of Kurtz is the new species of Gleichenites from Cerro Baguales; the *Asplenium dicksonianum* Heer of Kurtz is either the Dennstaedtia or the Dryopterites of the new collection, and probably represents both since Heer's species is polymorphic, and one of my genera is based upon fertile material, the sterile being much alike in the two genera; the *Cinnamomum heeri* Lesquereux of Kurtz is my new species of Menispermites; the *Protophyllum* cf. *rugosum* Lesquereux of Kurtz is my Paranymphaea; his *Sassafras acutilobum* Lesquereux, *Liquidambar integrifolium* Lesquereux, and probably some of the other of Lesquereux's species of Sassafras which he records, are the same as my new species of Sterculia from Cerro Baguales; Kurtz's *Salix proteaefolia* Lesq. is one of the two new species of Laurophyllum from Cerro Baguales, and probably includes also what Kurtz called *Quercus primordialis* Lesquereux; the second Laurophyllum from Cerro Baguales appears to be what Kurtz called *Perseophyllum hauthalianum.*

The foregoing seem conclusive, but do not dispose of all the names recorded by Kurtz. One or two comments seem pertinent to the remainder, although these must be regarded as tentative, since they are based upon opinion rather than factual evidence. I regard what Kurtz called *Liriodendron meeki* Lesquereux as a leguminous leaflet and not the same as what passes by this name in the northern hemisphere, which is also probably not related to Liriodendron. Kurtz's seed of Abietites is not related to the pines and probably belongs to some genus of the family Proteaceae. The Sequoia twig is probably of the same nature as the one recorded by Engelhardt from the Tertiary of Chile, *i.e.,* a Podocarpus.

If my conclusions are correct it means that the genera Sassafras, Liquidambar, Quercus, Protophyllum, Liriodendron, Abietites (Pinus ?), and Sequoia remain unknown on the South American continent, either from the Cretaceous or later down to the present. It means that there is no present basis for the concept of over a score of Dakota plants from the northern hemisphere reaching South America in a body and unchanged at near the beginning of the age of flowering plants in Mid-Cretaceous time.

It does not mean that there was not an avenue of land communication between North and South America at some time during the Upper Cretaceous. This is as clear as ever, and the Cerro Baguales flora is distinctly related to, and seems to have been derived from the northern hemisphere, as is also true of the Paleocene and Eocene floras of Patagonia.

As to the exact age of the Cerro Baguales flora it is, as aforesaid, definitely Upper Cretaceous. It seems quite as definitely to belong in the Patagonian stage known as the Salamanca. What precisely this is in the international Upper Cretaceous time-table is not so clear. Kurtz called his Cerro Guido plants Cenomanian, because the Dakota sandstone was then considered to be of that age, although I have long regarded it as Turonian. The most similar plants in the northern hemisphere to those from Cerro Baguales come from horizons usually referred to the Turonian, Emscherian and Aturian stages, but concerning which there are differences of opinion, especially as between the botanical and the zoological evidence, the paleobotanists usually considering the various horizons as about one sub-stage older than do the paleozoologists, although the latter authorities are not always in agreement. My tentative opinion is that this flora is late Emscherian or Aturian in age, and this would also include the Kurtz flora from Cerro Guido.

EDWARD W. BERRY
JOHNS HOPKINS UNIVERSITY

OBSERVATION ON EXCITATION OF FIREFLIES BY EXPLOSIONS

THE writer had an opportunity to observe an extraordinary phenomenon of excitability of fireflies by explosions on the Fourth of July, which is worthy of communication so that others who have a similar lucky opportunity may be prepared to make more exact observations or even experiment if located where loud noises can be made without objection.

While resting in his garden during the twilight of the evening of the Fourth to watch the fireflies, which this year have made there a much finer display than usual by their great numbers, the writer was startled by the sudden flashing up of the entire grass plot in front of him when some boys fired cannon crackers in the street in front of the house, about 80 feet away, while before only common firecrackers had been exploded half a long block down the street. In an area twenty by twenty feet directly before him, in which before and after only half a dozen fireflies at the most, usually less, could be observed, between forty and fifty were now counted.

The brilliancy of the spectacle was greatly enhanced by the more rapid flashing of the insects, which was at intervals of the ability to count one-two, while before and after it was at the rate of the count one-two-three-four—or a little slower—with now and then an excited individual flashing at the rate one-two.

A third striking feature was that all the fireflies kept in the grass or darted around just above it, altogether not more than one foot above the ground, and none whatever flew up to a height of ten or more feet, as a few always do under normal conditions.

When the infernal noise stopped after a short interval, probably not more than ten minutes, the entire grass plot, as the rest of the garden, fell into complete

darkness, all fireflies having ceased to flash except three that now rapidly rose into the cherry trees. After a time, which I failed to measure, the fireflies reappeared in their normal number, resuming their regular rate of flashing and their usual mode of flying in very irregular courses and at various heights.

The fireflies were determined by H. C. Fall through K. F. Chamberlain, assistant state entomologist, as belonging to the *Photinus scintillans-marginellus* group. As no "glow worms" were observed in the grass, it is probable that the females were of the luminous kind and flying. Only males were captured, however.

As Lutz in his "Field Book of Insects," points out, the lightning, in *Photinus* at least, is principally for sexual attraction. He adds: "Another view is that the light is a warning signal to nocturnal birds, bats, or other insectivorous animals. The family Lampyridae to which the lightning bugs belong is known to be refused by birds in general." It is therefore readily understood that the fireflies when frightened by the air vibrations, if not the noise of the firecrackers, raised their warning signals at double speed. This is especially obvious when it is remembered[1] that the flashing is the result of a stimulus conveyed by special nerves whereby oxygen is brought to the network of tracheae in the adipose tissue, thus producing a slow combustion, and being of the nature of a reflex motion.[2]

The sudden lighting up and nearly as abrupt darkening of the garden could be considered as rude major synchronous flashing induced by vibrations of the air. This is somewhat in line with the observations of Hess,[3] who found that he could initiate synchronous flashing by means of a pocket flashlight and even cause the insects to adopt a somewhat higher frequency of flashing. Also in this case the more rapid flashing was of the nature of a warning signal, and it is worth noting that the fireflies excited by the cannon crackers showed a double frequency of flashing. Flashing, therefore, on occasion serves undoubtedly as a warning signal besides its usual sexual function.

A perusal of literature indicates that various theories have been advanced to explain the concerted action or photosynchrony. Most recent authors[4] believe that the synchronous flashing is led by a pacemaker. This theory of "sympathy" is supported by observations like those of Alexander who saw the flashes passing like waves over a long row of trees near Bangkok and noted slight differences in time of flashing but not in frequency. Others have tried to explain the synchronous flashing by the influence of concerted movement. Thus von Osten-Sacken (see Brehm's Tierleben) observed the synchronous flashing of the American species *Photinus pyralis* L. to be connected with rhythmic up-and-down movements of the swarms of fireflies, and Allard[5] notes that as the creatures arise very slowly, each flash is attended by a sudden upward flight-impulse which may even carry them almost straight up several feet. On the other hand, the frightened and more rapidly flashing fireflies which the writer saw in his garden kept strictly near the ground and Morrison observed the synchronism near Bangkok on still as well as on quite windy days. It seems, therefore, that the photosynchrony is somewhat dependent on the movements of the beetles, but independent from the stimulating influence of breezes, as one might suspect. The major influence in the synchronism is then apparently the reflex action of the fireflies on seeing the light of the luminous pacemaker. This mass action may, however, have been originally induced by a strong external stimulus, such as the air vibrations proceeding from the cannon crackers, and the writer had, indeed, the impression that there followed upon the general luminosity of the fireflies a period of longer intervals of more general flashing and of prevailing darkness.

RUDOLF RUEDEMANN

NEW YORK STATE MUSEUM,
ALBANY

[1] See Vernon L. Kellogg, "American Insects," p. 269, 1908.

[2] The sudden luminosity of the fireflies upon being frightened reminds the writer of a similar effect he saw on a night when the Atlantic Ocean was brilliantly phosphorescent and the bathtub filled with sea water would become a fiery phosphorescent mass every time the water was agitated. Also in this case, the *Noctilucas*, even though lowly protozoans, responded by suddenly flashing up upon being disturbed, in this case the layer of protoplasm below the cuticle being active.

[3] W. N. Hess, *Biological Bulletin*, 38: 39–77, 1920.

[4] As, for instance, T. F. Morrison, SCIENCE, 69: 400–401, 1920, and G. Alexander, SCIENCE, 82: 400, 1935.

SECONDARY BINOCULAR VISION IN BIRDS

IT has been pointed out by Dunlap and Mowrer that "due to the relatively restricted magnitude of possible eye movement in most avian species, the field of vision is usually changed by means of quick jerky movements of the entire head instead of by means of the so-called 'saccadic' eye movements so conspicuous, for example, in human beings and other Primates." They called attention to the possibility of the nictitating membrane, or "third eyelid," having a function in birds somewhat comparable to that of a shutter in a motion picture camera.

The head movements of birds, in so far as they are concerned with vision, are of three types: (1) Movements that effect a change in the visual field; (2) movements tending to maintain a given visual field during bodily displacement; and (3) movements tending to hold the image of a moving object motionless on the retina.

[5] H. A. Allard, SCIENCE, 52: 539, 1920.