THE CAUSE OF HYPERPIESIA

PRESENTATION OF A HYPOTHESIS

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Of the several theories that have been presented as an explanation of the common type of high blood pressure two alone receive an appreciable degree of general support. These are: (1) the toxæmic theory, and (2) the mental stress theory. The toxæmic theory may be subdivided into two groups, according to the suggested origin of the toxin. One suggestion is a focus of chronic infection, whilst the other postulates absorption of derivatives of protein digestion. The mental stress theory maintains that hyperpiesia arises as the result of an over-responsive vasomotor system consequent upon a high-pressure existence or of mental stress.

The aetiological factors established regarding hyperpiesia do not help much towards consideration of these theories, but one such factor, the geographical and racial distribution of the disease, affords some definite facts that require consideration when any theory is presented. The distribution of hyperpiesia is not world-wide. The condition is exceedingly common in Europe and North America. In Egypt¹ it is common among certain classes, more particularly the educated, whilst among the hospital classes it is rare. It is rare among Chinese and Orientals,^{2,3,4} who have apparently lower average blood pressures than Europeans. Conception and Bulatao⁵ have made similar observations in the Philippine Islands, whilst my own findings⁶ among the natives in Kenya Colony were of the same nature. The native of South Africa apparently only very seldom develops a high blood pressure,⁷ whilst in the African in America there is quite an appreciable incidence of the condition.^{8,9} The distribution of hyperpiesia throughout the world does not demonstrate a clear racial distribution, but shows an incidence that corresponds more closely with civilization. The African native seems immune from hyperpiesia whilst he lives in primitive conditions in Africa, but when he has been transported to America and adopts a mode of living associated with civilization, he becomes subject to it. Foster records,² among 4,000 hospital patients in China, one case only of hyperpiesia, that of a nurse, a highly nervous woman, who had gone to America to finish her education, and had returned with the habits and attitudes of a "Westerner."

I have stated elsewhere⁶ that my observations amongst African natives afforded evidence that, in my opinion, lent support to the mental stress theory. A consideration of other observers' findings, together with some observations that I have made in general practice in England, have led me to form some tentative conclusions regarding the manner in which mental stress might lead to hyperpiesia. I propose to present my conclusions in the form of a hypothesis, and will subsequently consider the evidence bearing on it.

CANNON'S EMERGENCY REACTION

The theory that mental stress can be held responsible for the development of an established high blood pressure suggests that Cannon's emergency reaction might have a bearing on the problem. Cannon's observations¹⁰ have demonstrated that a rise in blood pressure occurs in animals as a result of an emotional stimulus, and that such rise serves the purpose of preparation "directed towards efficiency in physical struggle." An animal confronted with a situation embracing features of an emergency receives an emotional stimulus which produces a

characteristic physiological reaction dependent on stimulation of the sympathetic nervous system and an outpouring of adrenaline into the blood stream, and manifested by general vaso-constriction, rise of blood pressure, rise of blood sugar, increased cellular content of the blood, and inhibition of motility and secretion in the alimentary tract. This reaction is essentially a physiological one, and cannot be held responsible for the development of a pathological condition without qualification.

The most outstanding fact known regarding the aetiology of hyperpiesia is its dependence upon civilized conditions for its incidence. Cannon's emergency reaction appears alike in the civilized and the uncivilized. What factor dependent on civilization can lead to a variation in the response to this reaction? Human evolution has reached a stage where the struggle for existence has ceased to be a physical one, and the first contrast in the changing circumstances of human evolution is the fact that Cannon's emergency reaction continues to be called into play, but often is not followed by physical struggle. Crile¹¹ and McDowall¹² have suggested that the muscular activity of the physical struggle that follows an emergency may act as a safety-valve for relief of the rise in blood pressure by causing widespread vaso-dilatation in the voluntary muscles. In civilized conditions this natural safety-valve action often would not arise.

The hypothesis is suggested, therefore, that the development of hyperpiesia depends upon the following sequence of events: (1) repeated mental stimuli bearing factors of "stress"; (2) the induction of Cannon's emergency reaction by such stimuli; and (3) the absence of physical struggle following the reaction. Resulting from the consideration of this hypothesis certain questions arise which require careful consideration.

REPEATED STIMULATION AND PATHOLOGICAL CHANGE

Can repeated stimulation of Cannon's emergency reaction give rise to the pathological changes associated with hyperpiesia?

It is generally accepted that the initial structural changes that arise in hyperpiesia take place in the arterioles, and manifest themselves by hypertrophy of the musculature of the media and also by some intimal hypertrophy. Degenerative changes appear secondarily to the hypertrophy in both intima and media. Turnbull¹³ has indicated that, whilst medial hypertrophy is apparently directly proportional to the height of the blood pressure, intimal hypertrophy is less directly dependent on the height of the blood pressure, and more dependent on other factors, such as age of the patient, and he concludes that intimal hypertrophy and degeneration are a result of, and not a cause of, high blood pressure. It is in the arterioles that the fall in pressure occurs from the arterial pressure of about 120 mm. Hg to the capillary pressure of about 20 mm. It is in the arterioles that the sympathetic vasomotor system exerts its chief influence upon the vascular system.

Cannon's emergency reaction is brought about by an outpouring of adrenaline into the blood stream and by stimulation of the sympathetic nervous system. That excessive secretion of adrenaline can produce pathological changes closely resembling those found in hyperpiesia has been demonstrated by the report of cases of tumours of the suprarenal glands causing a high blood pressure, and in some cases removal of the tumour has resulted in a fall of the blood pressure to normal levels.⁹ That there is an excessive secretion of adrenaline in hyperpiesia is distinctly doubtful. Vaquez¹⁴ first put forward the view that overaction of the suprarenal glands was the cause of hyperpiesis, but this view has been subjected to much criticism, mainly on the ground that several

observers have tried to demonstrate an excess of adrenaline in the blood of patients suffering from established hyperpiesia without success,¹⁵ and transfusion of blood from people with high blood pressure into normal individuals does not lead to a rise in blood pressure.¹⁶ Cannon's experiments have only demonstrated an outpouring of adrenaline as a response to an emergency. Some more recent experiments have demonstrated that, in addition to a rapid response to an emergency induced by the influence of adrenaline, there is a delayed response dependent on sympathetic stimulation and independent of the suprarenal glands.¹⁷ Consequently the failure to demonstrate an excess of adrenaline in the blood of cases of hyperpiesia does not exclude the possibility of Cannon's emergency reaction as a fundamental factor in the causation of that condition.

The effect of repeated stimulation of the sympathetic nervous system has been demonstrated by Goormaghtigh's experiments.¹⁸ By removal of the carotid bodies and section of the depressor nerves he claims to have produced not only a high blood pressure but lesions in the renal glomeruli exactly resembling those found in hyperpiesia. There is no evidence that these structures are interfered with in any way in hyperpiesia,¹⁹ but these experiments, and also the vascular changes in thrombo-angiitis obliterans,²⁰ do show that structural changes can arise from overaction of the sympathetic system.

EMOTION AND THE EMERGENCY REACTION

Is Cannon's emergency reaction produced in human beings by emotional stimuli?

No one would dispute that an emotional stimulus readily gives rise to an increase of blood pressure in human beings. This is a characteristic of all races, irrespective of civilization. The question as to whether this increase of blood pressure is a specific response to an emotion or is part of a more general reaction such as that described by Cannon is not an easy one to decide, as it depends upon demonstration of a coincident rise in blood sugar and other manifestations. Indirect evidence that there is an elevation of the blood sugar in emotional reactions in human beings has been obtained by Folin, Denis, and Smillie,²¹ who demonstrated sugar in the urine in about 18 per cent. of students after they had sat for important examinations. Of seventy students tested, one only had a trace of sugar before the examination, whilst afterwards thirteen showed glycosuria.

More striking evidence of the relation of both blood pressure and blood sugar to emotional conditions was obtained in a case of mine in which a fortunate coincidence enabled me to make a series of observations.

Mrs. P. first consulted me in September, 1929. She was then 24 years of age. She had two children, the younger being 2 months old and breast-fed. She came to me complaining of attacks suggestive of migraine. Blood pressure was found above normal for her age, the lowest readings obtainable being 152/96. Nothing else abnormal was found on examination except a faint trace of sugar in the urine. Owing to lactation it was concluded that the sugar was probably lactose, but the patient was advised to have her urine examined again after cessation of lactation. This she failed to do.

She consulted me again in February, 1932, for further typical migraine. Attacks varied in incidence from about once every three weeks to daily occurrences, and they tended to come on more readily if she was worried. She had had two attacks just prior to the consultation. In between attacks she felt quite fit. On examination she was found to have a blood pressure of 145/100, and glycosuria was present.

Six days later she was seen again. She had had no migraine in the interval. Her blood pressure was found to be 128/85 and the urine contained no sugar. On this occasion close questioning revealed the fact that she had been considerably

agitated and worried, owing to the fact that her mother-in-law, who lived with her, had been somewhat trying and difficult to get on with. The mother-in-law went away about the time of the previous consultation. It was considered that the glycosuria required investigation, so a sugar tolerance test was carried out. Blood sugar examinations were carried out by MacLean's method and revealed the following figures:

	Per cent.
Fasting blood sugar	0.070
Three-quarters of an hour after 50 grams glucose	0.100
One and a half hours after 50 grams glucose	0.088
Two and a quarter hours after 50 grams glucose	0.082

The glycosuria was thus dependent on a low renal threshold, and some subsequent observations confirmed its coincidence with mental stress.

It thus appears that in this case we have mental stress leading to a tendency for migraine attacks, a raised blood pressure, and glycosuria. In the absence of mental stress the blood pressure is within normal limits, and glycosuria does not normally occur. The presence of a low renal threshold afforded the opportunity of demonstrating the fact that the blood sugar rose with the blood pressure and fell with it in response to the emotional condition of the patient, thus suggesting that the rise of blood pressure in response to emotional stimuli is part of the more general reaction as described by Cannon.

REPEATED STIMULATION OF CANNON'S REACTION

What evidence is there that repeated stimulation of Cannon's emergency reaction can produce hyperpiesia? Repeated stimulation of Cannon's emergency reaction should lead to establishment of high blood pressure by means of vaso-constriction in the arterioles, and we should also expect some indication of effects on the blood sugar.

There are theoretical reasons, pointed out by Fishberg,⁹ for supporting the view that vaso-constriction is the essential factor in the pathogenesis of hyperpiesia. The laws governing the flow of fluids through tubes have been studied by Poiseuille, and, though they may not hold exactly for branching tubes, it has been shown that they do apply fairly closely. These laws demonstrate mathematically that the radius of the vessel is the factor, variation of which would have most influence on blood pressure. Vaso-constriction would imply muscular activity, and the pathological finding of medial hypertrophy as the earliest morbid change affords strong support. That overaction of the sympathetic system can lead to a high blood pressure and the morbid changes characteristic of hyperpiesia has already been demonstrated.

Further consideration of the question of the bearing of Cannon's emergency reaction upon hyperpiesia can arise out of the blood sugar changes. If repeated stimulation of the reaction can produce, in certain circumstances, an established rise of pressure, then one would want to know what would happen to the blood sugar. O'Hare²² reports on a series of twenty-three cases of hyperpiesia in sixteen of which he observed diminished sugar tolerance. On the other hand, Marshall²³ records that he could find no relation between blood sugar and blood pressure, but his investigations were carried out on elderly people, all over 65. Musser and Wright²⁴ found marked lowering of sugar tolerance in a group of thirty obese subjects of hyperpiesia compared with a control group of obese people with normal blood pressure. Other references in the literature seem to reveal very varying standards of normality in sugar tolerance, and, when referring to hyperpiesia, are very indefinite regarding the nature and stage of the condition. Marshall has indicated that in elderly people diminished sugar tolerance is usual,

so that conclusions based on advanced cases of hyperpiesia must be accepted with caution. It is the sugar tolerance of the early case of hyperpiesia that might afford information of value regarding the hypothesis, and on this point the literature seems to reveal no definite information. A thorough investigation upon this point has been beyond my facilities, but I have managed to make scanty observations on one case.

Nurse R., a district nurse, who had worked in co-operation with me and who had been overworked throughout the winter, consulted me on March 4th, 1932, on account of headaches, dizziness, and mental depression. The only abnormality of importance that I found was a blood pressure of 170/110. Thinking that I had here an early case of hyperpiesia I took a specimen of blood for examination at between four and five hours after breakfast. Blood sugar was 0.122 per cent. The blood pressure remained high for several days, so I sent her for a month to the South Coast. On her return she felt much better, and her blood pressure was 135/105, so I arranged to repeat the blood sugar estimation under identical conditions. It was 0.058 per cent. (Both analyses were of venous blood.)

To sum up the evidence bearing upon repeated stimulation of Cannon's emergency reaction as a cause of hyperpiesia, theoretical and pathological considerations are considerably in favour of the hypothesis, but confirmation from sugar tolerance in the early hyperpietic seems at present to be lacking. Literary references seem indefinite and conflicting. One case of my own lends some support to the theory, but clearly further investigation on this point is indicated.

ABSENCE OF PHYSICAL STRUGGLE

What evidence is there that lack of physical struggle, that should naturally follow Cannon's emergency reaction, is an essential factor in the development of hyperpiesia? Attention has already been directed to the suggestion that the physical struggle that usually follows stimulation of the emergency reaction under primitive conditions acts as a sort of safety-valve for the raised blood pressure. Civilization has led to changes in the response to emergencies, which are comparatively infrequently followed by physical exertion. That this factor may be an important one in the causation of hyperpiesia is suggested by the fact that that condition shows an incidence dependent on civilization rather than on race, and on mental rather than on manual labour.

In order to obtain further evidence on this point an experiment was carried out on a volunteer. The aim of the experiment was to arrange to stimulate the emergency reaction and to follow such stimulation with vigorous exercise on one occasion and with rest on another. Then observations were made at intervals on the blood pressure and blood sugar in order to contrast the effects of exercise and its absence on the reaction. It was almost impossible in practice to devise a method of giving on two occasions emotional stimuli that could invoke reactions of equal intensity in a subject who was aware that he was being experimented upon. Consequently subcutaneous injections of adrenaline were given, as by this means stimuli of equal intensity could be applied on two occasions under controlled conditions.

The volunteer for the experiment, a healthy man aged 27, was given a light breakfast. Two and a half hours afterwards he was given a subcutaneous injection of 1/2 c.cm. of adrenaline chloride (1 in 1,000). Blood pressure was recorded before the injection and at half-hourly intervals afterwards for two hours. Blood was taken from a vein for estimation of sugar at the commencement of the experiment and at one hour and two hours after the injection. The blood sugar determinations were made by MacLean's method. In the first experiment, immediately after the injection of adrenaline, the

subject began some vigorous exercise, digging during the first half-hour, a brisk walk during the second half-hour, and more gentle walking in the remaining intervals. The exact figures obtained are shown in the following table.

EXPERIMENT 1.—With Exercise

	Systolic Blood Pressure	Diastolic Blood Pressure	Blood Sugar Per cent.
Before injection	132	85	0.093
1/4 hour after injection ...	135	85	
1 hour after injection ...	118	78	0.097
1 1/2 hours after injection ...	116	78	
2 hours after injection ...	116	76	0.085

EXPERIMENT 2.—With Rest

	Systolic Blood Pressure	Diastolic Blood Pressure	Blood Sugar Per cent.
Before injection	118	78	0.092
1/4 hour after injection ...	136	70	
1 hour after injection ...	128	75	0.125
1 1/2 hours after injection ...	124	76	
2 hours after injection ...	115	80	0.106

The first blood pressure reading in the first experiment was apparently elevated, evidently due to apprehension, as subsequent observations revealed that the normal blood pressure of the subject of the experiment was nearly constantly about 118/78. In both experiments the systolic blood pressure rose to about 135 mm. shortly after the injection. With exercise, however, it fell to normal within one hour, whereas without exercise it fell much more gradually, and did not reach a normal figure until two hours after the injection. This demonstrates how exercise acts as a sort of safety-valve after an emergency reaction in leading to a rapid lowering of the blood pressure to normal levels. No very definite variations of the diastolic blood pressure appear in the experiment. Blood sugar estimations serve as a useful confirmatory observation regarding the effects of the reaction, and effects similar to those on the systolic blood pressure are noted.

The subjective sensations of the subject were interesting. The dose of adrenaline was quite sufficient to produce subjective symptoms, such as slight shakiness and a sensation of being "strung up" in both experiments within the first half-hour. In the experiment without exercise these symptoms were definitely more marked and of longer duration, lasting about an hour.

These experiments demonstrate how stimulations of the emergency reaction without subsequent muscular exertion, as must occur repeatedly in the lives of many civilized human beings, must have effects differing from those obtained when such stimulation is usually followed by physical struggle. The difference may probably be more marked than this experiment would suggest, since these results are demonstrative only of the effects of adrenaline, whereas a delayed response dependent on sympathetic stimulation and independent of the suprarenal glands also occurs,¹⁷ and this may conceivably result in still further delay in the fall of the systolic blood pressure to normal levels in the absence of physical exercise.

NATURE OF STIMULUS TO CANNON'S REACTION

What is the nature of the stimuli required to induce Cannon's emergency reaction in civilized conditions?

The hypothesis here presented implies that the causation of hyperpiesia is essentially psychological. An analysis of the factors requisite for the induction of Cannon's emergency mechanism reveals three stages as defined by

psychologists: first, cognition or perception, by means of one or more of the sensory systems, that an emergency has arisen; secondly, affection; and, finally, conation—a striving to influence factors for the benefit of the individual concerned. Cannon's emergency reaction is essentially a part of conation, in that it prepares the individual for dealing with an emergency by physiological anticipation of the imminent need for violent physical struggle. It will be helpful to consider the nature of the stimuli required under civilized conditions in the light of this psychological classification. Excessive induction of Cannon's emergency reaction would imply an excess of one or more factors in the process of cognition, affection, and conation.

Cognition depends on (1) environmental factors bearing features of the nature of an emergency, and (2) sensory perception thereof. Disorders of sensory perception involving an excess of cognition independent of environment would imply some form of delusions, and need no further consideration as a factor bearing on the aetiology of hyperpiesia. Environmental factors bring up many considerations. It has already been mentioned that civilized conditions have led to circumstances that favour the development and dissemination of factors calculated to present features of an emergency. Occupations involving heavy responsibility are clearly going to be fruitful in suitable cognitive factors, often referred to as factors involving mental "stress." The process of affection involves association of the emergency factors perceived with past experience, by which we recognize that a given combination of sensory perceptions implies something that is potentially harmful. This association with a past experience may be a conscious association, as when an emergency indicates a known danger; or it may be an unconscious association, such as may occur when the memory of an unpleasant experience has been repressed into the unconscious, but association invokes the emotion coupled with that experience. This is the essential mental process at work in psychoneurosis, and hence it would appear that in a condition of psychoneurosis, and particularly in that type referred to as an anxiety state, the disordered process of affection would increase the facility for suitable stimuli.

The stage of conation leads us into the realm of physiology, and manifests itself by a characteristic response to the condition that invokes the appropriate stages of cognition and affection, or, in other words, a conditioned reflex, as described by Pavlov, is induced. This reflex, or Cannon's emergency reaction, serves the purpose of preparation for physical struggle, which under primitive conditions is usually necessary when an attempt is made to influence the environmental factors in favour of the individual. This reflex reaction is subject to certain principles and laws governing reflex actions, among which facilitation, or "Bahnung," is of special significance in this instance. According to this, when an impulse has passed once through a certain set of neurones to the exclusion of others it will tend, other things being equal, to take the same course on a future occasion, and each time that it traverses this path the resistances in the path will be smaller.²⁵ This establishes on a scientific basis what the clinician refers to rather loosely as vasomotor instability. Often repeated stimulation of the emergency reaction would lead to a lowering of the threshold for that reaction and a heightening of the response to it. This would account for the variability of the blood pressure that is so frequently observed in the earlier stages of hyperpiesia, usually manifesting itself as an excessive reaction to emotional stimuli.²⁶ It has been suggested by Millais Culpin, in connexion with the causation of asthma, that an originally emotional stimulus could evoke a reflex

response by which a number of physiological reactions become abnormally labile. Such an explanation of a psychological aetiology of a physical condition is clearly capable of wider application.²⁷

To summarize considerations of the stimuli that would induce Cannon's emergency reaction and hyperpiesia in civilized conditions, it seems that the main initiating factors would be environmental conditions involving "stress" or heavy responsibility, and psychoneurosis. It would appear that these two factors would act as alternatives, though in any given case some element of each could be present. Vasomotor instability or facilitation of the emergency reaction serves as an important accessory factor in the causation of hyperpiesia, but it is probably incorrect to regard it as a primary factor. The readiness or otherwise with which facilitation would supervene in a given instance might determine whether, in a given set of circumstances, a high blood pressure would develop or not.

CLINICAL EVIDENCE FOR HYPOTHESIS

Having considered theoretical implications of the hypothesis in the last section, I shall now consider to what extent those implications are supported by clinical evidence. It is often stated by clinicians that high blood pressure is most prevalent among mental workers, and the city business man is often cited as the typical example. Literary evidence in support of this fact is scanty. In my own series of 117 cases collected in general practice sixty-three were in women whose occupations were household duties, in which the degree of mental stress involved is difficult to estimate. Of the remaining cases thirty were in occupations in which there was clearly an element of mental stress (for example, manager or owner of private business, nurse, accountant, teacher), whilst only two cases occurred in heavy manual workers.

With regard to the incidence of psychoneurosis in the early stages of hyperpiesia, literary references afford information of value. O'Hare, Walker, and Vickers²⁸ report a series of cases in which there was an early history of nervous temperament or vasomotor weakness in 42 per cent. and, in a smaller series, studied in greater detail, in 87 per cent. A control series of people with normal blood pressure gave 23 per cent. of cases with such a history. Stieglitz²⁹ describes several cases of patients complaining of physical distress dependent upon psychic strain in whom marked emotional rise of blood pressure was recorded. Ayman and Pratt³⁰ stress the fact that the earlier symptoms in hyperpiesia are of psychic origin, and that emotional stress is usually found as an antecedent. Davis³¹ and Riseman and Weiss³² make similar observations. Barton Hall³³ investigated the blood pressure in various forms of psychoneurosis, and demonstrated that in neurasthenia and psychasthenia blood pressure is abnormally low, whilst in cases of prolonged mental strain and anxiety neurosis it may be abnormally high, falling with treatment of the neurosis. In my own series of cases a perusal of the histories reveals the existence of symptoms suggestive of past neurosis in 65 per cent. In many cases in which no such record exists I find that they are advanced cases that have probably been established for many years, and no report has been made of inquiry into more remote history of symptoms of neurosis. I am of the opinion that if such inquiry had been made in every case the percentage would have been distinctly greater.

As has already been mentioned, Ayman²⁶ has drawn attention to the lability of the blood pressure in early stages of hyperpiesia. Backer³⁴ mentions the same fact. Both authors suggest that the hyperpiesia subject has a

vegetative nervous system which reacts excessively to slight stimuli. Ayman adds that

"in a limited number of observations it has seemed to me that the patient with essential hypertension tends to walk and work faster than the average; he is often more sensitive and more easily embarrassed than the average. Whereas the blood pressure of the normal person may rise from 10 to 30 mm. of mercury during excitement, that of the hypertensive patient more often rises from 30 to 100 mm."

Barton Hall has drawn attention to the variability of the blood pressure in anxiety neurotics. In my own series of cases I find notes of fairly decided variability of the blood pressure recorded in 54 per cent. In many of the remaining cases it was probably observed but not recorded, as it used to be my custom to ignore an initially high reading and to record only the lowest pressure obtained after several observations.

In the last section, when considering the stimuli likely to lead to development of hyperpiesia, I indicated how an occupation involving mental stress and psychoneurosis were to be regarded as alternative factors in aetiology, but vasomotor instability was probably itself not a primary factor, but was dependent for its development on one of the other factors. Consequently it would be helpful to analyse my series of cases regarding an occupation involving mental stress and a history indicative of psychoneurosis as alternatives. It was found that a number of those cases in such occupations presented no history of psychoneurosis. Grouping the two factors together, eighty-nine out of the 117 patients gave a history of one or both factors (76 per cent.). In the remaining twenty-eight, nine presented evidence of vasomotor instability, which some authors have accepted as evidence of nervous instability, and which at all events suggests that more careful inquiry would probably have led to evidence of this being found. The figures quoted in this series have been compiled from ordinary case notes collected over a period of four years. During the major part of this period the present inquiry was not foreseen, and no special attempt was made to elicit a history of significant symptoms. It is noteworthy that a number of the remaining twenty-eight cases were of elderly people in whose notes no evidence was afforded regarding conditions which would have been remote; sixteen of them were 65 years of age or over. There remained a small, clearly defined group of cases that fail to present features that support the hypothesis presented. These cases were in women at or after the menopause in whom adiposity was a characteristic feature. It would appear that the possibility of a different aetiology might have to be considered in this type of case.

SUMMARY

1. A hypothesis as to the causation of hyperpiesia is presented for consideration. This hypothesis suggests that hyperpiesia arises as a result of: (1) repeated mental or emotional stimuli bearing factors of "stress"; (2) the induction of Cannon's emergency reaction by such stimuli; and (3) the absence of physical struggle following the reaction. Evidence bearing on the hypothesis derived from literary references and from personal observations is reviewed.

2. The importance of the absence of physical struggle is demonstrated by a consideration of the geographical distribution of hyperpiesia. An experiment is described comprising observations on blood pressure and blood sugar after injections of adrenaline. It is demonstrated that the rise of blood pressure and blood sugar that follows an injection of adrenaline falls to normal levels much more rapidly if the injection is succeeded by vigorous exercise than in the absence of this.

3. Detailed consideration is given to the nature of the stimuli required to induce Cannon's emergency reaction in civilized conditions, and it is suggested that such stimuli either are mental stress in a life involved in heavy responsibility or arise as a result of a psychoneurosis. Vasomotor instability, which often appears to occur in the earlier stages of hyperpiesia, probably results from facilitation, and is dependent for its development on one of the foregoing factors.

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At a meeting of the New York Board of Health, on March 20th, the whole question of bathing in the tidal waters of New York City was considered. It was shown that there was as yet no agreement among sanitary authorities as to the bacterial standards which should be adopted for bathing beaches. A study of the 557 cases of typhoid fever in the city last year showed that only fifty-one of these were ascribed to bathing in polluted waters. In practically all of these cases the victims had bathed in Jamaica Bay, Gravesend Bay, or the Harlem River, areas in which the water is heavily contaminated with sewage. A report concerning the sanitary conditions and bacteriological examinations of the waters at the Bronx beaches and Orchard beach was considered. This, together with the fact that the local waters are so largely diluted with the waters of the Sound, led the Board to sanction a continuance of bathing at these beaches, at least for the coming summer. The Board directed that a determined effort should be made to control direct sewage pollution of bathing beaches generally. It also decided that sanitary and bacteriological surveys should be undertaken during the summer in order to gain more definite information as to the bacterial standards to govern the waters of bathing beaches.