mobility with internally developed pressures is normally productive of dikes, sills and batholiths as well as lava flows, small and great.

Again, the fact that solid rock is heavier than its own melt is vital to the question. Ocean bottom, once broken into blocks, would sink and present no obstruction to the advancing continent. In fact, the advancing continent would act as an "ice breaker" and ride down the obstructions as encountered.

The stage is set for action by considering such an accumulation of temperature under the continental mass that bursting pressures occur and rupture takes place along a line following, of course, such lines of weakness as have been previously developed. A con-

[1] Science News note, SCIENCE, May 31, 1935.

[2] SCIENCE, September 6, 1935.

[3] "Radioacitvity and the Surface History of the Earth," Clarendon Press, 1924.

dition of gross movement is, of course, that the violence of eruption is sufficient to shatter adjacent ocean bottom.

Under these circumstances the line of fracture becomes a line of volcanic eruption and lava discharge, and this creates the side thrust necessary to separate the edges and widen the crack by floating the regions apart. Of course, such movement would occur only when the opposite continental edges can break up and ride down the opposing ocean bottom.

It is quite unnecessary to consider the thermodynamics of eruption, either of geyser or volcano, in detail. It is sufficient to recall that the action is that of a heat engine in which gas is produced by heat energy, expands on reduction of pressure on its upward movement, receives heat from its liquid surroundings, thereby approaching the isothermal, rather than the adiabatic process, and by its rapid rise through the liquid accelerates the latter to produce a spouting action.

This heat-pump action will actually produce a higher liquid level in the crack than exists on the opposite side of the continental block and will maintain such a differential head so long as the widening crack continues to uncover a fresh supply of superheated liquid.

Movement will cease when the material uncovered is so cool that it ceases to foam or when a portion of ocean bottom is encountered which holds its place.

On this view continental migration is an episode to be compared with a volcanic eruption or major lava flow. Its occasion is an unusual combination of accumulated thermal potential energy and worldwide catastrophe. That it has occurred not more than twice in two thousand million years entitles it to be classified as rare; we may not look for another continental scattering soon.

Though much time has elapsed since the Atlantic Ocean was formed, we still should be able to discern some evidence of such a world-shaking event. Three items of such corroborative support are offered: (1) The mid-Atlantic swell; (2) the Pacific foredeeps; (3) the Gulf of Mexico.

The crystalline rock material of the earth crust is brittle; very brittle, as any stone mason's hammer will show. Moreover, earth movements have shattered the most of it to bits at one time or another, as can be directly observed in the marble and granite of our great buildings. This clearly indicates that the fracture of a continent would be attended by vast crumbling. Of course, this crumbled material, being specifically lighter than the magma into which it tumbled, would form a swell or ridge in the Atlantic Ocean bottom following the general line of fracture. That there is such a swell in mid-Atlantic throughout its extent is corroborative evidence of the migration and of its episodal nature.

If the continental masses moved over the Pacific area, riding down blocks of ocean bottom, it might reasonably be expected that as the continental motion ceased, the down-going blocks would be caught and jammed in place forming deep holes in the ocean bed. The foredeeps of the Pacific constitute precisely such a system, as might be expected.

The central position of the mid-Atlantic swell indicates approximately equal masses of land in each of the traveling continents or an earlier stoppage of the American side. The general absence of foredeeps off the American shore indicates the former, while the Gulf of Mexico and the Easter Divide points to a collision stoppage of the American fragment.

Any one who accepts as reasonable the hypothesis of rapid continental migration here presented will recognize that the frail isthmus structure connecting the two Americas could never have withstood the hazards of so turbulent a voyage. Clearly the notch formed by the Gulf of Mexico and the Caribbean Sea was made after the crossing. The most plausible view of such a happening is that the central part of the American continent encountered an ocean bottom (the Easter Divide) which did not yield and that the inertia of the ends was sufficient to "break its back."

The fragments produced by such an impact would move about with much randomness in the boiling magma but would have a general tendency eastward with the current. Meanwhile the original angles of the two Americas would be changed and probably their north-south relation as well. In short, in a breakup of such magnitude and complexity anything could happen.

In discussing the subject there has been no intention of evaluating the evidence regarding continental migration: only to show that there is an adequate source of power whereby, under certain conditions, it might be accomplished.

However, in reading such discussions of the subject as have come to hand, it has been noted that the argument for continental migration which appears the most valid and convincing to the writer has never been mentioned. Briefly, it is that when nature assembles material, the resulting natural form is round or oval. This is true from spiral nebula to snowflake; from a swarm of bees to a colony of bacteria; from star to dewdrop. So we should naturally expect that when the lighter sial was separated from the heavier basic magma, whatever the process, the result would be an oval mass and that fragmentation into present land forms has been the result of later, disruptive processes.

If, as seems probable, the process was one of fractional distillation, followed by selective condensation and selective solidification, the anticyclonic wind action would certainly give a radial distribution of material with considerable uniformity. A similar case is the radial distribution of snow to form the ice barrier which smooths the ragged edges of the Antarctic Continent. Here a new type of rock (ice) is formed and deposited through thermal, chemical and mechanical processes somewhat like those which probably acted to produce the original continental structure.

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PROTECTION FROM MOSQUITO BITES IN OUTDOOR GATHERINGS[1]

THE adult female mosquito has been the pest of mankind since time immemorial. In areas where mosquito eradication is not conducted at all or only to a limited extent, prodigious numbers of mosquitoes on the wing offer a great menace to our health and comfort, making it practically impossible to spend a summer evening outdoors without being badly bitten up. Some individuals are so highly susceptible to the after effects following these bites, which usually cause irritation and swelling, that they are afraid to leave their houses, screened porches and similar protected enclosures in the evenings. While the mosquito annoyance is especially unbearable in farm communities and suburban districts, towns and cities are by no means free from it.

The problem of temporarily ridding a small area of adult mosquitoes where a large number of people could comfortably enjoy a summer evening has often presented itself. Such places may vary in area from a few square yards to several acres and may consist of a well-cared-for lawn, shrubs, flowers, trees and other valuable vegetation which must not be injured. It is obvious that in order to eliminate mosquitoes the area must be treated in such a way that those on the wing or resting in the grass within the area are killed or incapacitated, while those outside of the treated area are repelled.

The New Jersey mosquito larvacide[2] contains a light petroleum oil and pyrethrum and has been extensively applied during the last three years in exterminating larvae and pupae in waters without injury to fish, water-fowl and vegetation. Pyrethrum was shown to be toxic[3, 4] as well as repellent[4] to adult mosquitoes. Furthermore, it had been observed by many mosquito workers that the female mosquito will not lay eggs on water covered with kerosene or fuel oil. Evidently light petroleum oil also possesses repellency against the adult mosquito. In view of the above properties it was conjectured that the larvacide, applied as a diluted spray over the entire area where the meeting takes place, might prove effective and economical for temporary protection.

Accordingly experiments were conducted with various dilutions of this larvacide. Up to date the writer has records of some 50 tests on areas ranging from a few square yards to 5 acres, involving evening gatherings of from 10 to 2,000 people. The results indicate that it is quite possible and economical partially or completely to protect an outdoor gathering such as carnivals, picnics, open-air theaters, lawn parties, etc., from mosquito annoyance by spraying the area with the larvacide diluted 1:10 or 1:12 with water without any appreciable injury to vegetation and without discomfort to the audience. The spray is applied in the form of a fine fog, covering the grass, ground, shrubs, as well as throughout the air.

DIRECTIONS FOR SPRAYING

About half an hour before the gathering takes place the area is completely sprayed with the larvacide diluted 1:10 or 1:12, that is 1 part of larvacide is mixed with 10 or 12 parts of water. The spraying is done with a power sprayer capable of developing a pressure of 100 pounds or more per square inch and equipped with a spray gun. Before mixing with water the concentrated stock larvacide should be well shaken. Also the diluted spray should be frequently stirred or agitated in order to secure uniform distribution throughout the spraying operation. The spray is applied in the form of a fine fog directly to the grass, grounds, tents, trees, shrubs, etc. Then the stream is directed upward so as to saturate the atmosphere with the fog. At no time should a coarse spray be applied, since it is unnecessary and may injure vegetation. The grounds for about 20 feet outside the area should also be thoroughly fogged, especially when tall grass, shrubs, woodland and other vegetation are present offering a hiding place from which adult female mosquitoes may issue suddenly at dusk in large numbers. If the area has been thoroughly fogged one treatment may suffice for two hours or even the rest of the evening. If mosquitoes become bothersome later in the evening, the area on the outside of the "gathering" grounds should again be fogged, directing the stream primarily upward and towards the ground to be protected. This outside fogging may be repeated again if necessary. On small areas, such as back-yards, private lawns, etc., a knapsack sprayer or bucket pump capable of producing a fog spray, of 10 to 15 feet high, can be used.

1 Paper of the Journal Series, New Jersey Agricultural Experiment Station, Department of Entomology.

2 J. M. Ginsburg, *Proc., 17th Annual Meeting N. J. Mosq. Ext. Assoc.*, p. 57, 1930.

3 J. M. Ginsburg, *Proc. 21st Annual Meeting N. J. Mosq. Ext. Assoc.*, p. 21, 1934.

4 J. M. Ginsburg, *Proc. 22nd Annual Meeting N. J. Mosq. Ext. Assoc.*, 1935.