

## Mysterious form of referred sensation in man

("Mitempfindungen"-itch, tingle/skin corpuscles-Haarscheiben/acupuncture/double sensory stimulation)

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**ABSTRACT** A phenomenon is described in which scratching a small excrescence on the skin on one part of the body is referred to a distant point as a "prick" or a "tingle." "Referral" points are elicited mainly by absent-minded scratching of the skin when attention is not focused on the local sensation produced by the scratch. Location of "referral" points seems to follow definite patterns: in all instances, "referral" points occurred on the same side of the body as the "stimulus" points; each "referral" point was rostral to its "stimulus" point; and each "stimulus" point was associated with only one "referral" point. "Stimulus" and "referral" points seem to have a fixed relationship. Pathways from a "stimulus" point to a "referral" point are not known at present. Although parallels can be drawn between this phenomenon and Bender's "double simultaneous stimulation" phenomenon, both remain mysteries.

For many years I had occasionally observed that scratching the skin on one part of my body—for example, the knee—elicited a very brief unmistakable sensation of a "sting" or "prick" on some distant part—for example, the tip of the shoulder. Somehow it did not occur to me until 5 years ago to keep records of each effective scratch "stimulus" and of each resulting "referral" point.

This report summarizes observations that my wife and I have made on the phenomenon, utilizing ourselves as subjects. Some observations were made as a result of systematic scratching on all surfaces of the body, but most occurred as a result of absent-minded scratching.

Many individuals must have experienced this phenomenon, but to my knowledge they have never subjected it to a special study. I have observed it over 100 times on myself; my wife over 50 times on herself. A full account of this phenomenon as observed to date should call attention to its existence and stimulate other observers to keep records of the location of their stimulus and referral points; and it should also provide material for determination of the neurological connections between the stimulus and referral point. It might also raise a question of whether present knowledge about the central and autonomic nervous systems is adequate to explain the phenomenon, or whether new concepts are needed.

### METHODS

**Body Charts and Examples of This Phenomenon.** Printed pads of male and female body charts (front, back, right, and left sides) constituted the only equipment. Fig. 1 shows one of these charts with only three views of the body and gives records of the phenomenon elicited on different parts of the body on three occasions. Xs mark stimulus points; dots mark "referral" points. Lines join each of the three pairs: I, scratching a spot on the left leg below the knee elicited a "sting" just posterior to the left axilla; II, scratching a spot just above the left knee resulted in

a "sting" just anterior to the left axilla; III, a scratch on a spot on the inner surface of the right knee elicited a "sting" on the middle of the lower right back.

### RESULTS

**Conditions That Favor Appearance of Phenomenon.** These were: (i) absent-minded scratching—e.g., during reading, writing, talking; (ii) warm, sweaty skin; (iii) wearing light, loose clothing; (iv) generally relaxed frame of mind.

**Anatomy of Stimulus Point.** In most instances, each stimulus point occurred over a usually just perceptible excrescence on the skin. The excrescences were just barely large enough to offer slight resistance to the nail of the scratching finger.

**Nature of Referral Point.** We have had difficulty in describing the sensation of the referral response to the scratch. It can be described either as a "sting," a "prick," or a "tingle," but in any case it is a clear-cut sensation. It occurs instantaneously with the scratch, rarely lasts more than a second or two, and usually becomes refractory to any further immediate scratching. In some instances, however, immediate repetitions of the scratch four or five times within a few seconds elicited a "sting" with each scratch.

Thus far, we have not found that referral points can be detected either by sight or touch. We have not actually been able to locate many referral points with any degree of accuracy because most of them were out of sight on the back, shoulders, or arms. Those that we examined did not show an excrescence as was found over stimulus points.

**General Distribution of Stimulus and Referral Points.** To obtain some perspective on the distribution of stimulus and referral points, I plotted them on body charts without consideration of pairing of the points. Fig. 2 shows a distribution chart with all four views of the body for 107 pairs of only well-recorded points. It shows a sharp division between the two kinds of points. They did not overlap: all stimulus points occurred on the legs below the waistline, and all referral points, on the trunk well above the waistline. A large gap separated the two sets of points. Most of the stimulus points appeared on the anterior and inner lateral surfaces of the legs; most of the referral points were on the back and under the arms. Only a few stimulus points appeared on the posterior surfaces of the legs; only a few referral points were on the front of the body.

Greater accessibility during absent-minded scratching may account in part for the denser distribution of stimulus points on or near anterior and inner surfaces of the knees.

**Location of Referral Points with Relation to Stimulus Points.** (i) In all instances the referral point occurred on the same side of the body as the stimulus point. (ii) Each referral point occurred rostral to its stimulus point. (iii) Each stimulus point was connected with only one specific referral point. They did not show any random associations. Examples of this are shown in Fig. 3, in which each one of seven pairs was repeated twice (not shown); one other pair was repeated three times; two

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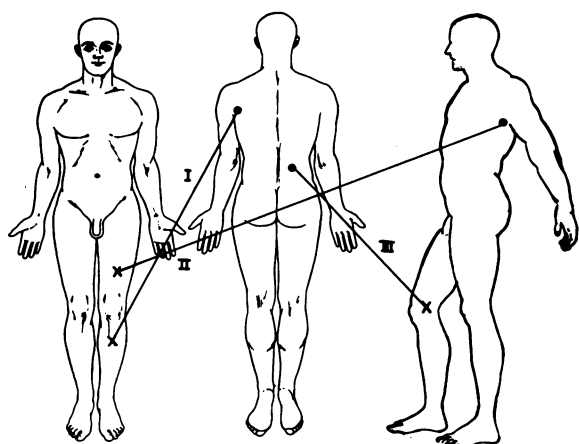


FIG. 1. Body charts showing three pairs of "stimulus" (X) and "referral" (●) points observed on three occasions.

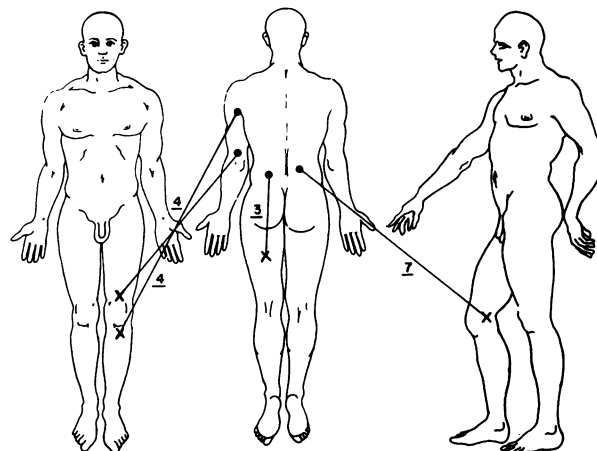


FIG. 3. Pairs of "stimulus" (X) and "referral" (●) points that were repeated three, four, and seven times.

other pairs were repeated four times; and one other pair seven times. (iv) Most stimulus points occurred on the front surface of the legs; most referral points were on the back and under the arms. This means that, with relation to location of stimulus points, most referral points occurred not only more rostrally but farther around the body from the front to the back—that is, nearer the spinal column. A few referral points on the front of the trunk occurred directly above their stimulus points on the legs, but no referral point occurred farther away from the spinal cord.

**Distribution Patterns of Groups of Pairs of Stimulus and Referral Points.** Fig. 4A shows a dense grouping of stimulus points just above and just below the right and left knees. Fig. 4B shows the referral points from these knee stimulus points without consideration of pairing. Points on the left back and elbow were referred from the left knee; those on the right back, from the right knee. The referral points were located in fairly symmetrical positions on the back (except for those on the elbow), mainly around the junction of the upper arm and the lateral part of the back.

Fig. 4C and D shows dense grouping of stimulus points on the inner surfaces of the right and left knees; Fig. 4C, D, and E shows the distribution of their referral points. Distribution differed from that of the stimulus points on the front of the knees in Fig. 4 A and B.

Fig. 5A shows location of referral points associated with stimulus points on the inner surfaces of the right and left thighs. Here the referral points were distributed over the chest and arms in almost symmetrical patterns.

Fig. 5 B and C shows the distribution of six stimulus points

located in a line along the lateral surface of the right leg. Referral points were located on the right back and arm with a somewhat similar spacing.

These samples may give some idea about the basic data collected so far for use in determining neurological connections between stimulus and referral points.

**Neuroanatomy of the Phenomenon.** Information about this phenomenon must come from introspection. This means that all experimental studies will have to be done on human subjects.

What is the anatomy of the excrescence? What is its innervation? How does the nerve leave the excrescence—does it go deeper below the skin or does it run under the skin?

Vernon B. Mountcastle suggested that the excrescences of the stimulus points might be *Haarscheiben*, discs or dome-like structures first described by Pinkus (1, 2) in the skin of man and later by Iggo (3) in the skin of cats and monkeys. Fig. 6 shows a combined light and electron microscope drawing made by Iggo and Muir (4) of one of these structures in the cat. In general, these domes occur near hair follicles. They range from 150 to 250  $\mu\text{m}$  in diameter and rise by 150  $\mu\text{m}$  from the surrounding area. They are innervated by a myelinated nerve that branches out to reach the seven or more epithelial substructures near the surface, as shown in Fig. 6. Some domes also contain an unmyelinated nerve, the function of which remains unknown but which might be of importance for the present consideration. In man, distribution of these corpuscles is uneven and does not necessarily follow the distribution of hair follicles. They occur in largest numbers on the back (particularly the scapulae), chest, abdomen, and volar surfaces of the upper and lower arms. They have a sparse distribution on some hairy areas, such as the

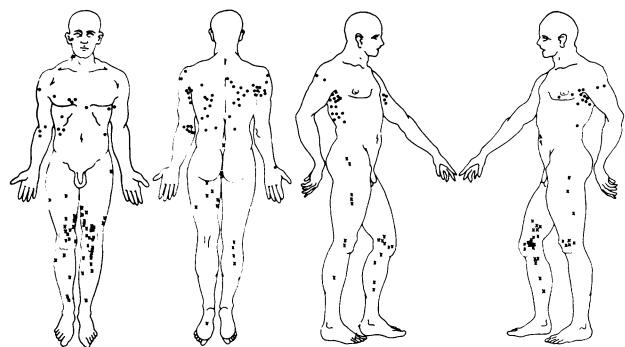


FIG. 2. Body charts showing distribution of 107 "stimulus" (X) and "referral" (●) points.

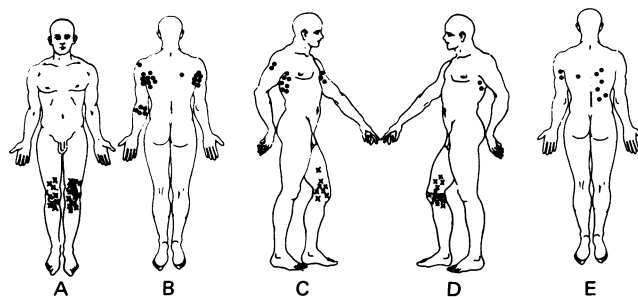


FIG. 4. (A) "Stimulus" (X) points on right and left knees; (B) "referral" (●) points; (C and D) "stimulus" points on inner surface of right and left knees; (C, D, and E) location of "referral" points.

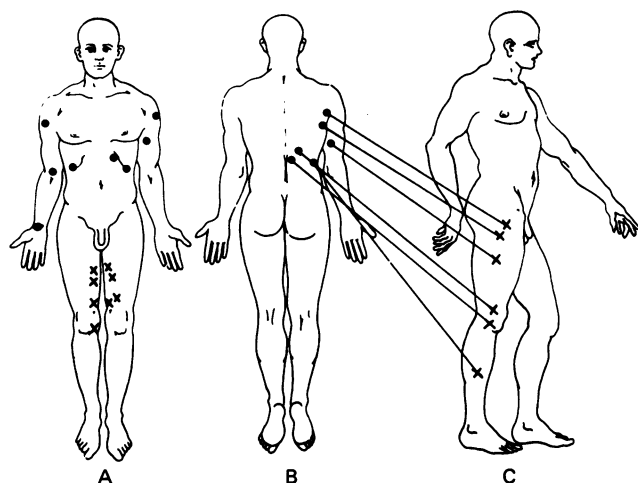


FIG. 5. (A) "Stimulus" (X) points on inner surface of thighs, and their "referral" (●) points. (B) Points referred from the "stimulus" points in C; (C) "stimulus" points along outer surface of right leg.

posterior surfaces of the thighs, calves, center of chests, and pubes. Most important for the present observations is that these dome-like structures are highly sensitive to mechanical stimulation. Werner and Mountcastle (5) studied them in great detail.

### DISCUSSION

That this phenomenon cannot be elicited at will constitutes one of its most puzzling features; also puzzling is that it appears usually only under the influence of absent-minded scratching of scarcely perceptible excrescences on the skin.

This could appear to be an almost hopelessly mysterious situation were it not for our knowledge of a similar phenomenon that has a firm place in the field of clinical neurology—the "double simultaneous stimulation" examination used particularly in determining presence of brain lesions and other central nervous system disturbances. Bender (6) showed, in keeping with observations made by earlier neurologists, that when two areas on the skin are stimulated separately the individual feels both stimuli; but when the two areas are stimulated at the same time the individual feels a stimulus in only one area. Sensation from the other area becomes extinct. This could be because sensation in this second area was less intense or on a less sensitive part of the body.

In relation to the present phenomenon, this would mean that two places on the skin receive stimulation at the same time—the scratch stimulus and the tingle sensation of the referral point. Ordinarily we feel only the scratch; the tingle sensation, less intense, is not felt. However, when in an absent-minded state we are paying little or no attention to the scratch, the tingle sensation becomes more intense and so may be felt.

Puzzling in Bender's phenomenon is that perception of a stimulus in one area of the skin is subject to influence from stimulation of any other area no matter how far removed. A stronger sensation at a distant place will block out perception in the original area.

In discussing the extinction phenomenon Bender observed:

That a sensation evoked by a stimulus in one area is influenced by a stimulus applied elsewhere is a fact which has been known in the normal subject for years. However, neither the clinician nor the experimentalist has stressed this point. This lack of emphasis may be due in part to the difficulty in explaining a phenomenon, such as extinction of sensation, in terms of the classical neuronal theory—the theory which

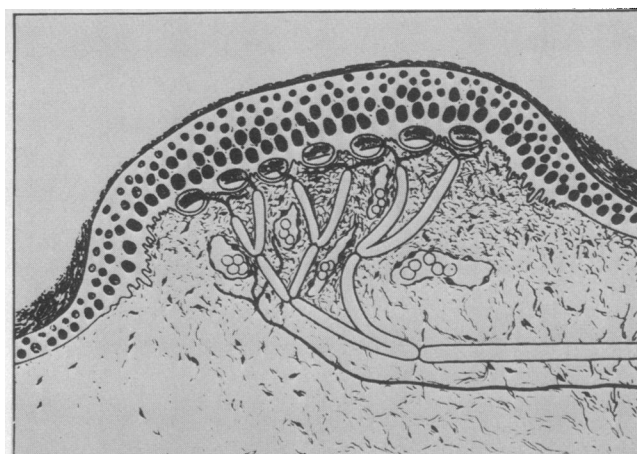


FIG. 6. Combined light and electron microscope drawing made by Iggo and Muir (4) of a skin corpuscle of a cat. [By permission, from ref. 7, Cambridge University Press.]

postulates that the nervous system is a mosaic of specific centers and junctions connected by discrete and restricted pathways.

This statement could well apply also to the present phenomenon.

**Possible Role of This Phenomenon in the Origin of Very Early Acupuncture Points.** Early man must have possessed the same stimulus and referral points as are described in this paper. Because their discovery does not depend on any anatomical knowledge or dissections, or on any equipment besides fingernails needed for scratching, it is possible that these stimulus and referral points were discovered by man in prehistoric times. Sparsely clothed at all times, primitive man had a much better chance than modern man of discovering such points.

Discovery of the points could have served as a basis for all kinds of ideas and beliefs, especially owing to their unpredictable existence (appearances and nonappearances of the points). An early Chinese medicine man or priest could have set up charts of locations of the various stimulus and referral points and then attributed special significance to each one. These could have been the original acupuncture points. This would imply that the stimulus and referral points have connection with internal organs. At the present time there is no evidence for any such connection.

### ADDENDUM

A number of neurologists and anatomists at the Johns Hopkins Medical School and at other Universities who, in 1975, read the present paper had never heard of this phenomenon. Charles Phillips, editor of *Brain*, to whom I submitted the paper for publication in June 1976, likewise, had not heard of it. He rejected the paper, possibly because of misgivings about existence of the phenomenon. Four months later a paper, "Referred Itch (Mitempfindungen)" by Philip R. Evans of Guy's Hospital appeared in the *British Medical Journal* (7) and showed that the phenomenon actually had been known for some time.

Evans himself described much the same phenomenon. He had also made his observations without the knowledge of the existence of any earlier studies. However, in his search of the literature he had succeeded in finding references to a number of earlier studies:

N. Kowalewsky, a physiologist in Kazan, Russia, described the same phenomenon in 1884 in a paper "Zur Lehre von den Mitempfindungen". Kowalewsky reported results of 21 observations on himself (8).



Evans found that, over the years after 1884, a number of investigators rediscovered the phenomenon with no knowledge about earlier work, particularly Kowalewsky's.

In 1897, Mitchell reported that rubbing or pinching a small mole on one leg produced a sharp pain in the chin (9).

In 1900, Sherrington reported one observation on himself. He found that a mustard leaf placed on the upper part of his sternum produced a strong tingling sensation on the inner surfaces of both upper arms (10).

In 1949, D. C. Sinclair, a neurologist in Oxford, reported results of 18 observations on four subjects in a paper "The remote reference of pain aroused in the skin" (11).

Evans in 1976 reported results of 152 observations, but did not give the number of subjects. His results agreed in general with those reported by Kowalewsky, Sinclair, and myself. Methods used in producing stimulus points differed among the workers: some used rubbing; others used pinching or scratching; some used only irritated areas to start with.

Scratching, the mildest of all stimulation used, may not suffice to bring out stimulus points on all parts of the body especially the upper trunk.

This present study brings out for the first time the psychological aspects of this phenomenon: the role of extinction of the referral sensation, and the success of absent-minded stimulation of the skin in finding stimulus points. The high incidence of stimulus points found by several workers in the region of the knee suggests that a search for presence of the phenomenon in new subjects should start with the knees. Availability of a large number of subjects should ultimately make it possible to work out the underlying mechanisms.

The results of the observations by the various workers leaves no doubt about the existence of this mysterious phenomenon.

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1. Pinkus, F. (1902) "Ueber einen bisher unbekanntem Nebenapparat am Haarsystem des Menschen: Haarscheiben," *Dermatol. Z.* **9**, 465-469.
2. Pinkus, F. (1905) "Über Hautsinnesorgane neben dem menschlichen Haar (Haarscheiben) und ihre vergleichend-anatomische Bedeutung," *Arch. Mikrosk. Anat. Entwickl.-mech.* **65**, 121-179.
3. Iggo, A. (1962) "New specific sensory structures in hairy skin," *Acta Neuroveg.* **24**, 175-180.
4. Iggo, A. & Muir, A. R. (1969) "The structure and function of a slowly adapting touch corpuscle in hairy skin," *J. Physiol. (London)* **200**, 763-796.
5. Werner, G. & Mountcastle, V. B. (1965) "Neural activity in mechanoreceptive cutaneous afferents: Stimulus-response relations, Weber functions, and information transmission," *J. Neurophysiol.* **28**, 359-397.
6. Bender, M. B. (1952) *Disorders in Perception* (Charles C Thomas, Springfield, IL), p. 29.
7. Evans, P. R. (1976) "Referred itch (Mitempfindungen)," *Brit. Med. J.* **2**, 839-841.
8. Kowalewsky, N. O. (1884) "Zur Lehre von den Mitempfindungen," *Aerztlicher Anzeiger*. 3 & 4. Not available in our libraries but reviewed by Nawrocki, f. (1886) *Jahresber. Fortschr. Anat. Physiol.* **13**, (2), 26.
9. Mitchell, S. W. (1897) *Clinical Lessons on Nervous Diseases* (Lea, Philadelphia and New York), p. 234.
10. Sherrington, C. S. (1900) *Textbook of Physiology* (E. A. Schäfer, Edinburgh & London, Pentland), Vol. 2, p. 981.
11. Sinclair, D. C. (1949) "The remote reference of pain aroused in the skin," *Brain* **72**, 364-372.