

DIAGNOSTIC VALUE OF BLOOD SUGAR CURVES IN NEUROLOGY *

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This study was begun with the idea of ascertaining whether characteristic sugar curves were found in instances of suspected glandular anomalies, for the purpose of differentiating one type from another through the curve characteristics. The only thing of value discovered was a low sugar curve and an increased tolerance in some cases in which dysfunction of the pituitary was evident. In such instances the diagnostic value of the curve was of little importance when contrasted with other symptoms and findings. As this work went on it became evident that some other factor was present which produced curves of a distinctly abnormal kind in cases which showed no clinical evidence of glandular dysfunction. This element by exclusion was thought to be some kind of mental anomaly associated with or originating from emotional abnormality. Of particular importance in this early series of cases were states of anxiety, fear, apprehension, repression and conditions to which the term depression was given. In many instances a high sugar curve was found. There was nothing in cases of this kind to cause a deviation from the normal except the mental state. General and neurologic findings in these patients were uniformly negative. The curves were tabulated as a possible aid in differential diagnosis. About this time F. H. Kooys' article on "Hyperglycemia in Mental Disorders" came to my attention. The significant point in this paper is the conclusion that the emotional state is responsible for the altered types of curves, no matter what particular type of disease the patient clinically presents. This conclusion appeared to confirm the observations made in our early preliminary series.

The study of sugar curves was then extended for the purpose of answering several questions naturally arising:

1. Are characteristic types of curves found in certain diseases and not in others?
2. Have these curves any diagnostic value?
3. Is emotion in a broad sense the factor of consequence?
4. Are sugar tolerance studies of sufficient value neurologically to make the procedure routine in all cases?
5. Have blood sugar curves any prognostic or therapeutic value?
6. What physiologic and chemical mechanism produces such curves?

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In order to answer these questions an unselected series of neuropsychiatric cases were studied in reference to sugar tolerance curves. From these were excluded those in which sugar values might be influenced by other than neurologic factors. Diabetes, acute infectious diseases, thyroid abnormalities, gastro-intestinal diseases, hypertension, etc., were excluded. About 150 instances fell in the category of primary neurologic cases, and these form the material on which this study is based. An analysis of this material shows that it includes all the ordinary neuropsychiatric diseases such as might be admitted into the neurologic service of a general hospital. Thirty-eight were frankly psychoses; that is, cases in which the mental symptoms dominated the picture. The neuroses are next in number; then come epilepsies, brain

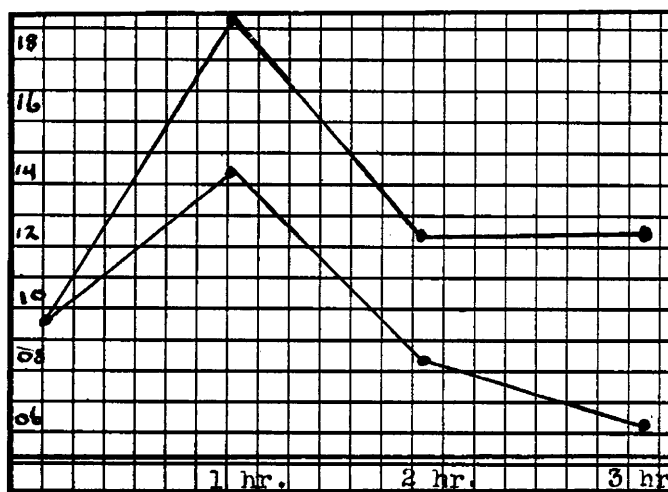


Chart 1.—Normal blood sugar curves preceded by twelve hours of fasting; findings given at the end of one, two and three hours.

tumors, cerebrospinal syphilis, encephalitis and other types of organic nervous diseases. These cases were all studied under hospital conditions and were put through the neurologic routine usual in the neurologic service of the Barnes Hospital. The laboratory work was carried out under the direction of Dr. Olmstead, head of the metabolic ward of the hospital. This work was done under exactly the same conditions, so far as technic was concerned, as was used in the study of a series of cases published by him recently under the title of "A Study of Blood Sugar Curves Following a Standardized Glucose Meal." This paper is referred to for the laboratory technic and methods. Attention should be called to the fact that in this series of cases two methods of sugar determination were used—Meyers and Bailey's modification

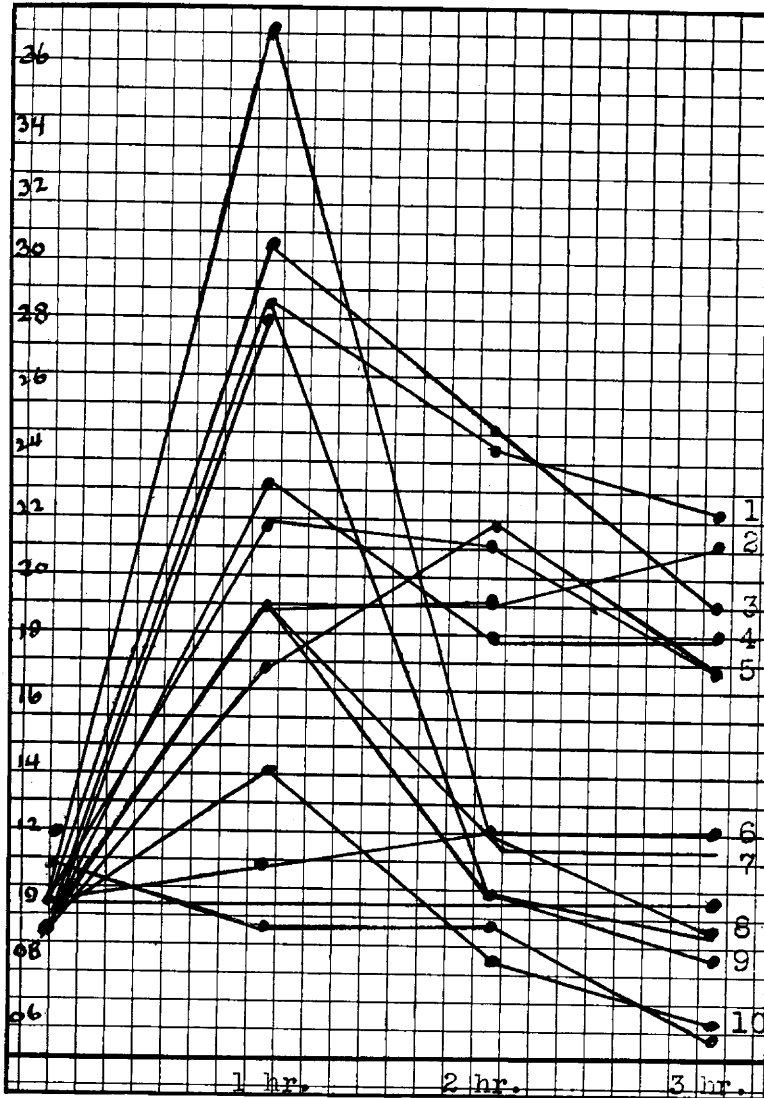


Chart 2.—Blood sugar curves from a group of patients with psychoses after twelve hours of fasting. 1, manic-depressive cases; 2 and 6, dementia praecox; 3, toxic disorientation; 4, psychosis (hallucinoses); 5, senile psychosis; 7, deterioration; 8, depression (paranoid); 9, organic dementia; 10, depressed state (suicidal).

of the Benedict and the Hartman-Schaffer; one is a calorimetric and the other a trituration—an iodometric. Although there is a difference in the amount of sugar percentage obtained, the Hartman-Schaffer giving a consistently higher value, the characteristics of the curve are not altered. The typing of curves, therefore, can be used without reference to the technic employed. In the series of cases here studied a normal curve was first obtained as a laboratory standard and a clinical control by the study of five normal persons and a series of about forty patients in the hospital who showed no demonstrable cause for disturbed glycolytic function. These curves agree with those of

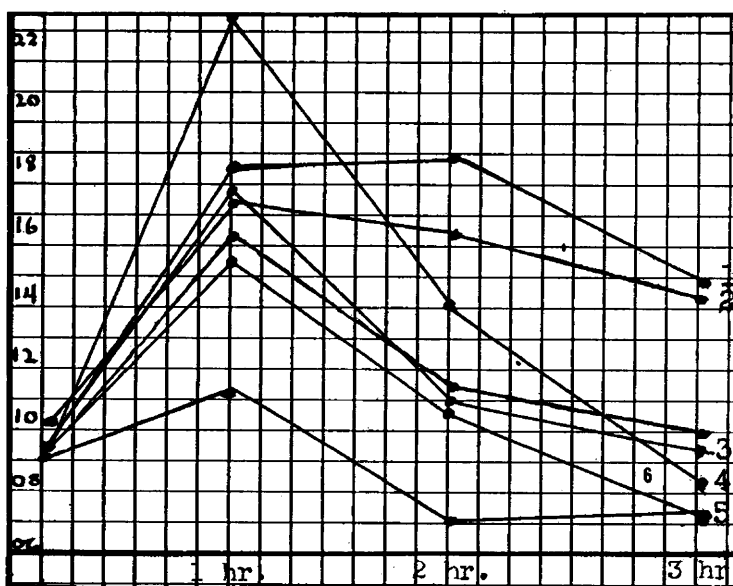


Chart 3.—Blood sugar curves from a group of patients with neuroses after twelve hours of fasting. 1, 4 and 5, hypochondriasis; 2, psychasthenia; 3, neurasthenia; 6, hysteria.

other observers. Figures for the normal curve are as follows: After a twelve hour fasting period the blood sugar shows a variation from 0.09 to 0.1; after one hour from 0.14 to 0.19; after the second hour from 0.08 to 0.12; after the third hour from 0.06 to 0.12 per cent. All curves which deviated in any considerable manner from these normals were regarded as atypical. In the study of abnormal types of curves particular attention was directed to two variations. First the high sugar content after the first hour; second, the sustained elevated curve and the low sugar value throughout the three hours. These represent the three extremes on which a diagnostic value might

be based. The initial hyperglycemia after fasting was considered of physiologic interest only, as was its opposite—a low one; that is, a hypoglycemia. Minor variations of all sorts which altered the normal appearance of the curves were not taken into consideration.

In the group of the psychoses twenty out of thirty-eight cases showed distinctly abnormal curves. These were shown by two things—an initial rise far beyond the normal and a sustained rise beyond

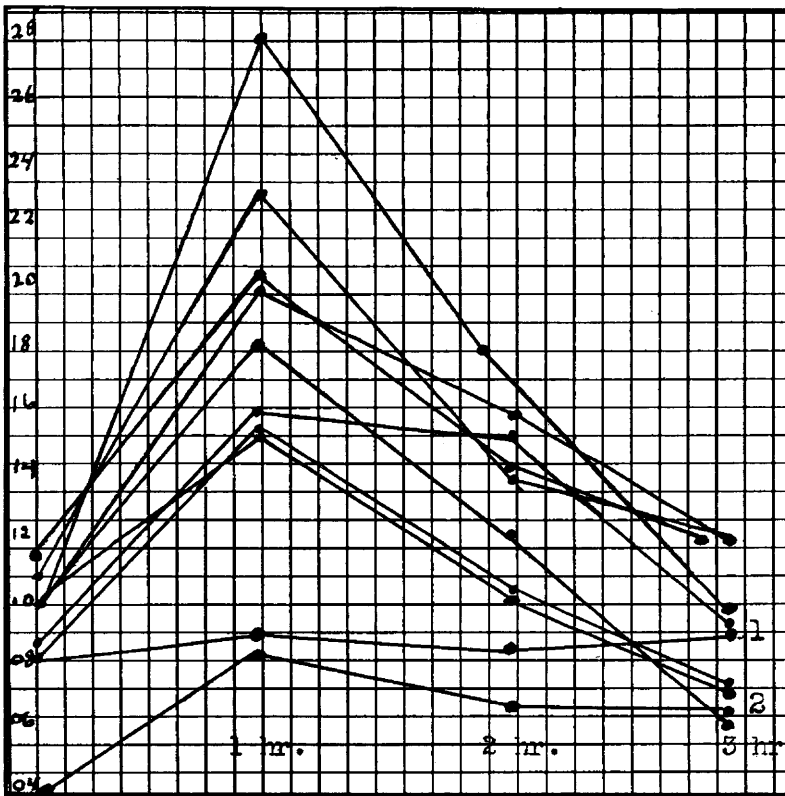


Chart 4.—Blood sugar curves from a group of patients with epilepsy after twelve hours of fasting. 1, postepileptic stupor; 2, pituitary disorder.

the second hour and often no return to the normal level. It is significant that the type of curve had absolutely no relation to the clinical picture presented; that is, there was no curve which might be said to represent, for example, dementia praecox, or manic depression, or any other condition. The patients who presented clinically a dull, apathetic, anxious, or depressed state seemed to show on the whole the most definite sugar value deviations. No diagnostic value other than this could be obtained.

In the neuroses group of twenty-five cases few abnormal curves were found. Six curves were definitely considered abnormal; two of these should be excluded on account of complicating factors. Of the three remaining, two were in marked cases of hypochondriasis in which the anxiety elements were pronounced. This is of some interest as it supports what has been previously pointed out—that of all the neuroses this type approaches more nearly a psychosis in mechanism.

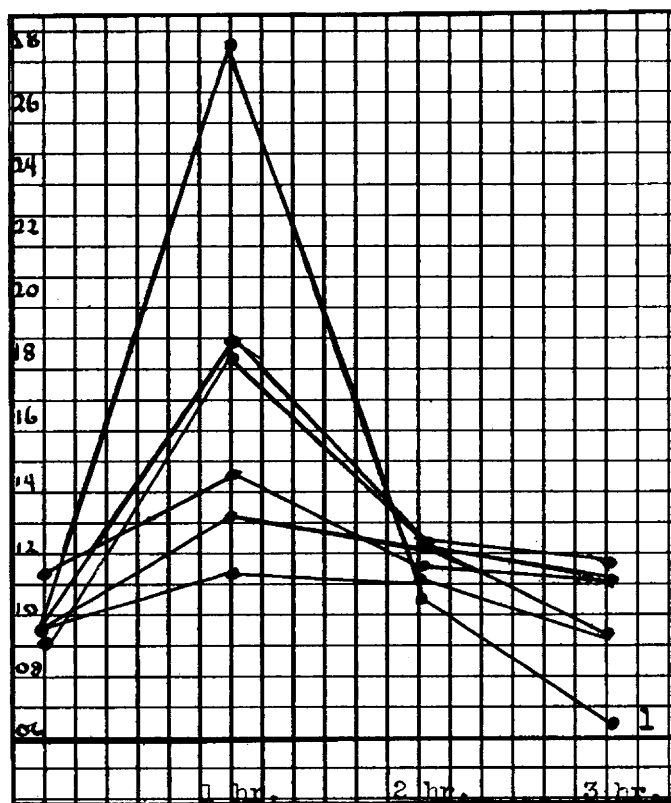


Chart 5.—Blood sugar curves from a group of cerebral tumors after twelve hours of fasting. 1, mental symptoms.

Practically no case of hysteria showed any abnormal curves. In the group of patients with syphilis of the nervous system no abnormal curves were found except in instances in which definite psychotic symptoms were present. The group with paresis showed no abnormal curves. In almost all forms of epilepsy the curves were normal, with the exception of one or two instances in which there were marked mental symptoms. The curves in cases of brain tumor, other than the two instances

in which there was evidence of mental symptoms, were normal. The remaining cases of organic nervous disease cannot be classified in respect to curves. They showed nothing that could be in any way connected with the particular disease in question.

Certain conclusions are fairly obvious, and I believe that the series itself is comprehensive enough to give a broad point of view on which the value of this procedure might be based. The abnormal types of sugar curves were found chiefly in the psychoses. Their occurrence in the neuroses is too uncertain and too scattered to be seriously considered. Organic diseases of themselves do not affect the sugar mechanism sufficiently to alter the curve value; if it is affected, an additional factor has entered into the case. Whenever anomalous curves are

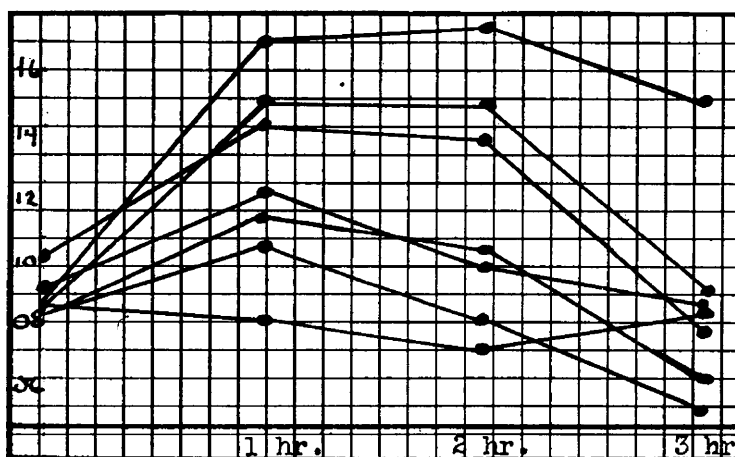


Chart 6.—Blood sugar curves from a group of patients with epidemic encephalitis after twelve hours of fasting.

found outside of the psychoses there is evidence also of an abnormal mental state, usually one in which there is no adequate muscular outlet. States in which there is a good deal of excitement or restlessness do not show an abnormally high curve. Unusually excited patients are not included in this series, as they are not commonly admitted to the neurologic service at the Barnes Hospital. The low curves seen in hypopituitarism or hypothyroidism are of little significance in material such as this, because the neurologic symptoms here present are not primary. The participation of these glands, as well as of the thyroid gland, in abnormal mental states is a matter in which so much confusion of opinion exists at the present time that no adequate conclusion can be formed.

It is believed as a result of a consideration of these curves that it is impossible to attach characteristic types of curves to one type of disease. This refers to the psychoses as well as to other types of nervous and mental disease; that is, there is no specific diagnostic value in any one type of curve. The most that can be said is that the group of psychoses as a whole shows by far the largest percentage of abnormal curves, and that in other diseases of the nervous system, whether

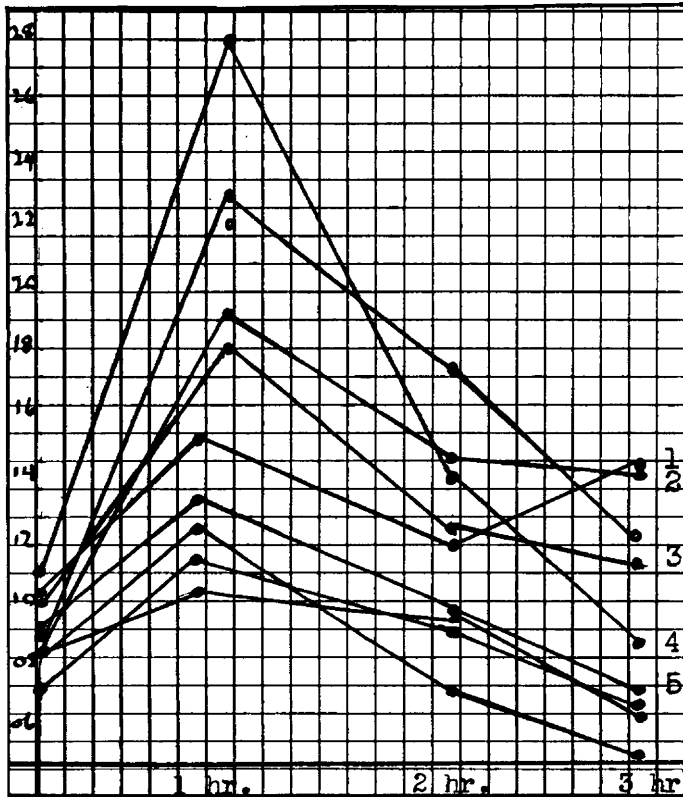


Chart 7.—Blood sugar curves from a group of patients with cerebrospinal syphilis after twelve hours of fasting. 1, dementia praecox; 2, 4 and 5, paresis; 3, tabes.

organic or not, in which atypical curves are found, the most reasonable causative factor seems to lie in the kind of mental reaction that is present.

Sugar curves have no important differential diagnostic value. The one factor that seems to stand out as a causation in the modification of sugar curves is emotion, or rather in a broad sense, the emotional factor in the patient's abnormal mental processes; that is, states of

primary depression, anxiety, apathy, unconscious conflict processes appear to be the states in which high sugar curves are almost universally found. The purely intellectual defects, such as are seen in paranoid states, do not seem to produce abnormal types of curves. On the whole it might be said that deteriorating processes or secondary dementing processes do not of themselves cause abnormal sugar values in the blood.

Sugar tolerance studies are not believed to be of sufficient value neurologically to make this procedure routine in all cases. The whole technic is difficult to carry out; it is time consuming, often disagreeable to the patient. Therefore, cases should be selected in which the type of sugar curve might prove of some value. Just what this value might be is somewhat difficult to say at the present time, but it is possible

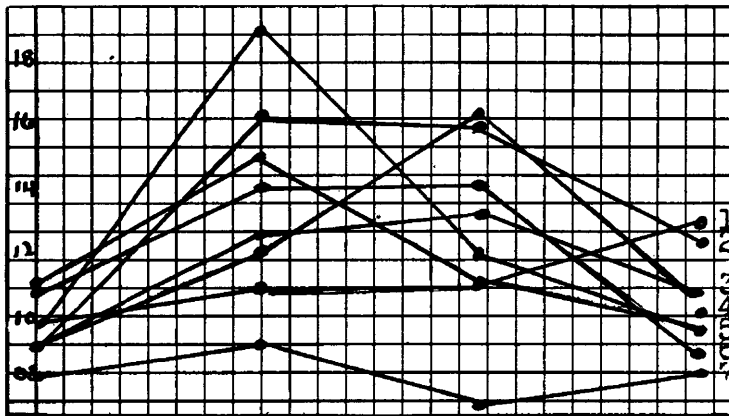


Chart 8.—Blood sugar curves in a group of patients with miscellaneous diseases of the nervous system after twelve hours of fasting. 1, arteriosclerosis (pontile hemorrhage); 2, Meniere's disease (otitis hemorrhagica); 3, neuritis; 4, cerebral hemorrhage, paralysis agitans; 5, dystrophy muscularis; 6, old hemiplegia; 7, trigeminal neuralgia.

that it might be used in differentiating cases in which it is important to find out whether the whole picture is primarily an emotional one or in which the emotional reaction is purely secondary. This would refer particularly to the neuroses in which the patient is in a borderland between neuroses and psychoses. Even here the value of this procedure might be questioned.

Blood sugar curves have no prognostic value, and their change in type cannot at the present time be interpreted as a proof of the effectiveness of therapeutic procedures.

The physiologic and chemical mechanism involved in the production of these abnormal curves is still a matter of debate. The theories

which have been advanced to explain them revolve chiefly around the original ideas of Cannon as a result of the various experimental studies on emotional glycosuria. The chemical factor that has shown the most definite causative influence is the increase in epinephrin. Even this fact has been disputed. The biologic significance of emotion in the production of abnormal mental states seems to be supported, however, by a study of this kind, and the fact that there is almost a constant increase in blood sugar values in emotional states that are organized into a picture of the psychoses seems to stand out clearly. Kooy has advanced the theory of the importance of the primitive emotional states in certain types of mental diseases. His conclusions in this regard appear to be amply substantiated by the results of the study herein recorded. The real value of his observation and of a wider study of blood sugar curves in psychoses is apparent. It may mean eventually that the nondegenerative types of psychoses associated with depression will be viewed from a biologic point of view as a return to primitive emotional states in which the increase of glycogenic function serves the definite purpose of supplying increased muscular energy in carrying out maneuvers for the protection of the individual. In the static conditions represented by the inhibiting influence of emotionalism seen in depressed and anxious states, the glycogenic mechanism provides an increased ability to keep sugar in the blood preparatory to the expected muscular overaction in maneuvers of flight, concealment and other protective measures.

DISCUSSION

DR. SMITH ELY JELLIFFE, New York: With regard to Dr. Schwab's statement that no precise diagnostic value is gained from these studies, I should like to ask him whether he would not use a different phrase, stating that there is no value for presently accepted diagnostic criteria. All observations are of value, and the only point of view is that the findings which he has narrated to us cannot yet be fitted into the imperfect schemes of diagnostic nosologic conceptions that we now have. There will come a time when our present unsatisfactory nosologic conceptions will be of great importance.

DR. WALTER TIMME, New York: Dr. Schwab's conclusions are practically similar to those that most of us have obtained through a long and wide experience.

A sugar curve taken per se, without any other observations, has about as much value as the temperature alone, and the diagnosis of a patient's condition from it, the pulse rate or any single factor is impossible. In order to be of any value it must be taken in connection with many other conditions which the patient presents. Under such conditions one can possibly go a little further into the diagnostic values of the sugar curve. It perhaps bears the same relationship to the patient's condition that a metabolic study does, being valueless in diagnosing the patient's condition unless all the factors at the time of the experiment are taken into calculation.

To name one or two specific instances, a blood sugar curve must be interpreted in relationship to the point at which it begins, which is the original

blood sugar content. A patient whose sugar content is 0.09 and who has a rise in the sugar curve is entirely different from the patient who begins with a 0.06 sugar content and has a similar type of curve.

The so-called psychoneurotic patients and the army patients with neuro-circulatory asthenia usually show a low sugar content as the first sign of disease. The slightest emotional disturbance will make the sugar content rise tremendously during the first and second hours and, depending on the character of the case and its compensations, it will go down.

Likewise the hebephrenic type of dementia praecox begins with a low sugar content, with a lower curve than the neurocirculatory asthenias, but with a fairly high sugar curve. The blood sugar curve must be taken in connection with other factors before a diagnosis can be determined.

DR. SCHWAB, in closing: In reply to Dr. Jelliffe's comments, my point is that at the present time we do not have sufficient differential diagnostic knowledge or information to make these things valuable.

All of the cases were studied with great care. I did not include clinical reports in this paper. All of the cases were examined in conjunction with the internal medical department of the hospital from every point of view, over quite a long period.

I excluded from the series all those instances in which the sugar curve might be influenced by other factors. This does not include any cases of cardiac disease, effort syndrome or diabetes. They were a group of neuropsychiatric cases studied primarily from the point of view of determining whether this procedure was valuable in a hospital study of the case. The initial hyperglycosemia was carefully considered in all of the cases, but it was of no value because of the variation which could not be interpreted. We have a curve as low as 0.04 in a person who had otherwise a perfectly normal case.

We found the highest blood sugar value in a young married woman, who had a fixed sensation of sweetness in her tongue and mucous membrane and was always haunted by a sensation of tasting sweet things. The initial first hour curve went up to 0.38, which was one of the highest initial curves, and the case was eliminated because of impossible differentiation from a diagnostic point of view.