avoid the consequences of the stark evolutionary processes there operative. This scheme has been essentially to provide sufficiently adequate transport facilities, by sea and by land, so that the physiologically obligate elements of the environmental complex, food, heat, shelter and clothing, could be in whole or in part taken from the temperate zone into the Arctic and act as a buffer between the exotic white man and the indigenous environment. In short what the Arctic explorer has always endeavored to do is to project, like a pseudopodium, a piece of the temperate environment into the Arctic environment, and move in and out of the country along the center of the pseudopod.

Stefansson's plan is philosophically quite different. It is based biologically upon the considerations: first, that the physiologically obligate essentials of life must be generally if not universally present in the Arctic, else there could and would be no Eskimos there; and second, given that these essentials are there, a sufficiently acute, penetrating and optimistically sympathetic application of the reasoning faculties of the scientifically trained mind should enable one man to avail himself of them and hence *live,* as well as another. It is quite easy, given a sufficient lack of knowledge of the facts, on the one hand, and of imagination, on the other hand, to prove conclusively by *a priori* logic that this theory of Stefansson's is all wrong. In point of fact a considerable number of the members of his expedition logically excogitated the matter and came to the conclusion that in holding such views Stefansson was not merely silly but probably also insane, and in consequence felt justified in (a) disobeying his orders as Commander of the Expedition, (b) in refusing to render him any aid (cf. pp. 114-115 regarding chronometers), and (c) in actively hindering his preparations and subsequent operations.

The best possible refutation of a purely logical proof that Stefansson's theory was all wrong was, of course, to carry through, over a long period of time and a wide range of area, travels in the polar regions, living entirely off the country as the native Eskimos do. Precisely this is what Stefansson did for a period of nearly five years, with brilliantly successful results, viewed from any standpoint. "The Friendly Arctic" is the record of how it was done and of what happened. With two or three companions, a few generally poor sledges (because the good ones were either left on the Karluk or retained by the logical but unimaginative southern party), some dogs, a rifle apiece with a modicum of ammunition, a little scientific apparatus for observing, *et prœterea nihil,* Stefansson moved about over the polar ice and lands freely at will, and added richly to the world's knowledge of the regions.

Every one who is interested in the philosophy of evolution, general biology and human psychology, as well as those interested in geography and Arctic exploration, should read this fascinating book. It records an extraordinary intellectual achievement.

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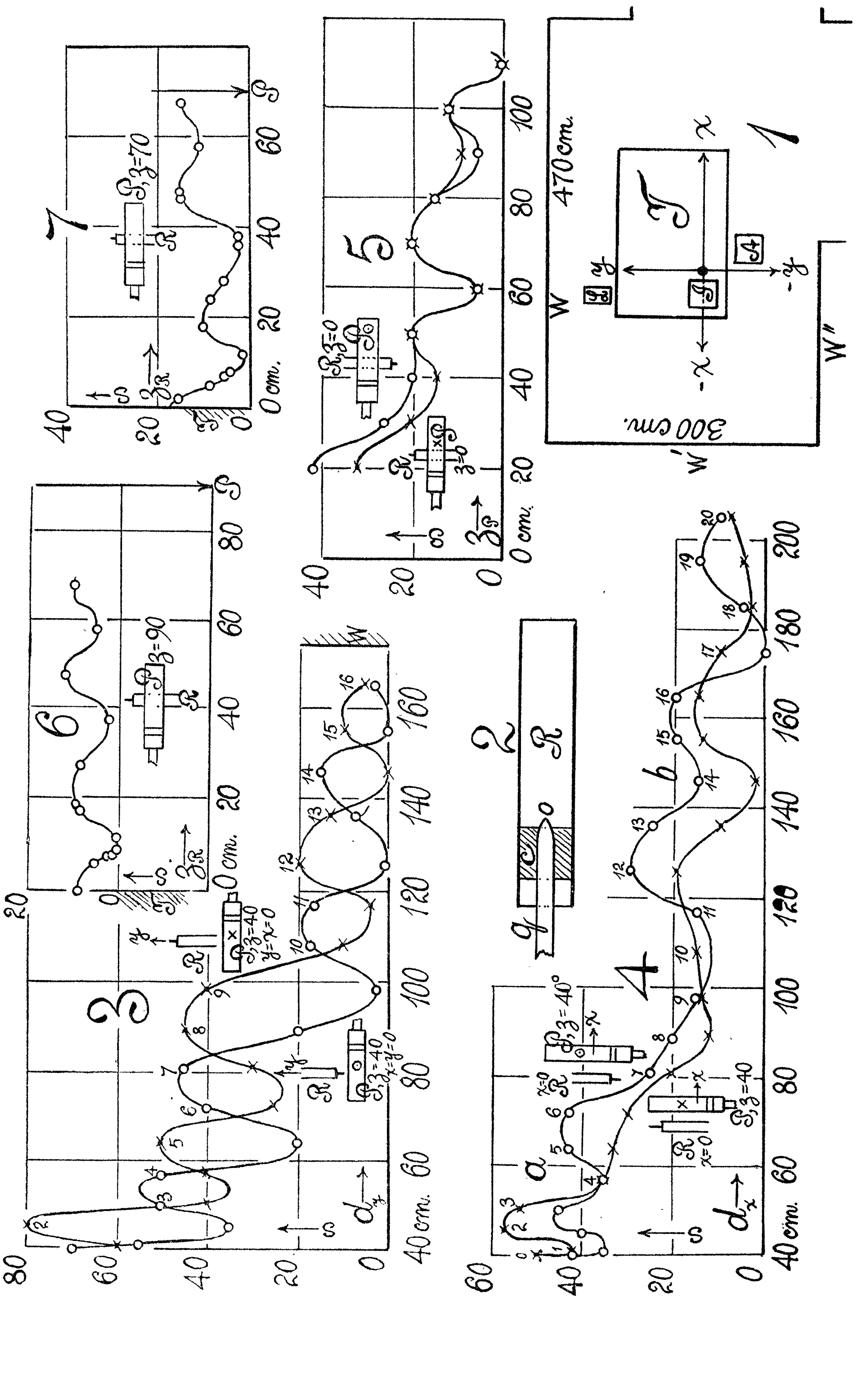
SPECIAL ARTICLES

ACOUSTIC TOPOGRAPHY IN A ROOM[1]

1. *Introductory.*—A plan of the room is given in figure 1, where W, W' denote the unbroken walls, I the interferometer and U-gauge, L the electric lantern, A other apparatus. The coordinates along which the surveys are to be made are x, y, z, y being between walls, x toward the open door and z above the table T. For more refined work, I. L, A, etc., should have been removed to another room; but for my present purposes this is unnecessary.

The pin hole probe described in this journal (SCIENCE, May 27, 1921) has since been found useful for the location of nodes in pipes and other vessels, both telephone and windblown. These experiments are omitted as without interest here, except in so far as they indicated the exceptional sensitivity of the probe to nodes. It is relatively quite unresponsive to ventral segments or to wave trains. The pressure variations in question are converted into static pressures through the intervention of the

[1] Advance note, from a Report to the Carnegie Institution of Washington, D. C.


1
470 cm.
300 cm.
2
3
4
5
6
7

pin hole and measured at a mercury U-gauge, read by displacement interferometry. As the pipes to be employed were to be of all kinds and intensities, it did not seem worth while to reduce the fringe-deflections to pressures. These deflections will therefore be reported as measured on an arbitrary scale s (.1 mm. collimator plate micrometer). The width of a fringe was however on the average about 2 scale parts. Thus the corresponding pressure increments p are readily found from $p = .00015\ s$ millimeters of mercury. The apparatus can be made more sensitive by enlarging these small fringes; but the latter would then usually be thrown out of the field of the telescope and the screw micrometer become necessary to restore them, which is irksome, particularly with fringe U-gauges.

The pin-hole probe at one end of an eighth inch pure rubber tube of any length (2 to 3 meters or more), at the other end of which is the gauge, is at once available for introduction anywhere. It fails however to give an appreciable acoustic record except in the inside sounding pipes. The plan of associating the pin hole probe with a resonator, of either the open or closed type, thus suggests itself.

2. *The closed pin hole resonator.* The outstanding trouble encountered heretofore was ascribed to the organ pipe; *i. e.,* to the continuity of notes lying very close together, but to only one of which the resonator responds effectively. A further difficulty was referable to two ends of the open cylindrical resonator then used, with a pin hole in the middle within; for these ends being 22 cm. apart are liable to lie in regions differing acoustically. The advantage of the tube is the ease with which it may be accurately tuned by mere elongation and hence its sensitiveness. The Helmholtz resonator, probably for this reason, was found much less sensitive. Hence the closed pin hole resonator qR, figure 2, suggests itself, consisting of the cylindrical tube (1.9 cm. diam., effectively 22 cm. long) R, closed by the snugly fitting cork c which carries the pin hole probe qO. The pin hole, O, is at the base of the tube R, the quill tube q being connected, as stated, by a length of gum rubber tubing with the U-gauge. This resonator has but one mouth and thus tests acoustically a single point, as it were, of the region, while the tuning may be effected with nicety by moving the cork c within R, or by elongation at the mouth of R. The pin hole at O must be salient (*i. e.,* carried by the conical end of the quill tube q) and not on a reëntrant or flat end. Moreover, the diameter of the pin hole must bear a certain relation to the size of the resonator R, to be found by trial. The construction of a sensitive pin hole resonator is extremely difficult; out of dozens of trials I netted but one or two adequately sensitive instruments. If of metal foil, it is liable to change in the lapse of time.

3. *Survey between walls;* y *coordinate.* The two series of results (pipe in azimuth 180° at $x = y = 0$, $z = 40$ cm., and resonator in azimuth 90° and 270°, respectively, at $z = x = 0$ and y) are given in figure 3. The abscissas, d_y, are the distances between centers of pipe P and resonator R. The y values of R (on the table) are given in decimeters on the curves. Insets show the orientation. The two curves are pronouncedly harmonic from $y = 0$ to the wall, and they are almost exact inversions of each other, crests in the one taking the place of troughs in the other, throughout. Moreover the crests seem to lie in successive levels; an initial high one ($y = 10\text{-}20$ cm.); an intermediate lower one ($y = 30\text{-}80$ cm.); a still lower one (100-140 cm.) beyond; etc. It is not feasible to go much beyond 160 cm.; for with the wall at 174 cm. the resonator pitch is beginning to be modified. A curious result is the initial maximum and minimum, the points not being at $y = 0$, but beyond at $y = 20$ cm. The horizontal mean wave lengths Δy to be obtained roughly from these curves are respectively $\Delta y = 34$ cm. and $\Delta y = 35.5$ cm., the range being from 30 to 40 cm. The mean d intervals, Δd_y, are about 30 cm.

The precipitous descent of the graphs between $y = 70$ and 90 in one case and $y = 90$ to 100 in the other, makes less impression on the wave intervals than would have been anticipated and the mean wave length here, $\lambda = 35$ cm., does not differ from the earlier cases of $\lambda = 37$ cm. by more than the observations of a single curve. The graphs, figure 3, were obtained independently, one after the other.

Now in the line PP', normal to the wall W, 40 cm. above the table between pipe P and pipe image P' in W, the nodes should follow each other at a distance of $\lambda/2 = 24$ cm. apart; but as the distribution above and below is hyperbolic, the nodes at the level of the table must be further apart. Unfortunately, the equation is cumbersome. Without attempting to use it here, we easily surmise that the increased distance so obtained is inadequate; *i. e.*, not as large as the 35 cm. intervals found in the experiments, in place of $\lambda/2 = 24$ cm. estimated to increase to 27 cm. or 29 cm. One should expect 7 or 8 nodes in place of the 5 or 6 recognized. Thus it seems not unlikely that a frequency of a near order is contributed by the room itself, particularly as the reflected waves returning from 2 meters are too weak to compete effectively with the outgoing wave trains. Furthermore, there is another wall in the direction of negative y (at $y = -130$) and one at $x = -190$ cm. Although apparatus lies in the path here, they introduce further complication.

There remains the reflection from the table, so that the pipe and its image 40 cm. below, make the plane of the table a region of reenforcement; or, with regard to the loss of $\lambda/2$ at the surface, a locus of nodes, though the term node would be strictly applicable only for the case of normal incidence near the line pipe-image. The next nodal locus is hyperbolic and therefore higher than 25 cm. above the table, out of reach of the resonator which lies on it. Thus it is finally necessary to compound the phase reversed direct ray here in question, with the corresponding phase reversed reflections from the walls, to get the disturbance at any point of the table. This succeeds experimentally, as I will point out presently, for walls close at hand (within a meter or two); but for walls as distant as those of the room, the reflection wall effect is too small to account for variations as marked as those of figure 3. It is possible that a wide high wall, like W, may act obliquely by diffraction; but to speak on this subject, further inquiry will be needed. As a general fact, however, it is noticeable that a survey in y, between walls, here produces a much more marked harmonic distribution of acoustic pressure along that axis, than a similar survey along x toward the open door (§4).

The striking opposition of phase which figure 3 presents for an inversion of the resonator is more easily intelligible. As the length of the resonator is approximately $\lambda/4$, the rotation of 180° about its center will pass the mouth from a node to a loop of the stationary wave train, or between corresponding 90° phase differences. Now the pin hole probe, as above stated, is sensitive to nodes (compressions) only and scarcely responds to wave trains (or to the similar harmonic motion at the loops). The pin hole resonator might be thought to have the opposed quality, being stimulated by wave trains (or loops) and not by nodal phenomena or compressions: but (§ 5) this inference is not correct. We must therefore again anticipate nodes at the maxima of the graph and loops at the minima, when the pin hole resonator is used.

It follows from this that if half of the length of the resonator be added to the y coordinate of one of the graphs, figure 3, and half the length be deducted from the other, *i. e.*, if the *mouth* of the closed resonator be taken to define the coordinate y, the two curves of figure 3 should coincide at their mean position in y. Hence if the resonator is rotated on an axis passing through its mouth, the data obtained should be constant at all angles. Experiments were specially made to corroborate this inference.

4. *Survey (in* x*) toward the open door.* The example of this survey, which I will here communicate, was made somewhat differently from the preceding, by locating the resonator at the origin ($x = y = z = 0$) in two azimuths, 90° and 270°, successively. The pipe, kept horizontal, parallel to y and 40 cm. above the table, was now moved along the axis x. The abscissas, d_x, still refer to the distance between the centers of the pipe and resonator, while the coordinates x are marked in decimeters on the curves. The graph then shows the effect at the origin, of an f″ pipe sounding at different points along x, and the pressure distribution are here throughout quite different from

the y distribution between walls. The case for R 90° is now a compound harmonic which seems to dip into stationary wave trains at a and b. The other curve is quite similar in general character, only less pronounced. Horizontal wave lengths exceeding 35 cm. may again be detected at the double inflections.

5. *Survey in the vertical direction* (z). This was carried out by allowing the resonator to rest horizontally on the table, in a direction normal to the f″ pipe, the latter being raised successively in steps of 10 cm., keeping it in the same azimuth of 0°.

The graphs (figure 5) for two positions of the resonator are essentially identical, indicating stationary waves produced by reflection from the table. The z distance between crests and troughs, however, now varies between 24 and 25 cm. and thus corresponds very closely to the semiwave length, 24 cm., of the f″ pipe. In all cases the pipe must be raised some distance (40 cm.) before the periodic distributions begin.

The behaviour here in evidence is very much like Melde's experiment, though it is now made with a string of air (as it were) between the actuating organ pipe as one attachment and the table as the other. The only adjustment possible is thus the length of the string. Since the resonator lies on the table, certainly to be regarded as a nodal surface, we would be inclined to look for the maximum of wave production, when the direct and return wave train coincide in phase at the mouth of the pipe. This will take place at intervals of $\lambda/2$, or $\Delta z = 24$ cm. apart, conformably with the graphs. It would seem, however, that the maxima (in view of the loss of $\lambda/2$ at the table) should lie at $z = 5\lambda/4$, $7\lambda/4$, etc., whereas in the graphs they lie at $2\lambda/2$, $3\lambda/2$, etc. The latter demand a node at the mouth of the f″ pipe.

As the table is certainly a nodal surface, we here encounter the result of special sensitiveness to nodes on the part of the mouth of the pin hole resonator. The case is tested in figure 6, where the pipe, P, in azimuth 0° is $z = 90$ cm. above the table and the resonator vertically below the pipe is raised from the table at $z = 0$. The evidence given by the curve is very satisfactory, the wave lengths of the graph being 24 to 25 cm., or semi wave lengths of the f″ pipe. There is complete absence of deflection at 10 to 12 cm. above the table; *i. e.*, at $\lambda/4$ for the pipe, so that the ventral segment is inactive. As the pipe at $z = 90$ cm. is approached by the resonator, the deflections naturally increase, but they do so very slowly. Obviously the present disposition with a raised pipe and with the resonator between pipe and table is conclusive; but because of the important evidence obtained I repeated it for an f″ pipe at $z = 70$ cm. (nearly $3\lambda/2$). The results in figure 7 are of the same kind as to wave length, inactivity for a resonator 12 cm. ($\lambda/4$) above the table, the marked effectiveness (maximum) of the distant node at the table ($z = 0$) and a maximum near the pipe ($z = 68$ cm.). Troughs and crests lie at positions which are multiples of $z = 12$ cm.

The above results for normal reflection may be summarized as follows: Both the organ pipe and the pin hole resonator are stimulated in proportion as their mouths lie in a nodal region or surface; they remain relatively uninfluenced by a ventral segment. Consequently an even number of half wave lengths lie between pipe and resonator when the response is a maximum. Although the mouths of the respective pipes are necessarily ventral segments, the anomalous features of these results disappear when it is remembered that the nodes are alternately dense and rare.

6. *Reflection from plates.* Using a plane about 1x.5 square meters in area, displaced along x and normal to it, in steps of 10 cm. from the origin successively, the effect of reflection (as I shall show elsewhere) came out beautifully. It was possible, by compounding the direct and reflected rays in each case, to interpret the harmonics and compute the wave length of the pipe accurately. At the distance of the wall (174 cm.), however, the reflection effect had dwindled to 10 to 15 scale parts. Diminution of the reflection effect also occurred when the plane was placed oblique to x, but not as abruptly as the law of reflection would predict. Furthermore the distribution of height in the successive maxima in the different reflection curves was quite as remote from

mere diminution with distance as is the case in figure 3. My impression is that if displacement of an air particle oblique to the table be resolved into tangential, and normal components, it is in the phase changes of the former (owing to a tangential slip, possibly with vibration) that a clue to an explanation may be looked for.

Location of the ray of maximum amplitude. Further experiments showed that if the pipe is successively lifted above the table, the corresponding unique or highest maximum continually moves away from the origin into greater x. So far as I have gone this position (*i. e.,* the position of the resonator on the table) is reached when the corrected (asymptotic) ray from pipe to resonator makes an angle of incidence of about 51° with the normal to the table. The same rule holds for the other corresponding maxima and minima. In a raised pipe the unique maxima will thus be found at 50 to 100 cm. outward from the origin, below the pipe. The location of interferences by the method of the preceding paragraph affords no clue. In any case it is astonishing that a diagram such as figure 3 or 4, should represent an actual distribution of acoustic pressures, certainly of nodal intensity on the table, whenever the organ pipe is sounding. In fact, in the present research which I have now been pushing for some time, whatever one predicts fails and what one does not expect comes out serenely. It will therefore be prudent to conclude with Newton, that there are fits of easy reflection.

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MEETINGS OF THE GENETICS SECTIONS

IN accordance with provisions made by the American Society of Zoologists and the Botanical Society of America, a joint program in genetics was arranged and held in connection with the recent meetings of these societies at Toronto. This program occupied all of Wednesday, December 28, and the forenoon of Friday, December 30. A. F. Blakeslee was elected to preside at the sessions and L. J. Cole to act as secretary. The complete list of the papers presented will appear in connection with the reports of the respective societies.

A committee, composed of L. J. Cole, R. A. Emerson, H. S. Jennings, A. F. Shull and G. N. Collins, was appointed to formulate a plan of organization for the Genetics Sections of the two societies. The committee reported the following articles of organization:

Resolved, That the Genetics Sections of the American Society of Zoologists and the Botanical Society of America organize for the purpose of securing a closer coordination of genetic interests.

The membership shall consist of those members of the two societies who shall indicate their desire to be affiliated with the Genetics Sections.

The following officers shall be elected at each annual meeting and shall take office at the close of the meeting:

1. A chairman to be chosen alternately from the Zoological Section and from the Botanical Section.

2. A secretary, who may be chosen from either section.

3. A society representative, who shall be chosen from the section other than that from which the secretary is chosen.

These officers shall constitute the executive committee of the Genetics Sections.

In addition to his usual duties the secretary shall, in consultation with other members of the executive committee and with the secretaries of the societies, arrange for the program of the meetings.

The secretary and society representative shall act as the representatives of the Genetics Sections to their respective societies.

At the annual meeting the chairman shall, in advance of the business meeting, appoint a nominating committee of three to nominate officers for the following year.

These articles were adopted as proposed.

A nominating committee, composed of R. A. Emerson, G. H. Shull and Charles Zeleny, announced the following nominees for officers for the ensuing year:

Chairman: H. S. Jennings.
Secretary: L. J. Cole.
Society Representative: B. M. Davis.

These were duly elected.

The secretary reported on the condition of the American Genetics Association and the needs of the *Journal of Heredity* and stated that efforts would be made to hold a conference of the executive committee of the Genetics Sections with the council of the American Genetics Association to see what steps can be taken for their mutual benefit.

L. J. COLE,
Secretary.