FROM THE WELLESLEY COLLEGE PSYCHOLOGICAL LABORATORY.

The Perception of Sound Direction as a Conscious Process.

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This report deals with an attempt to analyze the auditory perception of direction. The results have led rather to the discounting than to the high appreciation of timbre, pitch, and intensity as conscious criteria of position.

Preliminary Discussion.

Let us assume, for the moment, that (1) timbre, pitch, and intensity, (2) reflex and semi-reflex movements of the head and eyes in the direction of a sound, and (3) cutaneous impressions about the ears, neck or scalp all act from time to time as factors in the localization-consciousness. If they do so act, they are factors of a very different kind. The consciousness of timbre, intensity, or pitch must serve as the link or pivot in an ordinary case of associative supplementing. Such localization finds its parallel in the gauging of distance by visual size or distinctness of outline. On the other hand, definite reflex movements in response to a sound must be genuine motor local signs. They find their parallel in the reflex jerk of hand or foot toward any irritated bit of skin. Timbre, intensity, and pitch are homogeneous criteria,[1] that is, they are position marks in the character of the sound itself, but they are not in themselves place-ideas. The after-consciousness of a reflex movement is a heterogeneous criterion, yet it is in itself a crude localization, a rudimentary tactual-motor idea of direction. Finally, if sounds are localized by 'touches' due to air-impact, auditory localization is, *ipso facto*, reduced to cutaneous.

[1] Titchener, 'Experimental Psychology,' Instructor's Manual, Qualitative, p 357.

As a matter of fact, all primary criteria for localization are exceedingly elusive. Certain painstaking and trained observers maintain that a telephone-click correctly localized at different points does not seem to them to differ in timbre or in intensity or in any other way. Undifferentiated sounds seem to them to be instantly succeeded by differentiated ideas of place. Moreover, most observers note very rarely that they either move or 'want to move' when they hear the familiar sound of an experimental series. While practice diminishes the 'startling' effect of a sound, it notoriously increases the accuracy of localization. Apparently, just as a tap on the forehead may seem instantly to call up a picture of one's forehead or the word 'forehead' without any perception or memory of movement, so a telephone-click above one's head may evoke an image of the top of one's head and of the telephone held above it without any consciousness of head or of eye-movement.

Motor local signs doubtless play an all-important part in cutaneous localization in the days when the baby so assiduously explores with hands, feet and tongue the surface of his own small person. Yet we habitually localize that which touches us without attending to any group of sensations due to movement and perhaps without being conscious of any. It is hard to tell whether the motor local sign disappears from the content which introspection grasps through inattention and forgetfulness, as the act becomes habitual, or whether it ceases to come into consciousness at all. At any rate, it is conceivable, on the analogy of cutaneous localization, that motor local signs should for a time play an essential part in auditory localization and should then lapse from clear consciousness.

A serious objection may, however, be urged against this supposition. Auditory localization is decidedly inaccurate and is obviously improved by practice. Now, in so primitive and fumbling a process, motor local signs might be expected still to appear. The only answer to this objection is that the introspection of any process of localization is extraordinarily difficult, and that when practice has made the after-examination of auditory localizations easier, the motor sign has had time to lapse. The difficulty in introspection seems to be due to the fact that local-

ization, whether correct or incorrect, definite or indefinite, is so exceedingly rapid. The adult, when wide awake, does not leave for an instant any impression entirely unlocalized, that is, without any spatial associations. The explanation of this greed for spatial connection is presumably teleological. At any rate, even if a sound is assigned to a wide and vague area or is 'heard in two places at once,' some place-idea usually flashes into consciousness before one can catch it in the kindling.

We may, perhaps, assume that an observer with some training in psychological experiments will know, if in the long run he gauges position largely by timbre or intensity, or by 'involuntary' movement, or by cutaneous impressions. It cannot be forgotten, however, that an observer always tends to call a process which he himself cannot analyze 'elementary' or 'intuitive' or something of the sort.

In this report, the introspection of six subjects of some general training is taken in connection with the degree and the kind of error in their results. Apart from the aid of introspection, light upon the process of auditory localization has been sought in the effect of suggestion on the degree and direction of error. Laboratory exigencies compelled the employment of many untrained observers in these latter experiments and the massing of their results. The greater the effect of suggestion, the more likely is auditory localization to be an associative process, and the less likely is it to be the outgrowth of inevitable reflex movement. This we may surely assume on the basis of our general knowledge of the effect of suggestion.

A sharp distinction must be drawn between (1) the primary criteria of position, such as timbre, intensity, a 'touch' on the ear or the like, (2) the terms of localization, that is, the mental imagery of place or direction, and (3) the way in which the observer indicates position to the experimenter. However the direction of a sound is revealed to the observer, he may image the place or direction visually or in tactile terms or may name it. However he thinks of it in the first instance, he may either name it or point it out to the experimenter. We certainly tend to move our hands when we turn our heads, and in the same direction. Willing and ready pointing may, therefore, be an

indication of tactual-motor place-imagery and of a tendency to reflex movement of the head. The indication is, however, very insecure. With one of the six observers mentioned, ready pointing resulted simply from unusually definite visual imagery.

Apparatus and Method.

The sounds were all given at points on the surface of an imaginary sphere, having a radius of one half-meter and centering in the middle of the line connecting the observer's drum-membranes. The cardinal points were R and L, directly to the right and left in the 'auditory axis,' F and B, the points directly in front and behind in the same plane, U, the point overhead, 90° from the horizontal plane, and theoretically, D, the point 180° from U and under the observer's chair. The arcs limited by these points are called RF, LF, FU, and so on. Points on the horizontal and sagittal meridians are indicated by counting the number of degrees from R or L; points on the median meridian are counted from F or B. Thus, FU30 means 30° up from F on the median meridian. Directions are indicated in terms of opposite cardinal points. Thus, FB means backward, BF, forward, and so on.

In all the experiments, the sound was a telephone-click of fairly uniform intensity. The circuit was made and broken with a push-button two seconds after the spoken word 'Ready!' In the earlier experiments, the original Pierce and Münsterberg apparatus[1] was used with unimportant modifications. In the later experiments, the Titchener 'sound-cage' was employed. As adapted to our purposes, this apparatus consists of (1) an iron gas-pipe fixed in the ceiling, (2) a semi-circle of heavy brass wire, 102 cm. in diameter, rotating freely about the pipe as a vertical axis, and (3) a similar semi-circle just fitting within the larger, suspended from it, and rotating freely about a horizontal axis.[2] The vertical semi-circle is braced with a metal cross-bar. The telephone receiver is clamped to the center of the smaller semi-circle. Each semi-circle is provided

[1] Psychological Review, Vol. I., p. 464.

[2] Cf. Titchener, 'Experimental Psychology,' Student's Manual, Qualitative, p. 179. The apparatus is made by the Chicago Laboratory Supply and Scale Co.

with a disc graduated to hundredths and with a pointer. The readings give the position of the telephone in terms of the 'latitude and longitude' of the imaginary experimental sphere. The sound can be given exactly at any point except within a segment of about 72° in diameter which is cut out of the lower hemisphere by the chair and person of the observer. Moreover, one can instantly find the direction and degree of error if one moves the telephone to the point at which the sound is localized by the observer and takes the new readings. The apparatus is noiseless.

Of the six observers who came repeatedly and whose introspection has been especially noted, Cs. is an instructor in psychology, Ck. was laboratory assistant at the time the experiments were made upon her, D., P. and S. were senior students in a second year course in psychology, and G. is the writer.

The experiments fall into four groups: (1) Experiments with and without suggestion made upon unpracticed observers with the Harvard apparatus; (2) experiments of the same kind with the Titchener apparatus; (3) experiments on the observers, Cs., D. and G. with the Harvard apparatus; and (4) experiments on Ck., P., S. and G. with the Titchener 'cage.'

The details of method which are really important are: (1) the attempt to eliminate all anticipations of position, and (2) the pointing required of the six special observers. With the Pierce and Münsterberg apparatus, the range of positions from which the experimental series were made out included sixty-nine; with the Titchener apparatus it included one hundred and sixty-one. No observer had the slightest intimation of the points to be selected from these wide ranges. Only G. exactly knew the range of points from which the series were drawn. The earlier observers saw the Harvard apparatus. With the Titchener apparatus, however, the subjects were blindfolded,[1] and no one of them, except Ck. and G., had ever seen it. Under these conditions, it was necessary for all the observers except G. to indicate most positions by pointing. One complete series was

[1] The bandage was of black China silk, loosely folded; it extended merely to the temples, and was secured by narrow ribbons. It surely could not modify the sound impression.

taken with G., in which she simply pointed in the direction of the sound and avoided words, and another in which she stated position in terms of the apparatus readings in the series, all multiples of five. The other observers were allowed to correct their pointing in words. With the Harvard apparatus, unpracticed observers were permitted to indicate position in any way they pleased. Cs., D. and G., however, were required to point out the position of the sound first with the eyes shut and then with the eyes open.

These two circumstances taken together, (1) the elimination of expectation by the use of so many positions, and (2) the pointing, sufficiently account for the small number of right cases shown in the tables. They seem absurdly small as compared with the results of other experimenters. With an approximation to the conditions of Professor Angell and Dr. Fite and of Mr. Matsumato, however, our results approximate to theirs. Naturally, our observers often said that the sound came from a point far within the surface of the sphere. In these cases, the outer termination of the radius passing through the point (as nearly as we could guess at the line) was taken as the localization point. A given trial might not be repeated unless the subject professed inattention or complained of some indistinctness in the sound. This rule also tended to diminish the number of right cases. It was sometimes broken, however.

The questions put to the observers were: (1) How do you know where the sound is? (2) Do you seem to see the place or do you feel yourself move toward it or do you think it in words? Other questions were dropped as unduly suggestive.

Introspective Results.

Statements in regard to the terms of localization will first be considered, and second, testimony as to the primary criteria, the conscious clues to the place.

With G., visual imagery has been present from first to last in every series of experiments. The visual idea of place is deliberately translated into tactile terms, just as one pictures the relative position of objects in a dark room and then 'feels about' for them accordingly. Cs. and D. reported visual imag-

ery in nearly every case for which they gave any introspection. Cs.'s remarks on the required pointing show that it was secondary and deliberate. D.'s introspection is very scanty. No comment on the act of pointing can be found. Cs. and D. pictured some part of the 'cage' more often than G. did; G. 'saw' her own person, in the form of a vaguely outlined shadow, more often than Cs. and D. visualized themselves. Cs. and D. often pictured the cage without the telephone; G. almost invariably saw in a given position the telephone or a spot or streak of luminous color standing for the sound.[1]

Ck., on the other hand, showed a clear case of tactual-motor localization. She 'could have a clear picture of the room and the telephone if she wanted to, but the hearing of the sound did not call up the picture.' She 'simply heard and pointed, deliberately and not on impulse.' To this testimony she consistently adhered. P. and S. could give no lucid account of their imagery. At first, P. certainly had visual imagery, for she spoke repeatedly of a 'black marble' or 'ball of polished oak.' S. (although she also is a 'color hearer') seems to have localized rather more largely in words than did the other observers.

The great majority of the wholly unpracticed subjects saw something near their own persons—a line of some kind leading to their heads, a wooden ball, an ebony box, or the like. Two blind observers were tested. H. is a young woman who lost her sight by an accident at eight years old, and is now a teacher of the blind. She said that she 'saw the place in her mind' and that 'pointing was an expression of what was in her mind.' R. is a student at the Perkins Institute and has been blind from birth. She could give no clear account of her experiences. She said, however, that when she heard the sound, she 'pointed at once so as not to lose it.' Pointing seems, therefore, to have been deliberate.

[1] This observer shows a marked case of colored hearing. The color seen at first and most often was a sort of corn-color, the color of the click. Sometimes, however, pink, brown, white, green, or golden yellow would appear. The colors could not be anticipated. Of late, no color has been seen except the pale dull yellow of the sound. These phenomena are of interest in showing the highly visual character of the localization.

To turn to the primary criteria of localization. Cs. spoke in two cases out of 209 of a difference in intensity and once of a difference in timbre. D. spoke in six cases out of 248 of a difference in intensity; never, of a difference in timbre. G. knows that sounds given directly above her head are fainter with the Titchener apparatus than other sounds. It took her some time to discover this fact, but of late she has been able to use it successfully as a criterion. It must be noted that it was gleaned from the observation of sounds already localized with assurance. She has sometimes fancied that sounds given behind are 'thin' but makes mistakes in using this thinness (a visual character) as a criterion. Ck. noted no such criteria. P. said, late in the course of the experiments, that 'something in the sound' told her whether it was 'up or down,' 'right or left,' but not whether it was 'back or front.' She frankly remarked, however, that she thought she had 'once heard something of this sort in class.' S. said that sounds given in front and above were 'more explosive.' H. said that the sounds had an 'individuality due to their pitch' (timbre?). An unpracticed observer would occasionally allude to a difference in intensity or 'pitch.'

On the other hand, Cs. rather often (in fully 50 per cent. of her total number of cases) spoke of a touch, or a tickling or tingling somewhere on the scalp or on the inside of the ear. These pressure experiences often preceded her visualizations. The sound, however, was not always located on the same side as the skin impression. G. occasionally noted 'touches' on the head. She certainly feels the vibration when the sounds are given very far down and, therefore, very close to her body. D., Ck., S., H. and R. never noted such experiences. Other subjects, however, noted them not infrequently. Stress is laid on these experiences since Professor Angell and Dr. Fite say that, in their monaural experiments, they 'found no good evidence for supposing that cutaneous sensations played any part in the localizations.'[1]

Farther, Cs., G., D. and Ck. sometimes noted a tendency to involuntary head-movement. Ck. maintained that she had a general tendency to move her head toward the sound. G. did

[1] PSYCHOLOGICAL REVIEW, Vol. VIII., p 246 (May, 1901).

actually move more than other observers, but usually did so quite unconsciously. Cs. noted a feeling of movement in the greatest number of specific instances—in only about 6 per cent. of her total number of cases, however. The only testimony which indicates automatic hand movement is P.'s. She said, "If the stimulus should act more slowly or by steps, perhaps I could introspect, but it all happens so fast. I hear the click and realize that I know where it is. At about the same instant my finger is at the place I hear it."

To summarize: The only observer explicitly to claim a primary criterion was Ck., a tactual-motor localizer. She maintained, as a general observation, that head-movement was 'the natural way to localize a sound,' but that she pointed to the place deliberately. On the other hand, P., who sometimes visualized and who noted differences in the quality of the sound in different positions, made automatic hand-movements, independent of the quality-feeling. Cs. imaged position in visual terms, but the visualization was often preceded or accompanied by cutaneous impressions and sometimes by a consciousness of head-movement. Of D. we know only that she visualized constantly and that she once or twice noticed involuntary head-movements. S. localized in part verbally. She insisted that she 'could not tell how she knew where the sound was.' G. has always visualized sounds. She explicitly maintains that there is ordinarily nothing in consciousness between the 'sight' of the sound and the developed picture of a spot of color or of the telephone in a certain position. One passes into the other as if figures about a central figure, already dimly seen, came swiftly through a mist. She has developed one intensity criterion by experience, and uses it when the sound looks like a streak through the whole median plane. She occasionally is guided by 'touches' and sometimes perhaps by head-movements.

We may anticipate in saying that P., G. and Ck. localized with comparative accuracy; that Cs. and D. in spite of practice localized with about the average accuracy of unpracticed observers; and that S. and, strange to say, the two blind observers, H. and R., fell far below this average.

Experimental Results.[1]

Figures will be given simply (1) to show one peculiarity which runs through all of our results, (2) to make clear some of the individual differences of the observers who were studied separately, and (3) to indicate the effect of suggestion upon the ordinary tendencies in localization.

In the first place, it would seem from our results that observers, at least in the beginning, tend to localize sounds given at B correctly and to localize all other sounds farther back than they are given.[2] From 32 unpracticed observers tested with the Titchener apparatus, the following massed results were obtained:

Table I.

SHOWING THE TENDENCY OF UNPRACTICED OBSERVERS TOWARD LOCALIZATION IN THE REAR.

Point	Cases	Right Cases per cent.	Direction of Error Cases in per cents.			
			FB		BF	
			Under 72°.	Over 72°	Under 72°	Over 72°
F	117	2	14	81		
FU 36	119	1	9	80		
FD 36	119	1	3	94		
B	120	24			57	3
BU 36	118	10			59	4
BD 36	118	14			54	1
U	52	12	37	52		
R	103	25	38		28	
RU 36	118	5	36	1	45	
RD 36	117	11	41		40	
L	104	22	49		15	
LU 36	118	8	43		34	
LD 36	119	7	45		31	
Total,	1442	11	23	23	29	1

The number of small errors in localizing points to the rear is undoubtedly increased by the difficulty of pointing backward with precision.

The backward tendency is quite as striking in the results of

[1] The following students served much as experimenters: Misses A. P. Cromack and C. M. Locke, 1900; D. Donner, 1901; H. B. Decker and M. B. Wood, 1902, and E E. Pennell, M.A. 1901. Many other students took part as experimenters Special acknowledgment is due to Miss M. C. Smith, laboratory assistant, for help in the later work.

[2] The same tendency appears in the Angell and Fite results, though not in so marked a degree.

the subjects tested with the Pierce and Münsterberg apparatus. Points are correctly localized at B and BU 30 more than twice as many times as at F and FU 30. Localization is more accurate in the whole of the backward hemisphere. The points most correctly localized are not due R and L, but RB 60 and LB 60. The following results (including only errors which could be counted in degrees upon one meridian) were obtained from about 60 unpracticed subjects:

TABLE II.

ALSO SHOWING THE TENDENCY OF UNPRACTICED SUBJECTS TOWARD LOCALIZATION IN THE REAR.

Meridian.	Cases.	Direction of Error.	Degree of Error Cases in per cents Under					
			30°	60°	90°	120°.	150°.	180°.
Median	733	FB	10	15	9	2	4	4
		BF	8	7	2	.1	.7	5
Right horizontal.	729	FB	8	2	2	2	.7	
		BF	8	.7	.3	.1		.1
Left horizontal.	732	FB	7	2	1	.8		
		BF	6	2	3		.1	

The majority of errors which could not be computed upon one meridian consisted in taking the arcs RF and LF for RU and LU, an illustration of the same backward tendency.

TABLE III.

SHOWING THE INDIVIDUAL DIFFERENCES OF THE SIX SPECIAL OBSERVERS.

Observers Münsterberg Apparatus.	Cases.	Right Cases per cent.	Direction of Error.			
Cs., eyes open.	205	9	Tendency	FB . BF	27	26
Cs., eyes shut.	209	12		FB . BF	24	30
D., eyes open.	248	11		FB . BF	19	27
D., eyes shut.	198	10		FB . BF	18	29
G., eyes open.	225	24		FB . BF	23	30
G., eyes shut.	188	24		FB . BF	21	27

Titchener Apparatus			Cases in per cents			
			FB		BF	
			Under 72°	Over 72°	Under 72°	Over 72°
Ck.	Pointing blind-folded.	441	18	24	13	24	3
P		448	22	31	5	19	7
S.		426	6	39	23	19	9
G.		450	18	28	5	23	17
G	guessing at apparatus readings.	421	26	24	4	15	8

Table III., page 367, shows the comparative accuracy of the six special observers, and also their relative tendency to 'backward errors'.

The 'tendencies' FB and BF in the first part of the table are estimated by taking the percentage of errors FB and BF in relation to the number of cases given in front of the sagittal plane and behind it. With the Titchener apparatus, the points at which the sound was given were evenly divided between the hemispheres.

From these figures it would seem that the tendency to localize behind is not coupled with strong visualizing tendencies. From the fact that the tendency is so strong in the massed results of 90 unpracticed subjects it would seem that it is incident to the first systematic attempts at localizing sounds. It may be that the tendency has some teleological significance. The ears of an animal in a measure guard his rear. The tendency to turn vanishes as a sound becomes familiar. This is the only explanation which can here be offered. At any rate, the backward tendency is not due in any way to the position of the apparatus or of the experimenter. The apparatus was set up in two different rooms, and the direction in which the observers faced was, for a time, systematically altered to exclude constant sources of error.

To turn in the second place to the peculiarities of the six special observers: Cs., D., Ck., P., S. and G. It is hard to tell whether P. or G. is the more accurate localizer. G. is a very eye-minded observer, and is thus perhaps at a disadvantage in blindfolded pointing as compared with P. and Ck. It would seem from the first part of Table III. that a visualizing subject may be quite as accurate in pointing with closed eyes as in pointing with open eyes, provided he opens his eyes every moment or two and so gets his bearings. In the dark, however, the visualizer soon 'loses his place,' and his hand-movements resemble the random padding about of a baby who has not learned to 'use his hands.'

At any rate, the three most accurate observers all claim to localize immediately (that is, directly) in terms of hand-movement or visual imagery or head-movement, and not by any

character in the sound itself. G. has had more practice than the other observers. It is an odd confirmation of the automatism of her localizations that she places the sound more accurately when she is not paying very good attention.

It would be rash to infer that the imagery of localization affects its accuracy. Two of the more accurate observers localized in tactual terms and one visualized; of the less accurate observers, two visualized and one could give no clear account of herself.

The largest number of large errors were made by S.; the wildest and most anomalous errors were made by Cs. Cs. was the only one of the six who often confused the median and the sagittal arcs. The most perversely consistent errors were made by G., who habitually in her later work took B for F, BU 36 for U, and FD 36, a point practically in her lap, for some point in the arc BU. In the last (verbal) series she might have had 50 per cent. of right cases if she had not persisted in thinking of the horizontal plane as at the level of her neck, and R and L as straight out from the corners of her eyes, a natural error in an eye-minded subject. This stereotyping of certain tendencies may be another indication of automatic localization.

In the third and last place, the effect of suggestion must be considered. For a time, an attempt was made really to deceive the observers. They were flatly told that sounds would be given in a certain quadrant or hemisphere. A few of them detected the deception but many did not. To avoid this inequality of conditions for results which would have to be massed, the subjects in the later experiments were told to 'keep thinking' of a certain definite point.

The following table contains results from 64 subjects tested with the Titchener apparatus. Suggestion may or may not have been effective if a sound is both given and localized in the quadrant or hemisphere or at the point suggested. Such cases are marked with the sign ?. When the suggestion and the reality do not agree, suggestion is perhaps effective if the localization is in the direction of the suggestion and certainly ineffective if it is not. The first class of cases is marked + and the second — . In these experiments the points were evenly dis-

tributed between the right and left, front and back, and upper and lower hemispheres, and the same number of points were submitted to each of two opposite suggestions.

From these figures, it is clear that one effect of suggestion is to reduce the total number of right cases. To be sure, a rather larger percentage of cases are correct with right than with wrong suggestion. In general, however, the number of right cases with suggestion falls below the normal 11 per cent.

It is clear, also, that in the directions FB and BF, errors in accordance with suggestion are slightly more numerous than errors in defiance of suggestion. This statement holds true for errors upward and downward. It does not hold for errors to the right and left.

It looks, farther, as if suggestion diminished the normal tendency toward 'backward errors.' Moreover, in the earlier experiments with the Harvard apparatus, 'backward' suggestion seemed actually to produce a certain amount of accuracy. Here, when the arc FU was suggested (in 295 localizations) there were 4 per cent. of forward errors of over 90° in the median plane, whereas when BU was suggested (in 320 localizations) there were no backward errors of over 90°. On the other hand, in defiance of the suggestion BU, there were no errors of over 90°, whereas in defiance of the suggestion FU there were 10 per cent.

With the Titchener apparatus, the points most correctly localized by unpracticed observers, both with and without suggestion, were B, R and L. With the Münsterberg apparatus the maximum of accuracy shifts with suggestion from RB 60 and LB 60 to R, RF 60 and LF 60.

On the basis of figures which cannot be given, it is clear, finally, that suggestion most influences upward and downward errors. A given suggestion is not especially apt to produce corresponding errors, but any suggestion greatly increases the number of errors upward and downward. Errors forward and backward and to the right and left are actually fewer with suggestion than without it. The number of wrong cases with suggestion is swelled by the many upward and downward errors. Without suggestion, there are about as many of one as

TABLE IV.

SHOWING THE EFFECT OF SUGGESTION UPON UNPRACTICED OBSERVERS

Suggestion	Cases	Cases with Correct Suggestion.	Right Cases, %.	Cases with Wrong Suggestion	Right Cases, %.	Direction of Error Cases in Percent													
						FB							BF						
						Under 72°.				Over 72°.			Under 72°.				Over 72°		
						?	+	—	Total	+	—	Total	?	+	—	Total	+	—	Total
Quadrants FU and BU.	590	177	6	413	8	5	15	11	31	8	6	14	7	11	4	22	3	2	5
Hemispheres U and D.	220	88	10	132	9				21			10				26			12
Points F and B.	300	30	30	270	7		12	12	24	6	6	12		14	11	25	4	2	6
Points R and L.	80			80	15				20			23				11			1
Points U and D.	120			120	8				26			29				15			.8
No suggestion.	1442	Right Cases, 11%.							23			23				29			1

of the other (of errors UD, 32 per cent. under 72° and 2 per cent. over, and of errors DU, 34 per cent. under 72° and 1 per cent. over, in the sets of results represented in Table IV.). With suggestion, upward errors, large and small, are in the lead.

On the whole, the negative effect of suggestion seems more marked than the positive. Suggestion seems to disintegrate the localizing function. It lessens the tendency to a given sort of error and yet reduces the number of right cases. The thought of any special direction, especially if there have been conflicts between suggestion and reality, seems to produce a kind of paralysis, like that of the famous centipede who, when the toad for fun said, 'Pray, which leg comes after which?' then 'lay distracted in a ditch considering how to run.'

Conclusion.

The following conclusions are suggested for future verification:

1. The perception of the direction of a telephone-click is not usually based on the consciousness of timbre, or of intensity or of pitch, or of any kind of place-mark or space-value in the sound itself.

2. Timbre and intensity criteria develop with experience in auditory localization, and seem in a measure to presuppose it.

3. Cutaneous impressions about the ears and head do sometimes serve as factors in the localization-consciousness.

4. Auditory localization is a rough counterpart of cutaneous localization. It proceeds originally by reflex head- and eye-movements which drop with practice.

The immediacy of auditory localization, if a real directness, cannot well be explained except by the lapsing of reflex movements. Moreover, in ordinary life, we are frequently finding ourselves and others turning the head from side to side to localize some faint sound. Apart from such obvious considerations, the following points are noted as collateral evidence for the fourth conclusion.

(1) Suggestion has no very marked effect on strong tendencies in the perception of direction.

(2) On the other hand, it hinders accurate localization, as thought about an automatic muscular coordination hinders the process.

(3) Unpracticed observers tend to localize sounds behind them. This tendency is perhaps explicable on the basis of serviceable reflex movements in response to a noise.

(4) Alleged immediacy in localization is coupled with relative accuracy in the cases carefully examined.