BRITISH MEDICAL JOURNAL

LONDON SATURDAY FEBRUARY 12 1938

SUGGESTIONS RELATING TO THE STUDY OF SOMATIC PAIN*

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It is my purpose in this paper briefly to outline certain aspects of pain from the standpoint of investigation, and to suggest the use, or the more extended use, of the experimental method of studying pain. I shall deal particularly with descriptions and identifications of different varieties of pain, and almost exclusively with that derived from somatic structures.

Preliminary Consideration of Some Gaps in our Knowledge

It has long been manifest that a history of pain—as it is related, with the full circumstances in which pain is felt, by an observant subject—may be itself diagnostic of a given disease or of disturbance of given tissue. I believe time will show this method to possess a longer reach than we have suspected; but before its full worth can be attained descriptions of pain must be made more accurate.

It must be obvious to anyone who has given thought to the matter that most descriptions of pains—as these are supplied to us by those who suffer from them in words purely of their own choice—fail to convey sufficiently precise ideas of the sensations experienced and therefore do not adequately identify them. One reason for inaccuracy and inadequacy of description is the difficulty of calling up exact memories of what has been felt some time previously. It is certain that the closer the description is to the event the more accurate it becomes, and that the description is most accurate when given at the time pain occurs and deliberately revised when it recurs. Another reason is the difficulty of finding right words of description and apposite illustrations; to do this requires a degree of observational and didactic skill, and of experience, which very few possess.

To be complete a description of pain experienced must at least comprise a statement of severity, of kind or quality, of relation to time, of locality, and of the circumstances in which it is felt. I shall attempt to deal with these separate aspects of pain neither exhaustively nor even equally, but only so far as will serve to make clear such relevant observations and ideas as I have to offer, and to bring different features into perspective.

SEVERITY

The general level of a pain's severity is recognized to be of clinical value; few pains, however, can be properly described as agonizing, and most of these are known to be derived from the viscera. It is widely believed that the intensity of pain in patients can be evaluated by those possessing intimate knowledge and sound judgment of human types and motives; but it is clear that in very many

individual instances intensity cannot be gauged accurately either from the patient's account of it or from associated reactions. I am inclined to doubt if much, or even anything, would be gained by attempting to set up standards of pain severity with which spontaneous pain could be compared; and so I shall not speak further of the measurement of pain's intensity.

DURATION: TIME-INTENSITY CURVE

It is obvious that the diagnostic importance of a pain's duration rests on the time relation of the pain period and of its causal mechanism. This is well understood.

A feature of pain to which much too little attention has been given is what I may call the curve of pain intensity. It is of importance both because it is capable usually of accurate description and because it has a number of very significant associations. The curve portrays the manner in which pain starts, the rapidity of its culmination, the duration and smoothness at its height, and the manner of its decline. Pain may come and go in a flash, as when the skin of the face is pricked; it may rise to a plateau and last with little fluctuation for a long time before diminishing and vanishing, as when the skin has been burnt or in the attack of angina pectoris; it may be felt in rhythmic pulses, as in inflammation of dental pulp or in pulsating headache—an instance of more obscure derivation but one to which Pickering (1933) has made important and interesting contributions; it may be experienced as longer and less rhythmic phases, as in intestinal colic. All such variations must possess precise significances, related to the organ in which pain arises and to the manner of its origin. This is still largely an unexplored field, but a promising one for graphic record and other investigation.

LOCALIZATION

We know that the seat of origin of pain may be located by patients sometimes with precision, and that the general region from which it comes may be indicated clearly. The value of pain-localization as pointing to the seat of mischief is universally recognized; but accuracy in describing locality in which pain is felt begins to decline from the instant pain ceases. Localization should therefore be effected as far as possible while pain is felt; and it may be advantageous in the case of patients to test how closely the subject can localize appropriate pain when it is induced from a known region experimentally. There is another comment, and one which I think more important, that I would like to make in speaking of the localization of somatic pain. It is too generally assumed that somatic pain locates the seat of mischief. It locates the seat of mischief with great precision when this is the

* Work undertaken on behalf of the Medical Research Council.

skin or an exposed mucous membrane; but there is much less evidence that it does so when deeper somatic structures, such as subcutaneous tissue, muscle, etc., are concerned. There are already a few well-recognized examples—for instance, the reference of pain from diaphragm to tip of shoulder or from hip-joint to knee—which illustrate how faulty the location of disease by pain may be. But my point is that such examples have come to be regarded as exceptional and that too little experimental work has been done on pain derived from these deeper structures.

QUALITY

One of the least-studied features of pain, and one to which I shall give more space, is its kind or quality. A direct description is no more possible than it is in the case of sense of colour: here we use the device of exemplification or association, as when we talk of "blood-red" or "orange"; and the frequent descriptions and comparisons of everyday life enable us to attain a high degree of accuracy in conveying by this method the idea of particular colours or tints. In describing the kind or quality of pain we are likewise restricted to exemplification, but in this connexion experience is infrequent and limited and the art of description is unpractised and unchecked. It is my view that experience may be supplied and practice obtained in the recognition of pains of different qualities and the naming of them. Common parlance has acquired a few striking terms, as when we speak of pain as "burning" or as "pricking," quite distinctly meaning to associate such pains with those provoked by burns or pricks. Here are two instances achieving unusual accuracy. But many terms in use and of like origin, such as tearing, boring, cutting, stabbing, and crushing, owing to the comparative infrequency of corresponding physical damages, convey as between two persons no exact ideas. The common device of describing pain in terms linking it with various forms of injury has little scientific and, apart from a very few examples, little practical value. This method of description has been almost sterile, because, as already indicated, experience of the relevant kinds of injury is uncommon and thus the terms cannot recall the appropriate sensations, and for other reasons. Thus it is obviously not clear that a constant type of pain is produced by an act of crushing or of tearing, and it is known that one kind of pain can follow both a crush and a burn. Another defect of current terminology is that it is often uncertain whether a term is used to convey an idea of the quality of pain or to illustrate the sequence of events as portrayed in the curve of pain intensity. The erroneous impressions which arise and are conveyed by the use of such terminology are indeed very numerous and serious, as will become clearer later in my attempt to analyse and define various types of pain. In illustrating and in leading up to certain suggestions and generalizations, I propose to consider pain, and especially the quality of pain, provoked from three somatic structures—namely, skin, muscle, and tendon (or web, etc.).

Skin Pain

When pain is derived from skin its localization is very accurate; it varies in intensity and in its duration, it may change from moment to moment, but it does not vary in quality or tone. Though this idea has been expressed by previous workers (Becher, 1915; Alrut, 1909) and is summed up in the term "bright" pain ("hell Schmerz") of German writers, it is not apparent that it has been at all generally acknowledged. It is of so much importance if true that it deserves to be brought to the point

of demonstration. Pain can be provoked by injuring the skin in a large number of different ways, as by pricking with a sharp point, by pinching tiny folds of skin, by pulling on hairs, by burning, by the passage of electrical current, and by the application of irritant poisons. The quality of pain evoked in these several ways from skin can in fact be demonstrated to be unvarying, in that when the tests are properly applied the subject is unable to decide the manner in which pain is produced. A fine wire is bent at an acute angle and heated electrically; the angle is brought into quite transient contact with the skin, or, alternatively, the skin is pricked by a needle. A blindfolded subject cannot detect which of these two forms of stimulation is employed (Lewis and Hess, 1933). Similarly, a quick tug upon a single hair or the make-and-break shock of a galvanic current may be used. All these will be described as pricking pain without distinction. Naturally it is necessary that the subject should not be allowed to receive associated sensory (but unpainful) stimuli that are peculiar to the form of stimulation. Thus if the contact of the hot wire is maintained unduly its warmth may be felt in addition to pain, and the form of stimulation will then be detected at once. When a hair is to be pulled it should first be isolated so that it may be grasped and pulled without warning, which simple contact with this or neighbouring hairs will give; and counter-pressure should be exerted around its base so that when the hair is pulled the skin is not lifted. Similar counter-pressure should be exerted when needle-prick, hot-wire contact, or galvanic shock is compared with this form of stimulation. The greater the precaution taken to eliminate supplementary sensory stimuli, or to reduce these to uniformity in comparing different forms of painful stimuli, the more successful will be the tests. The subject tested is soon aware that it is impossible to distinguish the different pain stimuli and that, where the form of stimulus is recognized, the recognition depends upon a non-painful accompanying sensation. The stimuli just discussed are all brief ones, and their effects are all called "pricking."

A prolonged stimulus gives rise to pain described as "burning"; and this is always so, whether the pain arises from heat or not. The bent wire is carried just through a small cork and thus applied to the skin, and enough current is now led through the wire to heat it; a needle point is sunk in a similar cork, and from it a galvanic current of appropriate strength is turned into the skin; an isolated hair is pulled and held tense through a small slit in a cork held around it and in contact with the skin; or a tiny fold of skin is caught up in sharp-edged forceps and pinched in similar circumstances: the subject cannot differentiate. All these forms of stimulus give rise to pain that is described without distinction as "burning" pain. It is recognized as such, not because of its peculiar quality, but because it is a cutaneous pain *that continues*; it is called "burning" from association. The hot stimulus applied briefly causes what is termed "pricking" pain; prolong the same stimulus and it is called "burning." The initial pull on a hair causes a "pricking" pain, but if the hair is held tense the quality of the pain, though quite unchanged, is now called "burning." The difference between "pricking" and "burning" pain is not one of quality or tone, it is purely one of duration.

So far pain arising from and ending with brief or short stimulation of the skin has been discussed; but pain may also continue as an after-effect of injury. The most widely recognized pain of this kind is that continuing long after contact with an object hot enough visibly to injure

the skin. Pain quite indistinguishable from this arises out of injuries resulting from continued friction, abrasions, crushes, freezing, ultra-violet burns, and irritant substances. And here it is important to note that it is identical in quality with, though it is usually less in intensity than, the pain previously discussed—namely, that which occurs during the actual period of stimulation. A series of minute scratches, closely set, gives rise after an interval of time to a very definite continuous pain; it has precisely the same qualities as the pain which follows a burn or which occurs after chloroform has been held on the skin. Comparison should be made of two forms of stimulation, applied symmetrically and simultaneously to two arms; the result is then convincing in the sense indicated. This and similar observations establish the fact that pain of only one *quality* can be provoked from skin. When we speak of “smarting,” “burning,” or “stinging” we are using terms that lack precise distinction. Some think it convenient to say that smarting is less intense than burning, others describe smarting and stinging as pain which begins with relative suddenness or does not continue long at full intensity. In the last instance the pain produced by the stings of insects or of plants clearly guides the definition. There are many variations in the curve of pain intensity, but there is no variation in the quality of pain originating in skin. The quality is the same however the pain is produced, whether from stimulation of nerve endings or of nerve fibres. While anaesthetizing by hypodermic injection a small cutaneous nerve, previously and accurately located, it is not very unusual for the needle point to touch the nerve; a burning pain is then felt in the area of the nerve's distribution which in quality is indistinguishable from that produced by injury of the skin itself.

Muscle Pain

The second example of pain I shall consider is that derived from muscle. Experiments in which pain is deliberately provoked from skin are easy to devise and to control. To test deeper-lying structures it has been necessary to use different methods. If the circulation to a limb is stopped and a group of muscles is exercised voluntarily, or if a single muscle is forced to contract by direct electrical stimulation, after a time pain is produced in the limb. This pain, as Pickering, Rothschild, and I (1931) proved, is derived from the muscle, and we put forward abundant evidence to show that it is due to a chemical or physico-chemical pain factor arising in muscular metabolism. This pain is disagreeable, it is rather diffuse and difficult to locate, it is continuous, and it is thought by most to waver a little in its intensity; its quality is indescribable, but the pain is distinctive. It is impossible to confuse pain from skin and pain from muscle.

When convinced that pain derived from skin has a constant quality or tone I turned to muscle and tested this to see if pain originating from it possessed similar constancy. I first used isotonic acid solution (a phosphoric acid and disodium hydrogen phosphate mixture of pH 5.0 to 6.5), injecting 0.3 c.cm. through a fine needle into a dorsal muscle of the forearm and comparing the resulting pain with that produced simultaneously in the symmetrical muscle by working this under ischaemic conditions. The two pains were indistinguishable. I subsequently used hypertonic solutions (4 to 5 per cent. sodium chloride), injecting a similar quantity of this, or alternatively of 0.5 per cent. potassium chloride with enough sodium chloride to render the solution isotonic; these injections also gave identical pain. Pain can be pro-

voked mechanically by squeezing muscle firmly between finger and thumb; it can easily be elicited by light pressure over muscle that has been much used the day before. Similar pressure exerted upon the more superficial tissues is without effect; pain so induced is again found to be indistinguishable from that provoked by the same muscle by working it under ischaemic conditions. As an experimental method of producing muscle pain the injection of a minute quantity of a salt solution is the most satisfactory; it is very simple, harmless, and the stimulus is confined to a small mass of muscle. We have seen in the case of skin that pain, though it is of one kind, may be provoked for an instant or for indefinitely long periods. I have not succeeded in provoking very brief pain from muscle: once it appears in the field of consciousness it seems always to last at least a few seconds.

We have in this instance of muscle a second example of tissue from which pain of only one kind can be provoked: muscle pain, when it has been experienced often enough, can usually be recognized as such; it is pain most uniformly described as “aching” pain.

In these observations I have noted that muscle pain is referred to a distance. Thus pain arising from the lower part of the triceps is often referred down the inner side of the forearm to the little finger; from the trapezius it is usually referred to the occiput. I have been fortunate in interesting Dr. Kellgren in this matter. In a long series of very careful researches carried out in my laboratory he has formulated some very striking principles underlying the reference of pain from muscle—principles which appear to have an important practical bearing.

Web, Tendon, and Periosteal Pain

Thunberg (1902) distinguished a form of pain which he called “dull” pain (“dumpf Schmerz”) and which was probably derived from subcutaneous tissues: as he points out, pain of this quality is readily produced by tightly squeezing the short web of skin between two adjacent fingers. The quality of two pains is a little less easy to compare if they are derived from unsymmetrical structures. Despite this fact I believe that pain derived from squeezing the web and from squeezing tendons, such as the tendo Achillis or that of the biceps flexor cruris, can be recognized to be of one quality. Here it may be said that pain from a tendon has exactly the same quality whether induced by pressure or by the injection into it of a small quantity of hypertonic salt solution or of buffered acid solution. In the same class as pain from tendon I would place also pain derived from the periosteum. In eliciting the latter I anaesthetize a little piece of skin over the tibia and carry a needle through this until it impinges on the bone. Each time the needle is jabbed against the tibia a disagreeable diffuse pain is produced which lasts at its height for an appreciable time. Similar pain is provoked but is longer-lasting if a small amount of hypertonic saline is injected while the needle point is against the bone. This pain, presumably arising from periosteum, is similar to if not indistinguishable from web and tendon pain. If a joint is strained in rough walking, pain is felt subsequently at each movement of the joint; it is an intermittent and rather short-lasting pain, but its quality is the same as that here described. When I have provoked pain from the periosteum it has been located with much accuracy. Head and Rivers (1908) found deep pain from pressure on the dorsum of the hand, when the skin had lost all sensation, to be accurately located. But reference sometimes occurs. Thus I have noticed that pain from saline injections confined to the subcutaneous tissue on the dorsum of the

hand may sometimes be referred to curiously distant points. Web pain is easily elicited by pressure upon a hand in which all touch and pressure sense has been lost during the ischaemia of arrested blood-flow; the web now pinched is usually, but not always, identified by the observer. These instances and those spoken of under muscle pain are sufficiently striking to make it clear that referred pains from somatic injury should be closely and systematically studied in the interests of accurate diagnosis. They can be investigated without difficulty by the experimental method, inducing pain in normal subjects from the relevant structures.

Application to Patients

In passing on to the application of experimental methods to patients suffering from spontaneous pains it should be made clear that I have not in mind at the moment an application to such patients as a routine in diagnosis, but rather to patients chosen because they are observant and because they are sufficiently interested in tests of the kind to give close attention and to co-operate in attempts to solve the mechanisms of pain.

Speaking of the tissues of the limb, there is none which cannot be reached and tested by the methods described. It would seem that they are responsible for pain of distinct qualities, here described as "skin," "muscle," and "web" pain, and probably representing all the forms of pain experienced from somatic structures. The pain derived from skin is always of the same quality; it is the most distinctive, and is produced from no structures of the limb other than skin and the nervous apparatus supplying it. If we consider somatic structures generally we must add that this pain is also derived from mucous membranes, but it is simpler to take the case of the limb. Once pain is properly identified as having this particular quality, which when experienced continuously is called in common parlance "burning," its origin from the structures named is certain; such pain is not derived from muscle or other deep-lying structure.

Pain that is clearly recognized to have a different quality comes from deep structures, and it may be recognized as derived from muscle, or alternatively from one of several tissues which give rise to web pain. The point I would first emphasize is that for purposes of investigation, and ultimately perhaps for diagnosis, the quality of pain derived from the limbs should not be described under such terms as "boring" and "stabbing," but only as "skin" and "muscle" pain. These are descriptive terms of quality which can be used by the experienced with accuracy, and convey essential information. The second point is that descriptions of pain taken from the inexperienced are inaccurate, just as descriptions of colour by a child are inaccurate: to obtain accuracy the subject must obtain experience. The power to distinguish between "skin" pain and "muscle" pain can be cultivated in all subjects without difficulty; the difference between them is conspicuous. Observant subjects can, I think, be brought to differentiate between "muscle" and "web" pain by repeatedly inducing pain from muscle and from other suitable structures and focusing attention upon it. If each of these three pains is distinctive of the tissue from which it is derived, then the origin of any such pain is recognizable as soon as the pain is appreciated. It is my view that the power to recognize pain arising from different types of tissue can be carried by repeated observation to a degree of accuracy which renders it a valuable asset in investigational work. Accuracy is more fully assured if, in investigating spontaneous pains, a pain recognized as

identical in quality is produced experimentally in the same subject. It should be produced, if possible, in a symmetrical region and while the spontaneous pain is present. By inducing pain from skin, muscle, or tendon in an observant subject who suffers from spontaneous pain the origin of this pain in skin, muscle, or tendon may very probably be determined. The origin of headache from muscle or aponeurosis attached to the occiput can be determined by inducing such headache in quiescent periods by interferences with the corresponding structures.

I wish to emphasize the general principle that much exact information may be obtained in regard to spontaneous somatic pain by deliberate tests that provoke similar pain. It is clear that the quality of pain experienced may itself proclaim the type of tissue in which the pain arises. The locality in which pain is felt may likewise afford important evidence of the structure in which it is determined; but the evidence obtained from locality cannot be used safely where pains arising in deep structures are concerned, unless the reference of pain from such structures has been closely studied. Strong evidence that spontaneous pain comes from a given structure is presented when pain of the exact quality and distribution can be provoked from that structure. There are occasions when tests of pain can be carried a stage further.

Pain may sometimes be provoked in a normal limb—pain which not only is possessed of the appropriate quality and distribution but which presents the same time-intensity relations and is provoked under conditions suspected or known to exist in the case of the spontaneous pain being studied. I will cite two examples in illustration of this very complete type of observation. First, an area of skin on the dorsum of the foot is stated to be tender to light friction and to give continuous "burning" pain when the foot becomes warm or is hung down: a pain precisely similar in character and location, and provoked by the dependent posture and by warmth, follows the experimental procedure of burning the skin of the foot with ultra-violet rays (Lewis, 1933; Lewis and Hess, 1933). Second, a man suffers from what he describes as "cramp-like" pain in the calf of his left leg which comes on when he walks a hundred yards and continues when he rests; it is accompanied by tenderness on pressure over the calf. A pain identical in all these respects and associated with similar local tenderness can be provoked in the sound limb of this man on walking a hundred yards, provided that the circulation to his leg is first arrested (Lewis, Pickering, and Rothschild, 1931). These two examples illustrate the full application of the principle, for they not only display the discovery by the experimental method of the structures from which pain is derived but they throw a great deal of light upon the mechanism of syndromes which in these particular instances have been called "erythromelalgia" and "intermittent claudication," respectively.

It is my plea that the most informing statement concerning spontaneous pain is that it can be reproduced exactly by a closely defined experimental procedure, and that this method of studying pain by reproducing it is still far from exhausted. Its full worth, both in regard to accuracy and the extent to which it may be employed profitably to investigate pain in different circumstances, the future will disclose.

A Theoretical Consideration

In concluding that the quality of pain derived from skin or cutaneous nerve is constant and that pain of this quality is only so derived we are almost forced to infer that the

relevant pain impulses are connected ultimately to special receptors in the sensorium. Speaking of sensation generally, the nerve ending is specialized to receive particular forms of stimulus and to convert these into nerve impulses; there is reason to think that all these nerve impulses are fundamentally alike and that the nerves are mere conductors of a common pattern of excitation thrown into them by the end-apparatus. If this is indeed so, then the sensorium, which ultimately receives these impulses, alone determines the form of sensation, be it light, sound, or pain. The kind of pain which skin is capable of awakening is common to all parts of the skin and to the stratified mucous membranes; the corresponding nerves evidently belong to a common system and connect to a common centre.

We may for present purposes leave on one side the finer distinction between pain derived from muscle and that from other deep-lying structures, such as tendon, and deal only with pain from the skin and from deep-lying structures as a whole. The difference between the quality of skin pain and of deep pain is so clear, the quality of the former is so exclusive to skin and mucous membrane and of the latter to deep structures, that it is possible we are in error in classing both together under the one term "pain." It is a matter of usage; these two sensations have not been shown to possess the common properties which the use of a single term would imply, and I can see no conclusive reason for regarding them as more fundamentally akin than are other forms of sensation which are distinguished by separate terms. If we are right in concluding that the system of fibres subserving cutaneous pain passes to an appropriate and exclusive part of the sensorium which determines this particular sensation, we are brought to consider whether fibres subserving pain derived more deeply do not connect to a separate part of the sensorium.* At all events, we should bear in mind the possibly serious fallacy of regarding both types as represented in a common centre.

It is usual to-day to refer almost all peripheral sensations to the four specific systems—touch, pain, warmth, and cold—and there is a definite tendency to ascribe all other sensations, such as itch, tingling, and the various but different sensations classed together popularly as pain, to the touch or pain nerve system. This procedure is an arbitrary one, and has arisen out of a surrender to simplicity rather than from the dictates of evidence. It is conceivably the correct view, but it is not necessarily so, and we should be on guard. The difference in the quality of pain derived from skin and from deeper structures has led me to suppose that these may be fundamentally separate forms of sensation. The idea suggested that the two corresponding systems of peripheral nerves establish different connexions within the central nervous system is supported in other ways. Painful stimulation of the skin is well known to awaken quick protective reflexes. Painful stimulation of deeper structures does not appear to possess this association. Thus, stimulation of a decerebrate frog's toe results in instant withdrawal by flexion of the limb; so, too, will stimulation of any other part of the skin of the limb. But, if care is taken to avoid escape to cutaneous nerves, such reflexes do not seem to be obtainable from muscle or periosteum of the leg, or from abdominal viscus. While painful sensations derived from the human skin are associated with brisk movements, with rise of pulse rate, and with a sense of invigoration, those derived from deeper structures like

periosteum and joints are often associated, as are for the most part those from the viscera, with quiescence, with slowing of the pulse, a fall of blood pressure, and nausea, the last phenomenon being responsible for the common designation "sickening" which is applied to this but never to cutaneous pain.

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A PRELIMINARY ACCOUNT OF REFERRED PAINS ARISING FROM MUSCLE*

BY

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During the last year I have made an extensive investigation of the character and distribution of muscular pain produced experimentally in normal subjects. A detailed account of this work will appear in the next number of *Clinical Science*. Briefly I find that pain arising from muscle is always diffuse and is often referred, with a distribution which follows a spinal segmental pattern; and that this referred pain is associated with referred tenderness of the deep structures.

A number of cases of "fibrositis" or "myalgia" have been investigated from this point of view. The distribution of the pain was noted as accurately as possible, and experience of the distribution of pain provoked from normal muscles guided me to the muscles from which spontaneous pain might have arisen. Such muscles almost always presented tender spots on palpation. Pressure on these spots sometimes reproduced the patient's pain; but a method more often successful was the injection of sterile saline into the tender muscle. The injection of novocain may also reproduce the pain momentarily.

The search for the source of trouble by defining areas of tenderness is often confused by the patients calling attention to areas of referred tenderness. But referred tenderness is rarely conspicuous, and I have found it a useful guide to consider tenderness to be referred unless the patient winces under the palpation of a given spot. When these acutely tender spots were not too extensive they were infiltrated with 1 per cent. novocain, and the patients were then re-examined, more attention being paid to pain on movement and limitation of movement than to spontaneous pain. This infiltration often produced relief of the symptoms and signs, and sometimes abolished them completely.

In the eight illustrative cases here reported clear-cut results have been obtained in that the full spontaneous pain has been reproduced by manipulating the tender spots and all symptoms then abolished by anaesthetizing these spots locally; in these cases, therefore, it is sound to conclude that the widespread referred pain arose from the tender regions of the muscle. It has been found, too, that in instances in which novocain infiltration abolished the symptoms this effect often outlasted the actual anaesthesia and was more or less permanent. This suggests

* Pain of both kinds is conveyed by the antero-lateral tract, as is shown by the abolition of both in cases in which this tract has been divided surgically.

* Working under grants from the Medical Research Council Medical and Surgical Units.