him in the night, so that whatever the basis of the hysterical deafness might be, it clearly persisted during sleep, but was now no longer present. When I last saw him, on June 16th, he could carry on an ordinary conversation without difficulty. Mr. Mollison found that with the right ear, which had been previously almost totally deaf, he could now hear clearly spoken words at a distance of 18 inches, and with the left ear he could hear quietly spoken words six feet away, and a whisper at one inch. He himself has noticed that when his better ear is stopped he can carry on conversation when words are spoken slowly and clearly. At the same time his general health has greatly improved, and the noises in his head have almost disappeared. Whilst he learnt to give greater attention to sounds, he learnt at the same time to give less attention to sensations coming from his limbs, and consequently the paræsthesia of his limbs gradually disappeared.

Hysterical Hyperacusis.

The nervous individual who has a brisk auditory motor reflex which results in "jumping" at the least sound is familiar in civil life. An exaggeration of this condition was a common symptom in soldiers suffering from all forms of war neurosis which were emotional in origin. In its most marked form the patient jumped violently with sudden sounds, which could hardly be heard at all by an ordinary individual, and louder sounds produced violent universal tremors. The condition persisted during sleep, the patient showing the same exaggerated response to sounds, which did not necessarily wake him, although they generally slept more lightly than they had done before the war. The type of sound which produced this reaction was always one which was in some way reminiscent of shell explosions or other sounds of battle. Many patients realised this quite clearly in their waking state. In one severe case of the kind the patient, when deeply hypnotised, told me that he was always listening for shells, and jumped whenever a sound reminded him of them, although he had been unable to explain the symptom when he was awake.

I have already described the experimental and clinical observations which prove that the auditory motor reflex is a mid-brain phenomenon. I believe that its exaggeration in certain neuroses can be readily explained as a result of a mechanism exactly the reverse of that which leads to its abolition in hysterical deafness. Whereas in hysterical deafness the patient does not listen, a soldier who is in a state of constant terror becomes accustomed to listen for shells with abnormal concentration, and this concentration may persist when he is no longer at the front and no shells are bursting. Instead of the resistance at the synapses in the auditory tract being increased, as in hysterical deafness, it is diminished owing to the extreme degree with which the dendrites are extended. This results in an abnormally brisk auditory motor reflex, and probably also in abnormally acute hearing. We only tested the power of hearing accurately in one patient in whom the jump reflex was excessively developed. Captain E. A. Peters and I found that he could hear sounds at a distance four times as great as the average individual, which means that his power of hearing was 16 times greater than the average, as the intensity of sound diminishes inversely as the square of the distance. His acuity of hearing was most remarkable. Sentences whispered in one corner of a large room so quietly that a group of officers in the centre heard no sound at all were correctly repeated by him, although he was sitting in the opposite corner. The hyperacusis and jump reflex were quite uninfluenced by the administration of 100 gr. of bromide a day, and were only slightly reduced by plugging the ears with plasticine.

The increased resistance at the synapses in hysterical deafness persists during sleep. In the same way the diminished resistance in hyperacusis persists, as the patients wake with unusual ease in response to sounds, and also show a brisk jump reflex even when they do not wake.

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THE NORMAL BASAL METABOLISM IN MAN,

AND ITS RELATION TO THE SIZE OF THE BODY AND AGE, EXPRESSED IN SIMPLE FORMULÆ.

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THE present analysis is entirely concerned with the study of basal metabolism—i.e., the metabolism of the individual during complete muscular repose, where a period of 12 hours had been allowed to elapse since taking the last meal. The communication is necessarily preliminary in its scope. The data which have been analysed are only those in which the metabolism was determined indirectly, by measuring the consumption of oxygen in a given unit of time. The formulæ which I have established have all been derived, both in the case of males and females, from the admirable and carefully conducted series of experiments on basal metabolism by Benedict and his co-workers, and the results obtained by other observers and quoted by him. These formulæ have then been applied to the observations of other investigators in America and elsewhere. In the present communication the metabolism of newborn infants and quite young children up to an age of about 5 years is not considered, because, while there exists a relatively long series of observations upon newborn babies, there are but few observations covering the years 1–5, a gap in our present knowledge which it is hoped will soon be filled in view of its great importance.

The relation between body surface and heat production was already suggested by the French writers, Rameaux and Sarrus, in the late "thirties" of last century. In the early "fifties" Bergmann took up the same line of argument in Germany. Müntz, in France, carried out the first actual experiments definitely relating body surface and metabolism in 1880. When the "body surface" law of metabolism is associated with Rubner's name this has its justification in the fact that he was the first spokesman for this theory to support its claims with sufficiently accurate and numerous determinations. Almost synchronously Richet advanced similar views. To give a detailed account of all the arguments put forward by later investigators for and against the "body surface" law, is beyond the compass of this short note. It is only necessary here to refer to the papers of Benedict and Du Bois and their co-workers, and to emphasise the importance of the work carried out by these investigators. Briefly, Du Bois obtained greater accuracy in calculation, using the "body surface" law, by making allowance for the standing height of the individual (as shown in his body surface height charts), while Benedict and his co-workers declared against the view that metabolism was a function of the surface, and they worked out relationships based on weight, standing height and age, and showed the superiority of this method of calculation for the prediction of the basal metabolism of any given normal individual. The relationships are easily calculated from the tables published by this author.

Before discussing the results of my analysis of the various data on basal metabolism I will here state the formulæ by which I have established the relationships between basal metabolism, body weight, trunk length, circumference of the chest and age, as follows:—

(1) The basal metabolism is a function of the weight and the age, which can be expressed in the formula $\frac{W^n}{C \times A^{0 \cdot 1333}} = K_1$ where the power n is approximately 0·5 and K_1 is a constant. This formula indicates that basal metabolism is *not* a simple function of the body surface.

(2) The relation between basal metabolism and trunk length can be expressed in the formula $\frac{\lambda^n}{C \times A^{0 \cdot 1333}} = K_2$ where the power n is approximately 3/2, though more accurately in males 1·567, in females 1·597, and K_2 is a constant.

(3) The relation between basal metabolism and the circumference of the chest can be expressed in the formula $\frac{Ch^n}{C \times A^{0\cdot1333}} = K_3$ where the power is approximately 3/2, though more accurately in males 1·37, in females 1·76, and K_3 is a constant.

In previous communications formulæ have been given expressing the relationships between body weight, trunk length, and the circumference of the chest respectively, as follows:—

(4) $\frac{W^n}{\lambda} = K_4$, where the power n is approximately 1/3, though more accurately in males 0·319, in females 0·313, and the constant K is for males 0·38025, for females 0·36093.

(5) $\frac{W^n}{Ch} = K_5$, where the power n is approximately 1/3, though more accurately in males 0·365, in females 0·284, and the constant K is for males 0·662, for females 0·30213.

In all of the above formulæ W = net body weight in grammes, C = total number of calories produced in 4 hours, A = age in years, λ = trunk length in centimetres, and Ch = the circumference of the chest in centimetres. Instead of making use of the formulæ (2) and (3), it is simpler to make use of the following formula:—

(6) $\frac{W^n}{C \times A^{0\cdot1333}} = K_6$, where W = the theoretical weight in grammes calculated by averaging the weights corresponding to the given trunk length and chest measurements, which can be ascertained from the tables[1] already published, in order to save the laborious calculation of these weights.

The importance of formulæ (2), (3), and (6) becomes evident when one is dealing with persons whose weight has become abnormal as a result of disease, for it is obvious that with loss of weight a metabolism which would be definitely abnormal when calculated in relation to the observed weight might be perfectly normal when calculated in relation to the calculated weight, or vice versa. No such interference with the size of the constant K will occur if the metabolism is calculated in relation to the trunk length (2), and only to a small extent if calculated in relation to the circumference of the chest, (3), *or* what amounts to the same thing, if the metabolism is calculated in relation to the weight determined from these two measurements (6). Making use of the detailed data for weight, age, and total calories for 24 hours given in Tables C and D in Harris and Benedict's book for men and women respectively, the following constants have been determined. In the case of the males (Formula (1)) $\frac{\sqrt[2]{W}}{C \times A^{0\cdot1333}} = 0\cdot1015 = K$. In this case the observations on 16 athletes and 11 vegetarians have been omitted, leaving 109 observations for the determination of the constant. In the case of the females (Formula (1)) $\frac{\sqrt[2]{W}}{C \times A^{0\cdot1333}} = 0\cdot1127 = K$ derived from the 103 persons examined. If in the case of the males all 136 observations are made use of, the constant becomes 0·1018. In comparing the constants for males and females it is evident that, as also maintained by Benedict and other observers, the average male has a greater metabolism than the average female of the same size and age—namely, about 10 per cent. more than the female. In applying Benedict's tables to other observers' data on persons of greatly varying age, such as children, grown-up, and old persons, one is struck in some cases by the marked discrepancy between predicted and observed calorie values of basal metabolism, while in other cases prediction and observation are extremely close, and on an average the correspondence between prediction and observation is better than can be obtained by using Du Bois's surface height charts. In view of this it was of interest to see not only how close the prediction became, using the formula here given, but also to make comparison between the actual constants obtained, using the data of other observers. For this purpose the following table has been constructed:—

Investigator.	No. of persons investigated.	Description.	Average K using author's formula. $\frac{\sqrt[2]{W}}{C \times A^{0\cdot1333}} = K$	Regardless of sign. Average % deviation using formula. $\frac{\sqrt[2]{W}}{C \times A^{0\cdot1333}} = 0\cdot1015$	Regardless of sign. Average % deviation using Benedict's weight, height, age tables.	± % deviation for each group. Author's formula.	± % deviation for each group. Benedict's weight, height, age tables.
Palmer, Means, and Gamble	8	Men.	0·1037	3·70	4·40	− 2·12	− 4·40
Carpenter, Emmes Hendry, and Roth	31	,,	0·1014	5·94	5·30	+ 0·10	+ 0·46
Magnus Levy and Falk	10	,,	0·1000	5·06	5·27	+ 1·50	+ 3·71
,, ,, ...	5	Old men.	0·1045	9·90	10·36	− 2·87	+ 7·94
,, ,, ...	15	Boys.	0·1007	3·46	15·60	+ 0·79	+ 15·60
*Gephart and Du Bois	5	Men.	0·0989	6·10	7·37	+ 2·63	+ 6·75
Du Bois and Aub	6	Old men.	0·0993	8·20	19·83	+ 2·22	+ 17·80
,, ,, ...	8	Boy scouts.	0·0928	9·49	19·70	+ 9·37	+ 19·70

* In only five observations were the age and standing height given, and comparison therefore possible by Benedict's tables. The per cent. deviation for all seven observations by author's formula = 4·59 per cent.

From the above table it is readily seen how much better the agreement between prediction of metabolism and actual observation is when the author's formula is used than when Benedict's method of calculation is applied to this series of observations by different observers. It is also interesting to note that if the basal metabolism constant had been calculated from the eight series of observations, totalling 88 persons, the average constant would be 0·1004, giving a metabolism only about + 1·1 per cent. greater than the figure obtained from Benedict's and co-workers' observations. If the eight boy scouts of Du Bois and Aub are excluded, for similar reasons as the athletes (greater metabolism) were excluded from Benedict's series of men, the constant is 0·1012, a difference of only + 0·3 per cent., while these series show very marked deviations from his own observations when calculated by Benedict's method. The deviation between observation and calculation for Benedict's own series is, in the case of the males, 5·27 per cent. by the author's formula, 5·33 per cent. by Benedict's method, and 5·65 per cent. by Du Bois's method of calculation. In the case of the women the average per cent. deviations are by the author's formula 6·33 per cent., by Benedict's method 6·36 per cent., and by Du Bois's method 7·53 per cent. respectively. It should be pointed out that the deviations in the case of the author's formula will be considerably reduced if trunk length and chest circumference were considered. The actual data on this point will be published later. From the data available it is to be noted, as already emphasised by Benedict, that athletes have a greater metabolism than persons living a more sedentary life.

Conclusions.

(i.) The formula $\frac{W^n}{C \times A^{0\cdot1333}} = K$, where n is approximately 0·5 and K = 0·1015 in males and 0·1127 in

[1] "The Assessment of Physical Fitness by Correlation of Vital Capacity and Certain Measurements of the Body," by Georges Dreyer, in collaboration with G. F. Hanson. Cassell and Co. 1920.

females, expresses the basal metabolism in an extremely satisfactory manner over a wide range of body, size, and age, and indicates that basal metabolism is not a simple function of the body surface.

(ii.) By means of the various formulæ given in this paper it is possible to predict the basal metabolism of a normal person with greater accuracy than by the methods hitherto suggested.

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ON THE SIGNIFICANCE OF BLOOD AND SOLUBLE "ALBUMIN" IN THE STOOLS.

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WHENEVER a lesion of the alimentary canal is suspected an examination of the fæces for blood and for soluble "albumin," provided the tests are adequately controlled, is frequently of immense value in diagnosis and prognosis, and may give useful indications of the progress or otherwise of treatment. This paper gives a few practical points concerning the technique and the value of the tests to the ordinary clinician, who too often wholly associates fæcal examinations with complex chemical analyses only possible in a laboratory.

A. *Methods.* 1. *Blood.*

A reaction for hæmoglobin (or its derivatives) in the fæces is only of value if the diet is strictly controlled. Any possible source of hæmoglobin (e.g., meat) must be excluded; and drugs, especially those containing iron, should be withheld for some days before the test. For this purpose a milk régime is satisfactory and convenient, as the typical canary-yellow colour of the stools corresponding to the diet makes it easy to recognise whether the portion of the stool examined corresponds or not to the régime.

The question of reagents is of importance. The usual tests employed in clinical work are Meyer's (phenolphthalein reagent), Weber's (guaiacum and ozonic ether or hydrogen peroxide), and the benzidine test (either with fæcal emulsion or with a smear on a microscopic slide). A critical examination of these various tests has recently been made by Lyle and Curtmann.[1] They find that the benzidine reaction is unreliable, difficult to control, and too sensitive; that Meyer's phenolphthalein reagent is too sensitive also; and they use a new preparation derived from guaiacum as their reagent for the test.

This criticism is certainly corroborated by clinical experience. Meyer's reagent is altogether too sensitive for the positive diagnosis of an occult hæmorrhage. Its sensitiveness, however, makes a negative reaction of great importance, and enables one to rule out definitely the presence of blood. In practice it is therefore wise first to do the Meyer test,[2] and, if this is positive, to control by Weber's guaiacum test. A diagnosis of occult blood should only be made when the guaiacum test is also positive.

Description of Tests.

Meyer's test.—A small piece of fæces is taken from the middle of the stool of the milk régime and made into a thick suspension by the addition, if necessary, of a little distilled water. Fill a test-tube about a third full with this fæcal suspension, add a third of its volume of glacial acetic acid, mix thoroughly for a few seconds, and boil. Then cool thoroughly under the tap. Add about 5 c.cm. of ether, and mix very thoroughly by inverting the test-tube several times. Set aside to separate. If an emulsion forms the addition of a few drops of alcohol will usually bring about a speedy separation, and the supernatant ether layer can then be pipetted off with a teat pipette into another test-tube. To the ether extract add about 1 c.cm. of Meyer's reagent by means of a clean pipette; then add a few drops of hydrogen peroxide. If blood is present there appears immediately a deep red coloration, spreading down the tube. Only an immediate and quite definite reaction is to be regarded as positive.

Weber's guaiacum test.—An ether extract is made as above. To this add about eight or ten drops of fresh tincture of guaiacum[3] and a similar quantity of hydrogen peroxide. A definitely blue coloration, appearing within two minutes, indicates the presence of blood. A greenish or bluish-green tint is to be regarded as nothing more than "suspicious."

It is wise to do the test daily over a period of several days, as the presence of blood in the stools may be intermittent.

2. *Soluble "Albumin."*[4]

German authors have shown that the presence of soluble "albumin" in the stools is always pathological in the case of adults. Normally, coagulated protein (in the protein residues of the food) may occur in the fæces; soluble "albumins" taken in the food, however, are always digested in the course of a normal "digestive journey." Even the "albumins" of intestinal exudates are digested and absorbed with comparative rapidity, and therefore if any are found in the stools the exudation must be either great in amount or not too remote from the anus. Thus, the reaction for soluble "albumin" is applicable to the fæces of an ordinary diet, though it is wiser to carry it out on the fæces of a milk régime.

The usual technique is as follows:—

Take a piece the size of a large walnut from the middle of the stool to be examined, triturate well with distilled water in a conical specimen glass[5] to make a fairly thin emulsion. If the stool is fluid a certain amount can be put straight into the conical glass. Set aside for at least an hour, and then pour off about 20 c.cm. of the supernatant fluid into a suitable vessel, centrifuge the fluid if possible, and then filter; otherwise filter through filter paper previously wetted and plugged at the point of the cone with a little Kieselguhr. Two or three filtrations will probably be necessary before a clear filtrate results, and the filtration is usually slow if the fluid has not been previously centrifuged.

Take 10 c.cm. of this clear filtrate, add 1 or 2 drops of 1 per cent. acetic acid, and if there is any turbidity cautiously add acid drop by drop until the maximum turbidity develops. Then filter until a clear filtrate results. Take some of the filtrate and boil. A heat coagulum indicates the presence of soluble "albumin."

This test is somewhat tedious, and the optimum acidity for both "neutralisation precipitate" and for heat coagulation is often troublesome to obtain. A modification which simplifies the test, and which I have tried with some convenience in a few cases, is the following:—

Take about 10 c.cm. of a fairly clear filtrate from the original fæcal emulsion and add an equal volume of a saturated solution of ammonium sulphate. Filter. The fluid filters more quickly than by the previous method. It may still be necessary to use a little Kieselguhr. Boil the filtrate, carefully adding 1 per cent. acetic acid drop by drop. A coagulum indicates the presence of soluble "albumin."[6]

B. *Clinical Findings.*

Tests for blood and soluble "albumin" have been carried out upon a series of 156 patients suffering from gastro-intestinal troubles. Not many gastric cases are included; a majority of the cases occurred in a hospital in France, of which unfortunately notes are available only in the intestinal cases. In all the cases the "albumin" was tested for by heat coagulation in the presence of acetic acid.

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[1] Lyle, Curtmann, and Marshall: Journ. Biol. Chem., 1914, xix., 445. Lyle and Curtmann: Ibid., 1918, xxxiii., 1.

[2] Meyer's reagent is made up as follows: Phenolphthalein 2 g., anhydrous KOH 20 g., distilled water 100 c.cm. Dissolve and add zinc powder 10 g. Boil. The decoloration should be complete in ten minutes. If not, add cautiously a little zinc powder until decoloration is complete. Filter while hot. Keep in the dark with a little zinc powder in the bottom of the bottle.

[3] Except in laboratories, it is best to keep some guaiacum resin, and make up fresh tincture each time it is needed. This is done by dissolving a small fragment of the resin in 2 or 3 c.cm. of 90 per cent. alcohol.

[4] A more accurate term would be "coagulable protein."

[5] A "Gourmet" egg-beater is most useful for this trituration. It consists of a porcelain cylinder, into which fits the beater—a perforated disc attached at its centre to the end of a long handle.

[6] This modification, suggested to me by Professor Ramsden, lessens the sensitivity of the test by precipitating part of the coagulable protein; but in ordinary clinical work the immense saving in time and trouble probably more than compensates for this.