February, 1908); "Paleobotany" (reviews in *Am. Jour. Sci.*, April, 1908); "The *Williamsonias* of the Mixteca Alta" (*Bot. Gaz.*, December, 1909); "Further Notes on Seed Structures" (*Am. Jour. Sci.*, August, 1911); "The Williamsonian Tribe" (*Am. Jour. Sci.*, December, 1911), and "The Smaller Flowerbuds of Cycadeoidea" (*Am. Jour. Sci.*, February, 1912). In the last is ample confirmation of the author's interpretation of the old Cycad flower structure as announced by him nearly eleven years earlier. These papers, with the author's monumental volume, "American Fossil Cycads" (1906) constitute a remarkable example of the gradual uncovering of facts and their successful interpretation, and combination into a consistent phylogenetic scheme.

CHARLES E. BESSEY
THE UNIVERSITY OF NEBRASKA

SPECIAL ARTICLES

THE INEFFICIENCY OF WIRES AS A MEANS OF CURING DEFECTIVE ACOUSTICS OF AUDITORIUMS

IN the popular mind, one of the first aids for a hall with poor acoustics is to install a system of wires or strings with the expectation that in some way the defect will be cured. This prevalent idea is doubtless due to the fact that there are many halls where wires have been strung, and people naturally conclude that there must be some merit in the method. As a matter of fact, this popular impression does not seem to be well founded, for the author has inspected a number of halls thus treated, and has found no marked improvement in the acoustics.

Thus in Dr. Parkhurst's church in New York City where a thin network of silk fibers of large mesh was stretched horizontally about half way between the floor and the dome, there still persisted a reverberation and an echo. In the Royal Cathedral in Berlin, a number of silk cords are installed in a horizontal network, yet the acoustics remain very defective. A fishnet is stretched near the ceiling in one of the court rooms of the Berlin Rathhaus with no benefit to the acoustical properties. The Royal Albert Hall in London has a series of wires installed, and, while the acoustics there are improved, other features than wires have unquestionably produced the effect. The warden of a church in Nottingham, England, writes:

> Several dodges were tried to overcome the (acoustical) defect, such as stretching wires across the nave.

And so on for other cases that might be cited.

The conclusions of the author in regard to the inefficiency of wires have not always been in accord with the opinions of the auditors in the various halls mentioned. The janitor of Dr. Parkhurst's church, in answer to the question, "Does the net help the acoustics?" replied, "Some says it does, and some says it don't." In the Royal Cathedral in Berlin, according to the attendant's account, the Kaiser thought the wires produced no improvement while the Kaiserin thought they did. The direct question to the attendant as to his own opinion proved very embarrassing and brought only a shrug of the shoulders. Later conversation, however, revealed his conviction that no help had been rendered. In the majority of cases where opinions were asked for, there was a decided expression against the use of wires—"the acoustics are as bad as before," "The wires have not helped," etc.

Some people, however, claim that the method is advantageous, and that the acoustics are really benefited. The author believes these claims are sincere, but attributes the better hearing to other features than the wires. For instance, the acoustics are usually improved when a large audience is present. Also, the opening of windows produces a good effect. Furthermore, regular attendants in a hall with poor acoustics get used to the defect, and, by an adjustment of the attention, are able in some cases to subordinate the disturbing factors and hear better than before. Thus on one occasion the author fixed his attention on a particularly strong echo and was able to hear more distinctly than by listening to the words

as they came directly from the speaker. On another occasion in this same hall the leader of the band had great trouble in conducting a certain selection. The piece being played was a xylophone solo with orchestra accompaniment. After some time the leader discovered that he was beating time to the *echo* of the xylophone. The players near the soloist kept proper time, the others near the leader played in unison with the echo. The result may be imagined.

While both observation and opinion indicate that acoustical defects are not helped by wires, it is interesting to look for further confirmation from the standpoint of theory. It is well known that if a loud tone is sung near a piano, certain wires of the latter will resound. Perhaps this phenomenon suggested the use of wires in auditoriums, with the hope that the objectionable sound would be absorbed or broken up in some way. But the conditions for the response of the piano strings are very favorable. There are many wires tuned to different pitches, so that certain ones are in tune, or nearly so, with any tone sung, and these are the wires that resound. The wire in the auditorium would respond therefore to only one of the many tones present. To be effective on this score, there would have to be many wires tuned so as to cover a wide range of pitch. Secondly, the piano wire is backed by a sounding board, which absorbs considerable energy and communicates it to the wire. The response is thus very much greater than it would be without the sounding board. The wire in the auditorium has no such sounding board, therefore it absorbs less energy and has less effect on the sound. Finally, the piano occupies a considerable portion of the space of the room and gets energy not only directly, but also by reflection from the near-by walls and ceiling. On the other hand, the wire in the auditorium is small, and is struck by only a small part of the sound waves, direct or reflected, hence has a small chance to help matters. All of these considerations indicate the smallness of the effect to be expected.

One other way in which wires might be beneficial lies in the possible scattering of the sound waves. Here again, however, the small bulk of the wires allows but little effect. The sound waves pass around the wires in much the same way that large water waves on a pond pass by a stake projecting through the surface. It is only when the obstacle has some size compared with the waves that a disturbance is set up. If there were a large number of wires close together, the sound waves would be influenced. In halls, we find usually only a few wires installed, probably with the idea of having them inconspicuous.

From the various considerations mentioned, it is seen that the installation of wires in halls having poor acoustics is without marked effect. While much remains to be done on the problem of architectural acoustics, and though the means of cure can not be specified readily for each case, it is nevertheless of value to know that the installation of wires, as now used, will *not* serve to cure the trouble.

F. R. Watson

Berlin, Germany,
March 6, 1912

Color Variations of the House Mouse in California

While trapping for mice in the vicinity of Palo Alto, California, in November, 1910, a mouse was taken the under parts of which were colored white, as in the common Gambel's mouse (*Peromyscus maniculatus gambeli*), but which on examination, proved to be a house mouse (*Mus musculus*). Since that time, trapping in a number of localities in California by the author and others and search through previously made collections of California mammals have brought to light a considerable number of instances of color variations in the house mouse. So far, only a start has been made in the study of these variations. The meager results at hand are published at this time because the author is leaving California. It is hoped that such publication will direct the attention of students and collectors to the house mouse, an animal that is commonly neglected. Very likely further variations will be found in the same animal from other parts of America.