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"*Psychic Secretion: The Influence of the Environment.*"(1) By LIEUT.-COL. E. P. CATHCART, M.D., R.A.M.C., Professor of Physiology, London Hospital Medical School.

MR. PRESIDENT, LADIES AND GENTLEMEN,—Probably most of what I shall say to you this afternoon will be well known to you; indeed, many of you may think the information self-evident and trivial, but in spite of this I hope that what I say may serve to re-emphasise in your minds the fact that we are all very subject to our environment.

Consciously or unconsciously we are all inclined to look upon mankind as a superior caste of living organism—a something which occupies a place apart in the kingdom of the living. But this assumed divergence from all other life arises solely from the fact that some few of mankind think or pretend to think, and therefore have not unnaturally arrived at the view, that mankind is a class apart. We recognise and state in a superior sort of a way that the lower living organisms are subject to their environment—are indeed at the mercy of their environment, that their actions and manner of life are governed by their surroundings.

Yet in spite of our superiority we, too, as a class are subject to, and in fact one might almost say are victims of, our environment. We respond to the various types of stimuli which affect the despised lower members of creation, but unless we respond in a way divergent from the conventional social standard of conduct, we pursue the even tenor of our way almost blissfully unconscious of the fact. On the other hand, if we respond irregularly, or too actively, we immediately attract the notice of our friends, mayhap of the alienist, and sometimes even of the police.

Now, some of you may quite correctly inquire what has all this wordy preamble to do with the subject of my lecture, "Psychic Secretion." I would reply that it has everything to do with it. The so-called psychic secretion is only a demonstration of one of the simplest of the relations which we have to the outside world. The commonly used term "psychic secretion" is really a misnomer; all it is, in reality, is a reflex secretion in which the stimulus is not the usual commonplace one.

Let us for a moment consider the type of secretion to which the term

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"psychic" has been applied. It is common knowledge that under certain conditions, quite apart from the taking of food, our "mouths water." This mouth-watering was not considered worthy of the attention of physiologists until Pavloff—in whose laboratory at Petrograd I had the honour of working—took up the matter, and thoroughly investigated the conditions associated with salivary secretion. Pavloff first of all showed that it is not the mere flow of saliva which has to be considered: the composition of the saliva which results is also under control. If you tempt a dog with a mass of raw meat it gets very excited, but no saliva is secreted from the parotid gland. But show it dried meat powder, or dry bread, and immediately there is a free flow of watery saliva from the parotid gland. If, on the other hand, you are making observations on the submaxillary gland, and you show the animal the raw meat, a free secretion results. Pavloff then demonstrated that the different salivary glands are very sharply differentiated as to the conditions necessary for their activity; they show a marked selective action in the choice of an adequate stimulus. A very interesting point is, that the mechanical stimulus in the form of a material object is not the only potent stimulus.

The psychic stimulus is not confined to the salivary glands. Pavloff has demonstrated that the gastric glands react in the same way, thus confirming a very early observation of Bidder and Schmidt, who had noted that the offering of food to a hungry dog evoked a flow of gastric juice. The interesting fact about the gastric psychic secretion is, as Pavloff has clearly demonstrated, that the latent period of secretion is identical—*viz.*, five minutes—with that which follows the normal stimulation of the buccal mucous membrane. Pavloff further showed that the temperament of the animal tested plays a large part in the flow of the gastric juice. Lazy or impatient animals do not act as good subjects.

One of the practical results arising from these experiments was the conclusion that the taking of food is, or should be, a serious function; unless the meal is eaten with interest and enjoyment the full value is not obtained. Hence we are, indeed, at the mercy of our environment. It is not the mere food which is of primary importance; there are many additional factors which play an important part in this question of the taking of food. The refinements of life in our prandial ritual have gradually assumed a position of primary importance. Under normal conditions most of us make certain demands in connection with our meals: spotless linen, bright silver, a well-decorated table, and everything set in a special room. Unless we get this, along with well-flavoured, well-cooked, and well-served food, our appetites are apt to fail. Hunger is indeed the best sauce, but indoor work is not the best stimulus for the creation of hunger.

But there is still another side of the question, and this is an aspect

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which you here will appreciate perhaps more fully than I can, and that is the effect of mental strain or emotion on the appetite. We all know how often, when we are deeply interested in a piece of work, the usual meal-hour can come and go, and yet we are indifferent; or, on the other hand, how strain and worry literally destroy the appetite—the food may be taken, but it is eaten without enjoyment or interest, and the all-important psychic secretion fails. Or still further, we may be heartily enjoying a meal when some emotional storm sets in—say a quarrel starts, the temper is raised, and as a result of the violent emotion the digestion is actually brought to a complete cessation. Truly we are at the mercy of our environment. We respond to stimuli which of themselves play, and can play, no first-hand part in the secretion of the digestive uses, but yet which, in conjunction with a very early reflex, can be gradually converted into true stimuli of the first order. In other words, we form secretory habits, and unless the particular concatenation of events is present, or unless certain well-defined specific stimuli are present, the result is failure. You, above all other workers, appreciate the true importance of these apparently subsidiary factors in the realm of psychopathic studies—how certain individuals must have certain stimuli before what may be regarded as a perfectly normal act can be performed. Take for example a certain well-known speaker. What would he do if coat-lapels went out of fashion and his tailor failed to provide them! Then take those individuals who cannot speak without having something to play with. The stimulus of the coat-lapel or the piece of string, in themselves perfectly indifferent, and perfectly incapable of forming adequate stimuli for thought and speech, yet play a very real part in the smooth flow of thought and speech.

The facts underlying this reflex secretion have been investigated by Pavloff and his pupils, using the secretion of the salivary glands as the test. Pavloff carried into the realm of the central nervous system the methods of experimentation which had given such successful results in connection with mere glandular activity. The particular methods which he employed he has called the formation of "conditioned reflexes." He divided the salivary reflexes into two classes; he spoke of the "conditioned reflexes" and the "unconditioned reflexes." Pavloff would say that the so-called psychic secretion which resulted from a stimulus, perhaps indifferent in itself, was a conditioned reflex, whereas the ordinary stimulation of the buccal cavity on the taking of food—the normal way in which saliva is caused to flow—he calls the unconditioned reflex. From a study of these two reflexes Pavloff has evolved a wonderful method of gaining information about our relationships to the external world, that is, of our relationship to our environment.

In developing this relationship there are two fundamental mechanisms involved. The first is by what he called "temporary association"—that

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is to say, the bringing of external phenomena into relation with the reactions of the organism, this connection becoming more and more complex and the more subject to modification or influence as evolution of the higher centres proceeds. The other fundamental mechanism is that associated with the "analysers" usually called the sense-organs, *i.e.*, the eye, the ear, etc., the organs which sort out the many and complicated stimuli which bring us into relation with the external world.

As one of the simplest and most primitive of our relationships to the external world is the necessity of procuring food, in the course of the quest for a suitable supply of nutriment the means by which food is detected increase in number and complexity as the analysers are differentiated. As a result the variety of phenomena which gradually become associated with food increases in number, so that in the end, owing to the variety and number of the adequate stimuli, the impossibility of other than mere temporary or evanescent association is obvious.

How is the conditioned reflex—the formation of the temporary association—brought about? How is an indifferent stimulus converted into an active one? Why is it, for example, that one man reading in a newspaper—an indifferent stimulus—that coupons are no longer required for meat in a restaurant has, if he is a lover of a well-grilled steak, an anticipatory flow of saliva, whereas a man who is a vegetarian is left cold, except, perhaps, for a feeling of disgust that more meat is to be liberated, by the same announcement.

Pavloff showed that if a new indifferent stimulus be presented sufficiently often in conjunction with one which is known to cause a secretion, in the end the indifferent stimulus presented alone will evoke a response. It means that the reflex arc has taken on a new afferent neuron, but it has not taken it on unconditionally; the path is not yet beaten down hard: no right-of-way has been formed.

I shall now give you an account of how an indifferent stimulus may become a true reflex. Take, first of all, an example of an unconditioned reflex. As you know, if you give an animal food saliva will be secreted. Suppose, now, that every time food is given to a dog—for example, meat powder thrown into its mouth, so as to leave out the factor of chewing—a bell is rung, or a light shown, or a single note sounded on an organ, or the dog has its skin scratched on a particular spot. If the giving of the food and the application of the particular stimulus selected be made to synchronise a number of times—the actual number varies a good deal with the individual dog—it will be found that one day the superimposed indifferent stimulus, the ringing of the bell, if that were chosen, *used alone*, will evoke the secretion. In other words, a conditioned reflex to a specific stimulus has been created.

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This is an example of the genesis of a conditioned reflex, and similar reflexes can be generated by practically any phenomenon of the external world, provided the animal possesses a suitable analyser or receptor—that is to say, if it can form temporary associations between the external phenomena and the mechanism for the salivary secretion.

The point that is thus emphasised is that, provided a well-established primitive unconditioned reflex exists, by suitable treatment a previously indifferent external stimulus can be brought into intimate relationship with it.

The investigation would be very simple if it all ended here, but Pavloff has definitely shown that the problem of inhibition must be considered: that not only can one inhibit either externally or internally these reflexes, but in the end an inhibition of the inhibition may be brought about. Any external phenomenon may act under suitable conditions as an inhibitant. This fact is of serious import when the conditioned reflex is being developed in the laboratory: the experiments have to be carried out in dead silence every day; each time one has to use the same movements. Very frequently the very slightest outside disturbance—the banging of the door in another laboratory, for example—is enough to upset the experimental dog for the day.

The question of internal inhibition is much more subtle. When a conditioned reflex is properly developed, *i.e.*, when the indifferent stimulus alone evokes a response, if the animal is not presented on several successive tests with the food which it has learned to expect on the application of the stimulus, the conditioned reflex ceases to be effective. As a rule this type of internal inhibition is merely temporary, the conditioned stimulus being effective at a later period.

At the same time actual inhibition of secretion can be developed by suitable treatment—that is to say, we can build up reflexes for non-secretion or non-activity just as easily as we can build up a reflex for activity. It is a matter of training, and of the utilisation of special methods.

In one animal under observation we had developed on its fore-leg a little active spot which, when brushed, caused active salivary secretion. In the middle of its back, on the contrary, by a similar process we had developed an inactive cold spot, and when that spot was chilled inhibition of secretion took place; it was a spot trained for non-secretion. If the non-secretion reflex is first evoked, naturally there is no flow of saliva; if the active reflex is now called in there will still be no flow—active inhibition has taken place. The active stimulus, however, soon becomes effective again. You get the same thing if you try to present two different active reflexes simultaneously, or if an attempt be made to superimpose an active stimulus during the period of secretion produced by another active stimulus.

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It can also be demonstrated that the time element may play an important part. I have mentioned that in regard to the gastric flow there is a normal latent period of five minutes. A similar latent period may be developed in connection with conditioned reflexes. For instance, if in building up a conditioned reflex the food be not given until a definite constant period—say two minutes—after the application of the stimulus, it will be found that when the new conditioned stimulus is given alone there is a latent period of the duration established during the formation of the reflex, *viz.*, two minutes. During these two minutes of latency an active inhibition is going on to prevent the secretion of saliva. If, during this latent period, you throw in another perfectly indifferent stimulus—a stimulus which of itself would not produce a flow of saliva, one which the animal has not been trained to respond to—an active flow of saliva takes place; the indifferent stimulus has broken the spell, it has inhibited the inhibition, and an active flow of saliva ensues.

In dogs at least the development of a conditioned reflex is a very sensitive affair. Supposing you train an animal to the stimulus of an organ note of exactly 100 vibrations per second, that animal will be indifferent to a note of ninety-six vibrations on the one hand and to a note of 104 vibrations on the other; but as soon as the 100 vibrations are resumed the saliva flows again. Again, take the skin. One does not look upon the skin as in any way too sensitive when spacing it out with an æsthesiometer; yet the removal of the stimulating electrode or brush to a distance of only 1 cm. from an active spot will suffice to do away with the whole reflex.

Even painful stimuli can be used for the building up of conditioned reflexes. Thus an electric current strong enough to cause signs of pain in an animal may be built up into an apparently non-painful conditioned stimulus. If each time such a stimulus is used the dog be given food, it will be found that after a few repetitions all signs of pain from the stimulation have disappeared and a free flow of saliva occurs: the stimulus has lost its power as a painful agent. But move the electrode even a centimetre away from the spot and the dog will again show every evidence of violent pain. It must be admitted it is only with difficulty and under special conditions that you can develop these painful stimuli into good conditioned reflexes.

I think you will now see why I have insisted that we are victims of our environment—of the daily routine which is so dear to us; how it is that as we "get used" to a certain setting, we work better and more happily, we enjoy our food better—in general we are more comfortable. All these little amenities of our social life which we have come to look upon as more or less essential to our comfort and well-being are but indifferent stimuli, which, through constant application, have been converted into conditioned reflexes. Our environment plays such an

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enormous part in our happiness and well-being simply because we have physiologically developed conditioned reflexes.

Sir ROBERT ARMSTRONG-JONES said this paper was a very difficult one to discuss. It was *ex cathedrâ*, and in attempting to discuss it one was apt to wander off into platitudes. It was well known that if one's morning letters brought bad news, one did not want one's breakfast. As the Psalmist said, one's tongue clove to the roof of one's mouth, and altogether there was an inhibition of psychic secretion. He felt very grateful to the reader of the paper for having introduced a very charming phrase, which he hoped Colonel Cathcart would not regard as his copyright—namely, "the prandial ritual." It described very aptly all the social amenities and conventions which appertained to the taking of food. He had always said that the poor man and the rich man drank for two opposite reasons—the poor man because he mistook the feeling of stimulation imparted by a glass of beer for the satisfaction produced by a well-grilled chop, whereas the rich man drank in order to make his meal a better meal. The latter had all the æsthetic reasons around him—the charming napery, the brilliant silver, the flowers arranged before him—he had practically all the nice amenities, and there was also the sight of the champagne bubbling in the glass. All those were points which had to do with psychic secretion. He was greatly interested in the fact that man was so much looked upon as a creature of environment. Man, however, was only an ordinary creature, not a superior mortal, but he had five or six windows to him, through which boundless energies came to him from without. We were, no doubt, deaf or blind or insensitive to many of the forms which came in, but we were open to others. He maintained that one was kept going by one's environmental stimuli coming from without. He had seen many men who retired at 60, having made their pile, and he had seen them "drop out of life," so to speak; they had become members of an asylum population merely because they had retired and no longer had the customary environmental stimuli. But there was one point he could not harmonise with what the reader had said. Dementia præcox was the unemotional type, but the subject of this never failed to secrete his saliva and never failed to grow fat in the early stage of his dementia præcox. He also appreciated everything which came before him. If humanity was so much the creature of psychic secretion, why was it that in this characteristic form of insanity all the functions of the body seemed to go on satisfactorily for a time? It had been a most excellent psychological lecture, touching on similarity, contiguity, the power of appeal to the cortex to inhibit all these things. One heard and read of various stigmata produced by thought and by suggestion. There was the question of the fine balance kept between the internal secretions. Perhaps it was the want of that balance which made Napoleon grow fat and sleek, and develop adiposis dolorosa. The same thing probably obtained in abnormal conditions of the thyroid. He had heard it said—and he had no reason to doubt it—that certain cases of goître had been brought on by mental stress. Not infrequently he had seen neurasthenia in a shell-shocked soldier who had had goitre produced, perhaps by nervous influences. We had in our hands the creation of our own internal arrangements, and perhaps gigantism, acromegaly, goitre and similar conditions could be controlled if the inhibition were exercised. He had been well rewarded in coming to hear the lecture.

(1) Read at the Quarterly Meeting of the Medico-Psychological Association held in London on February 20th, 1919.

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