in his "Introduction to Historical Geology" (1916), says (p. 232):

> Insects such as bees, ants and wasps made their first appearance in the Jurassic.

Dr. C. Schuchert, in "Historical Geology" ("Text-book of Geology," part 2), 1915, p. 812, states that "with the Comanchian . . . insects (beetles, flies, ants, bees, wasps) took their rise." As a matter of fact, the oldest known bees are from Baltic amber (Oligocene Tertiary), and the oldest known true wasps and ants are from the Eocene. In the Jurassic, the peculiar family Pseudosiricidæ, apparently related to the modern Siricidæ, were well represented. One species of this extinct family (*Megapterites mirabilis* Ckll.) has lately been described from the English Eocene. There is a very dubious Jurassic Hymenopterous insect from Spain, supposed to be related to the Ichneumonidæ. These Hymenoptera were not in any way adapted to be pollinators of flowers. Considering the development of the Hymenoptera in the Eocene, it may be presumed that the wasps and ants, at least, originated as early as the Cretaceous, but there is no direct evidence on the point.

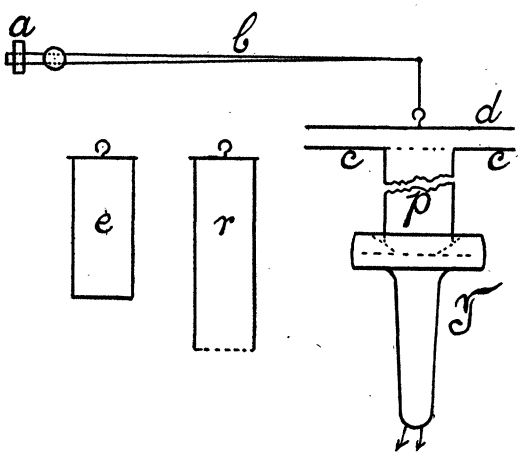
T. D. A. COCKERELL
UNIVERSITY OF COLORADO

## SPECIAL ARTICLES

### THE PNEUMATIC PARADOX IN ACOUSTICS

1. THE following pretty experiment is very instructive in its bearing on the Mayer-Dvorak effect, as well as on the experiments of the present paper. In the figure, *b* is the light wooden beam (30 cm. long, counterpoised at *a*) of a horizontal torsion balance, the torsion wire (of brass, .02 cm. in diameter and 18 cm. long on either side normal to the diagram) being seen at *w*. A light disc of cardboard *d* is suspended in equilibrium from the end of the balance. Below this is the telephone *T* to which the brass pipe *p* (13 cm. in length and 2.6 cm. in diameter) has been cemented, to form of a closed *c″* organ pipe of which the telephone plate is the bottom. The open top of *p* is surrounded by a fixed annular disc *cc* of metal parallel and close to the movable disc *d*.

When the telephone is strongly energized and emits a rising note (motor break and rheostat), no effect is produced until its frequency is in resonance with the pipe *p*, whereupon the disc *d* is at once attracted. Since the pipe *p* is closed above by this process, the telephone frequency must be slightly reduced to keep the discs in cohesion. On breaking the current *d* is at once released.




This is of course nothing further than a modified example of the familiar pneumatic paradox. When the pipe howls, the distance from which *d* may be attracted and held is perhaps 2 cm. beyond which the couche of diminished static pressure is ineffective. The thickness vanishes with the intensity of sound.

2. If now *cc* is removed and the disc *d* is replaced by the closed paper cylinder *e* of a diameter (2.1 cm.) sufficiently small to enter the mouth of *p* easily, the results of the experiment are the same. Here however the cylinder *e* may be made to enter the pipe as much as 1 cm. or more by successively decreasing the pitch, conformably by the gradually stopped mouth of *p*. Supposing the total displacement to be 2 cm., the force indicated by the torsion balance would be .7 dyne and the mean pressure decrement for the area 3.5 cm.$^2$, therefore .2 dynes/cm.$^2$ But as both the disc and cylinder come down with a jerk, the maximum forces are probably larger.

If there were a pin hole in the bottom of *e*,

the density of air contained would tend to increase and the cylinder fall for this reason also. But the present experiment is relatively too crude to show this. For the content of the cylinder $e$ (6 cm. long) may be taken as 33 milligrams of air. The forces registered by the pinhole valve in experiments with resonators did not exceed $dp \mid p = 3 \times 10^{-4}$. Thus the increment of weight of $e$ is but $10^{-2}$ dyne, which would lower the index of the torsion balance only .3 mm.

3. Finally let the closed cylinder $e$ be replaced by the cylinder $r$ open below and capable of entering the pipe $p$. Let the length of $r$ be such that the open cylinder is in resonance with $p$. Then the conditions of the experiment are obviously improved (though not as much so in the experiment as anticipated[1]); but the results will still be the same in character. The open end of $r$ will tend to enter the sounding pipe $p$; which is the equivalent of the Mayer-Dvorak experiment, here exhibited without any "neck" effect and without air currents.

4. I may add a comparison of the pin-hole compression observed in the given pipe (2.6 cm. diameter and 13 cm. long) when sounding loudly (*i.e.*, when resistance in the telephone circuit has been reduced as much as possible) and the compression observed in the open organ pipe of the standard form on the interferometer. The embouchured organ pipe, tested on the interferometer,[2] showed for the maximum compression $d\rho \mid \rho = 10^{-3} \times 14$ in case of a moderately loud note. The telephone closed pipe, tested with the pin-hole valve at the end of a quill tube thrust well within, gave a displacement of 20 fringes with 2,000 ohms in circuit. This is equivalent to a pressure increment of .0120 cm. of mercury when but 100 ohms are in circuit, as was approximately the case in the experiments of this paragraph. Thus in case of the probe $dp \mid p = 1.6 \times 10^{-4}$. Reservoirs at the U-tube of different volumes showed the same quantitative result. The increment (compression) does not quite vanish even in the plane of the mouth of $p$, but a little beyond. The ratio of the two compressions is thus 87; but while the interferometer direct gives a fringe displacement rarely exceeding 1, the pin-hole valve, under like conditions, will give fringe displacements easily several hundred times larger, depending on the degree of approach to the critical diameter of the pin hole.

Carl Barus

Brown University, Providence, R. I.

[1] On varnishing the paper resonator to stiffen it, forces above 2 dynes per cm.$^2$ were directly measured.

[2] Science, LII., p. 47.

## THE KENTUCKY ACADEMY OF SCIENCE

The Kentucky Academy of Science held its eighth annual meeting on May 14th at the University of Kentucky, Lexington. The meeting was called to order at 9:30 o'clock by President Coolidge.

The secretary's report showed 127 members, including 44 national members, 55 local members, 21 corresponding members and 7 honorary members. These represent 37 different lines of activity of which chemistry leads with 26 members. Twenty-one new members were elected.

The report of the committee on legislation proposed a large program to be worked for, including a state appropriation for the support of the academy; awarding prizes for research; increased appropriations for completing the topographical map of the state and soil surveys; a natural history survey of the state and the establishment of a natural history museum; increase in the teaching of science in the high schools; the preservation of the records of drilled wells; the setting aside of areas for preserving natural conditions and the endorsement of the law now before Congress to make Mammoth Cave and its environs a national park. This report was adopted.

The officers elected were:

President, George D. Smith, State Normal School, Richmond, Ky.
Vice-president, Lucien Beckner, Winchester, Ky.
Secretary, A. M. Peter, Experiment Station, Lexington, Ky.
Treasurer, Charles A. Shull, University of Kentucky, Lexington, Ky.
Member of Publications Committee, D. W. Martin, Georgetown College, Georgetown, Ky.
Representative in the Council of the A. A. A. S., A. M. Peter.

The program included an address by Dr. Henry