Dr. Murdoch: I will answer that by asking Dr. Patterson whether insanity is increasing or decreasing.

We have no statistics from which we can give a definite answer to either question.

Dr. Kilbourne: Most epileptics are very religious, and many carry their Bible with them, perhaps with an ambition to become theologians.

Mr. Swendsen: What do you think about that, Dr. Henry?

Reverend Henry: I will just say that in the beginning of my work here almost every patient insisted on shaking hands at the close of the service. Now I leave first and go on my way.

Mr. Swendsen: We are highly honored here this afternoon by having with us Dr. Wheeler, of the Mayo Clinic. Dr. Wheeler will give us a "Report of Survey of Incidence of Seizures in Epileptics," with stereopticon views.

The Doctor has done some research work in this institution, and the superintendent, Dr. McBroom, is very well acquainted with Dr. Wheeler's work here. I wish he would tell us what she has done with regard to research work.

Dr. McBroom: Dr. Wheeler volunteered to do this work, and we have had the most enjoyable contact for almost three years. She has carried on this work on her own hook, has paid regular visits to the institution to study our records, and has made a survey of the incidence of the seizures of all patients in this institution covering a period of three years. Her results will speak for themselves, but I think it is a forerunner of a very important thing in epilepsy.

Up to the present time we have had kind of a haphazard classification of the epileptics. We have had the group which had daylight seizures, patients who had only nocturnal seizures, and the diffused type. The nocturnal case would run along for a time, then would have seizures in the daytime, and finally would come into the diffused group.

Dr. Wheeler has made graphs and is now working in Illinois and Wisconsin. The result is very, very striking, showing the incidence of seizures in the different patients. It also brings out the fact that it seems as though the great majority of epileptic patients have either an inherited or acquired predisposition to a rhythm of seizures. They sometimes have periods of quiescence and again periods of frequency.

I heard Dr. Wheeler read this paper at Toronto and it brought forth a great deal of favorable comment.

Mr. Swendsen: It gives me great pleasure to introduce Dr. Wheeler.

31-GRI-TNW

GRAPHIC REPRESENTATION OF INCIDENCE OF SEIZURES IN EPILEPTIC PATIENTS

Theodora Wheeler, M.D., Rochester, Minnesota

During the year 1928 the Minnesota State Board of Control sponsored, for a number of months, an experiment on the effect of a ketogenic diet on a small group of epileptic patients at the Cambridge State Colony. The Mayo Clinic cooperated in this work, Drs. R. M. Wilder, H. W. Woltman and C. J. Barborka being interested in various features of the investigation. A graduate student dietitian, Miss Dorothy Proud, presented a description of a number of technical dietary aspects of the problem as a thesis in partial fulfillment of the requirements for the degree of Master of Science at the University of Minnesota, in September, 1929. She had been in residence at Cambridge for six months, and at the University of Minnesota and at Rochester for a similar time. Dr. Kuhlmann's staff had already given mental tests to many of the patients. As a result of his continued interest, and through this the cooperation of the Minnesota Institutions' Division of Research, this initial testing was completed, and later retesting was carried out on both experimental and control groups of forty-eight patients.

In the course of this study I was requested to plan a critical background which would help in an evaluation of the findings. As it was hoped to continue the work over a long period, it was thought desirable to collect somewhat full clinical, neurologic, psychiatric and psychologic data. However, as the experiment as first planned was found too expensive for long continuation, a considerable part of the clinical and psychologic program was not completed.

From among a large number of record sheets gathered at that time, interest has developed in a calendar chart of proved usefulness. This consists of an ordinate-abscissa hour-day chart covering a year's time. I adapted this from a pre-existing business form so that it illustrates many characteristics of each patient's seizure for one year. This chart gave such visual assistance in the study of epilepsy that Dr. McBroom made available for record, by this method, the daily ward observations of 136 patients who were inmates of the Cambridge Colony during the years 1928, 1929, and 1930. As a result of the practical help obtained from these charts, in January 1931 Dr. McBroom incorporated their use as part of the recording system at the Cambridge Colony. This chart is 12x14 inches in size, and it is arranged with 365 fine perpendicular lines representing the days of the year. The lines indicating each fifth day of the first twenty-five days of each month are slightly heavier, and those at the end of each month are decidedly heavier. Horizontally the chart is ruled in twenty-four prominent lines, representing the hours of each day; finer lines represent each interval of fifteen minutes. To facilitate plotting and reading, more heavily drawn lines identify 6 a. m., noon, and 6 p. m. This chart with its many fine lines could not be satisfactorily reduced for representation in this Journal, but a simplified form is shown in Figure 1. To plot a record of a patient's seizures, the symbol x is used for a major seizure and a dot for a minor seizure. These are placed on

each patient's chart to indicate the time (to the nearest fifteen minutes) of every seizure occurring in each twenty-four hours. For yearly summaries of the data two projections are found useful, one below the abscissa, and the other to the right of the ordinates. The incidence of seizures by day is shown by a vertical line directly underneath each day on which one or more seizures occur. These lines form a striped ribbon which resembles a spectrum, and may be called the "year-day seizure spectrum." The distribution of seizures according to hours is obtained by projecting the time of each seizure as a short line on the right-hand margin of the sheet. Thus arranged, these lines show clearly the different prevalences for the day and for the night and the special hour "peaks" which have long been recognized in the literature of epilepsy.

I feel that for concise reference emphasis can most usefully be laid on two aspects of the details obtained from such charts; (a) the number of days in the year on which seizures occur, and (b) the number of days in the same year on which more than one seizure occurs (seizure succession, Oppenheim). By using the former figure as numerator and the latter figure as denominator, a characteristic fraction can be given to each year's record for each patient. For further statistical analyses additional factors could be combined with this fraction. Thus the total number of seizures in a year, their grouping according to hours, their monthly or weekly average number, or many other factors, could be added or subjoined in some systematic fashion.

The present study gives examples of the three-year sequence of seizures of twelve patients, selected from the group of 136 patients at Cambridge whose records were charted from 1928 to 1930. On the first of June 1931 a somewhat longer descriptive presentation was given as a "Preliminary Report on the Graphic Representation of the Incidence of Epilepsy," at the Convulsive Disease Section of the American Psychiatric Association's eighty-seventh annual meeting at Toronto, Canada. I expect to continue these records and later to give an extended statistical account of the features they disclose. The patients chosen for this study suffer from mild or moderately severe manifestations of the disease; they have seizures on less than one hundred days in each year. Only one illustration of a higher incidence (Figure 14, A. L. 1929– $\frac{147}{49}$) has been selected, and that with the particular purpose of showing how the chart can be adapted to study the special time relationships of multiple seizure phenomena by the addition of a series of vertical projections. Rather full protocols for the first two patients' records (Figures 2 and 3) have been made, although the charts are largely self-explanatory. The later charts (Figures 4 to 14) receive only brief comment, either in the text or with the figures

Figure 2. G. B., f., aged 13 years. 1928– $\frac{5}{3}$, 1929– $\frac{2}{0}$, 1930– $\frac{6}{2}$.

This patient showed a low incidence of seizure for each of the three years. Three of the five 1928 seizure days showed more than one seizure. The first succession was in the first week of January, when the patient

had eight major convulsions between 5 a. m. and 10 a. m. A few days later a minor seizure occurred near 10 p. m. Soon after the middle of the month there was another seizure succession, not so severe as the first one. This commenced near 2 a. m. as petit mal, and was followed by two major seizures, one occurring near 3 a. m. and the other near 8 a. m. There were no more seizures throughout the year until about the middle of December. On the fifteenth of that month a major convulsion occurred near 11 p. m., and a day later there was a minor seizure at 2 a. m., followed in five hours by a major seizure. In 1929 there was a total of two seizures, a minor at 4 p. m. on January 7, and a major on May 22 at 10 a. m. In 1930 seizures occurred on six days; minor seizures on March 31 and April 5. September 19 a seizure succession occurred, beginning with a major at 3 a. m., followed during the next eight hours by some fourteen minor seizures. On November 29 there were four minor seizures at 4, 7 and 9 a. m. and at 3 p. m. Then, on December 8 and 14, single minor seizures occurred near 11 p. m. It may be noted that the majority of seizures occurred between midnight and noon, though there were a few in the afternoon and evening. In this three-year record convulsions did not occur between 6 p. m. and 9 p. m.

Figure 3. C. B., m., aged 42 years. 1928– $\frac{4}{0}$, 1929– $\frac{8}{3}$, 1930– $\frac{8}{1}$.

This is the record of a patient whose seizures over the three years averaged less than one in each month. In 1928 there was one seizure during February; there were two in March and one in June, with no seizure succession day. In 1929 there were eight seizure days in all, occurring during the months of May, July, August, September and December. During 1930 there were seven seizure days, not more than one occurring in any month. In April the seizure day was also a seizure succession day with two convulsions, a major at 7 a. m. and a minor at 10 a. m. During the three years the majority of seizures occurred between noon and 6 p. m., though almost every hour was represented. There were fewest seizures around midnight.

Figure 4. I. W., f., aged 42 years. 1928– $\frac{56}{14}$, 1929– $\frac{24}{3}$, 1930– $\frac{9}{0}$.

This patient showed an intermittent, decreasing, three-year seizure record, with most of the seizures of major type; there were four extended remission periods of from two to seven months' duration. In 1928 there were two seizure "peaks," one between 6 and 8 a. m. and the other between 2 and 5 p. m., while in 1929 and 1930, with smaller yearly totals, most seizures occurred in the afternoon.

Figure 5. F. D., f., aged 22 years. 1928– $\frac{37}{7}$, 1929– $\frac{24}{10}$, 1930– $\frac{28}{10}$.

During the first year and a half the majority of this patient's seizures occurred at night. During the last week of July 1929 status epilepticus supervened, with a total of 111 seizures in seven days. Following this there was complete remission of seizures for seven months. They commenced again in May 1930, starting in the late afternoon and evening; over the next eight months they extended gradually throughout the daytime.

Figure 6. V. B., m., aged 21 years. 1928– $\frac{63}{37}$, 1929– $\frac{36}{13}$, 1930– $\frac{60}{17}$.

The feature of this record was the absence of seizures during the first part of 1928 and 1929, and the frequent seizures during the latter part of these years; whereas in 1930 the seizures were spread more evenly throughout the year.

Figure 7. E. J., f., aged 42 years. 1928– $\frac{49}{21}$, 1929– $\frac{63}{26}$, 1930– $\frac{55}{24}$.

This patient showed throughout the three years a marked tendency to have seizure successions for three or four days, followed by remissions for three or four weeks.

In this brief presentation the relative severity of the disease and its variations from year to year have not been analytically considered. One may call attention to the fact that more than four-fifths of the patients had seizures on less than 100 days a year,* and that in most instances the numerical shift in yearly total of seizure days for each patient was small; in less than one-fifth of the entire 272 instances of year-to-year progressions was there a greater difference than twenty-five days. With regard to age distribution, it may be noted that this ranged between nine and eighty-two years, slightly over half of all patients being between eleven and thirty years of age. These findings need not be interpreted as representing general characteristics of epilepsy among patients of state institutions. Most of these patients had been transferred to Cambridge from the older institution at Faribault, and had been selected because they were individuals with moderate grades of epilepsy, and hence thought to be good risks for change to a new environment.

The data available on the charts suggest many problems of prognosis, such as spontaneous remissions or expected mortality. But consideration of such questions is necessarily deferred until the accumulation of further evidence provides sufficient material for rigid statistical treatment. Owing to the many possibilities of error in the observation and recording of the data here considered, judgment regarding the general reliability of the method must be reserved. At Cambridge special effort is being made to have records of seizures as complete as possible, and particularly to watch for petit mal and nocturnal seizures.

In the United States today there are probably several score or more of public hospitals and colonies where constant effort is made to keep accurate records of the time of occurrence of each patient's seizures. It is not unreasonable to hope that this condensed graphic chart, effectual as it is in presenting many time relationships of a year's seizure incidence for the individual as well as for groups of patients, will stimulate increased interest in observation and in the making of records.

*Foot-note—All individuals in the group of 136 patients except 23, and all patients whose charts are shown here, received from three-fourths to 3 grains of phenobarbitol daily during the three years.

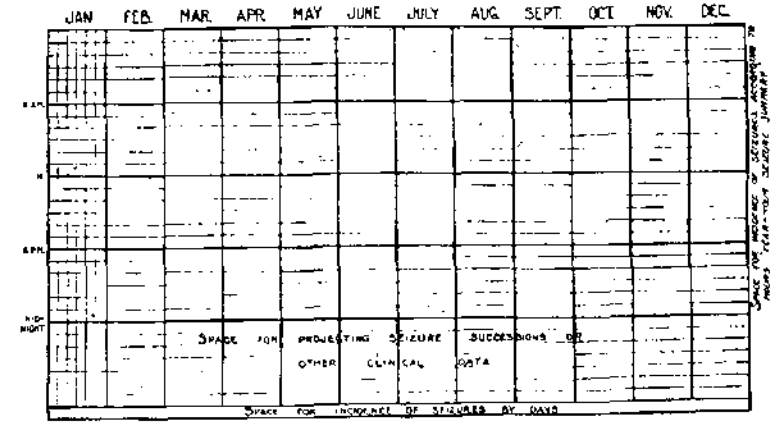

Figure 1. Simplified reduction of Minnesota chart for recording seizures of epileptic patients.

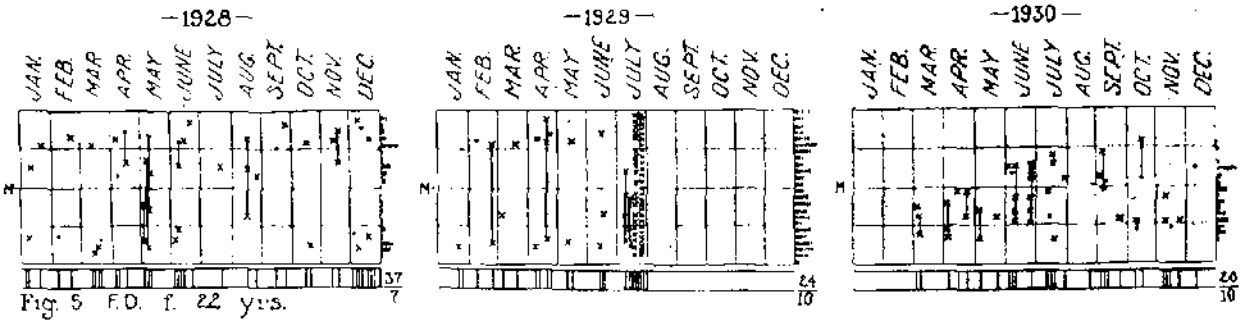

Fig. 5 F.D. f. 22 yrs.

Fig 6. V.B. m 21 yrs

Fig. 7. E.J. f. 42 yrs.

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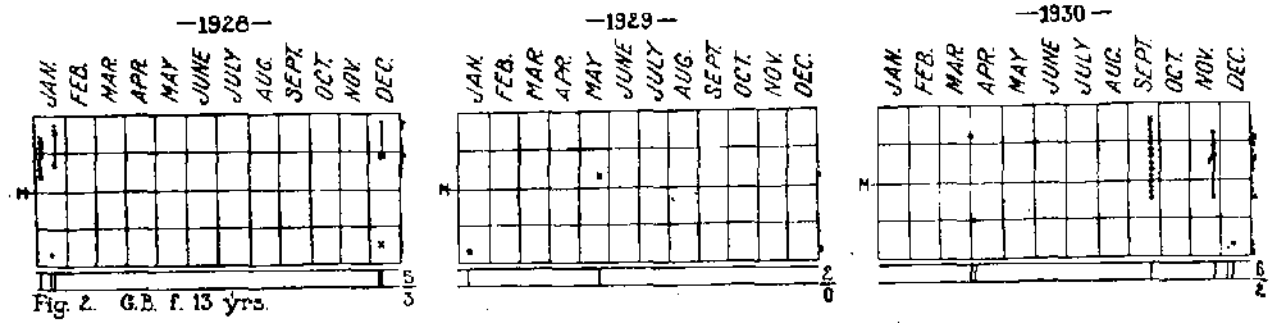

Fig. 2. G.B. f. 13 yrs.

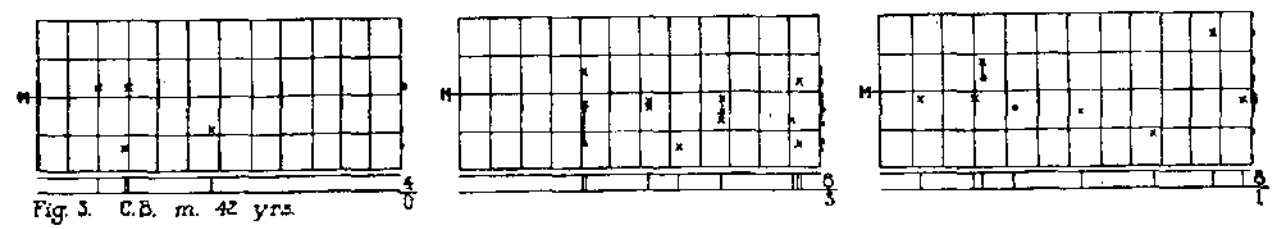

Fig. 3. C.B. m. 42 yrs.

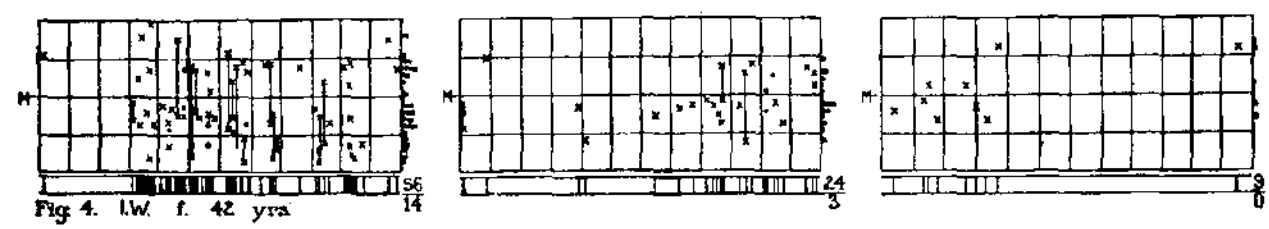

Fig. 4. I.W. f. 42 yrs.

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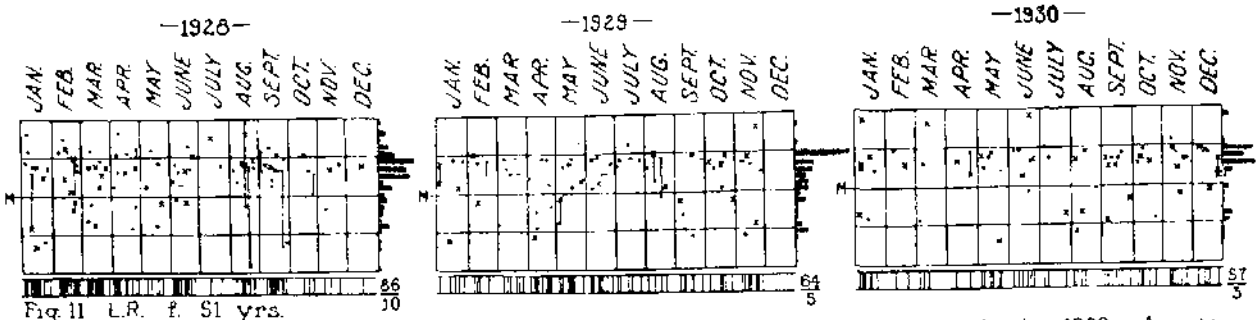

Fig. 11 L.R. f. 51 yrs.

Morning seizure prevalency all three years — definite arched lower margin in 1929 — Apr. to July narrowing of hourly seizure spread — Aug. and Sept. reversed process.

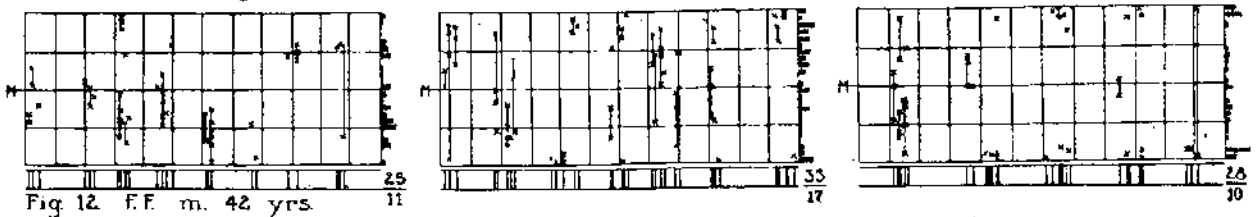

Fig. 12. F.F. m. 42 yrs.

Irregular alternating day and night seizure cycles - 2-5 month swings

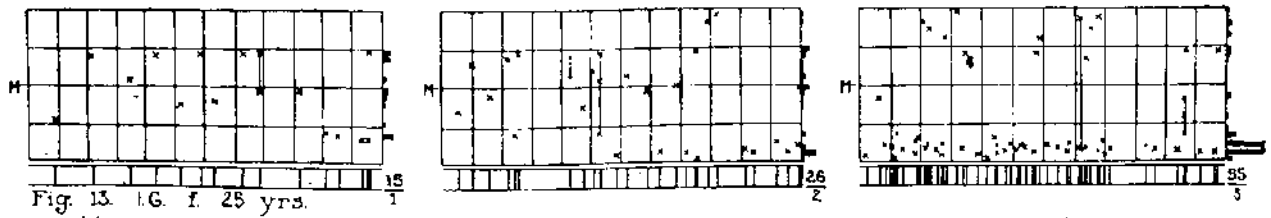

Fig. 13. I.G. f. 25 yrs.

Alternating day and night seizure prevalencies - 18 month exchange

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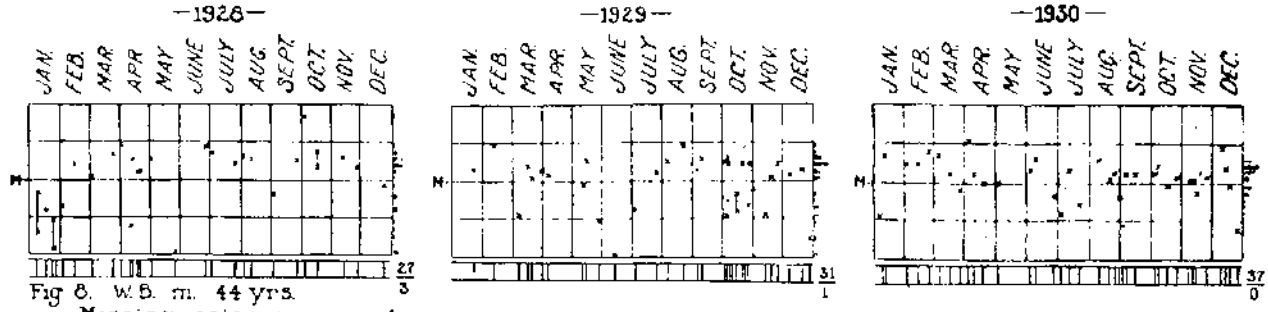

Fig 8. W.B. m. 44 yrs.

Morning seizure prevalency

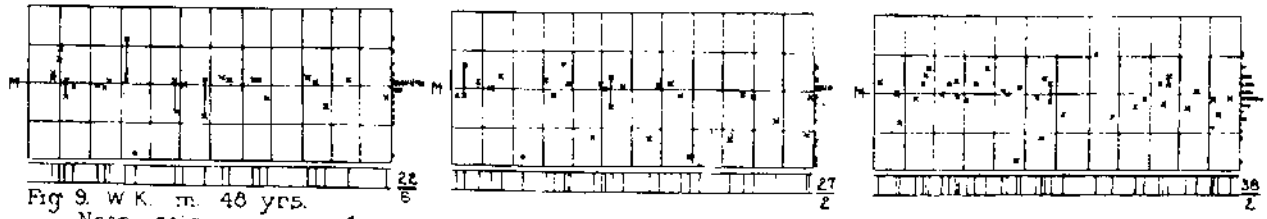

Fig 9. W.K. m. 48 yrs.

Noon seizure prevalency

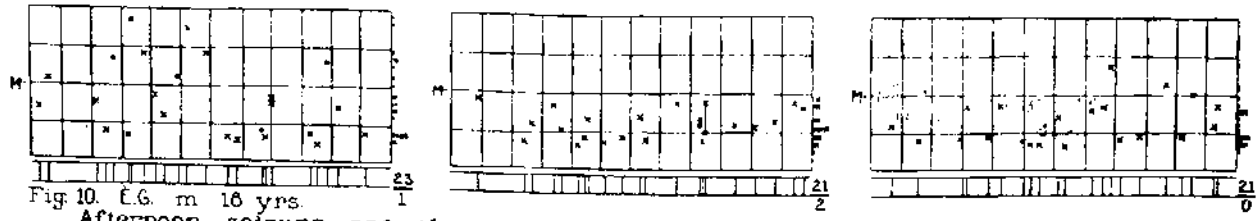

Fig 10. E.G. m 16 yrs.

Afternoon seizure prevalency

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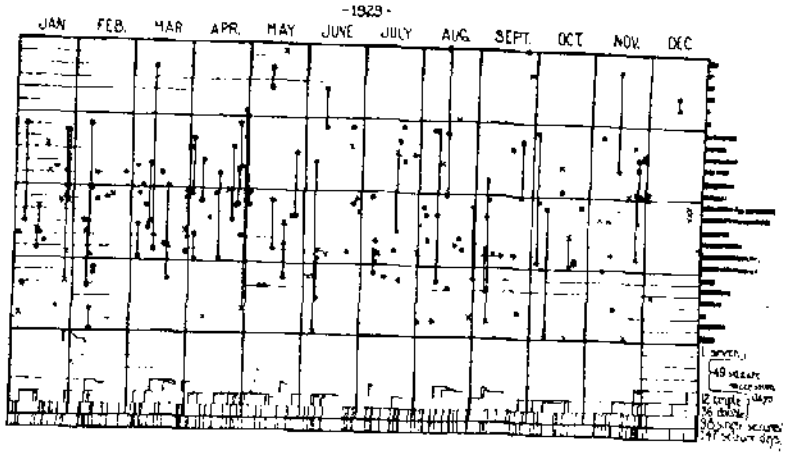

Figure 14. A. L., f., aged 57 years. $\frac{147}{49}$ Chart showing different series of vertical projections for total number of seizure days (147), single seizure days (98), and seizure succession days (49).

Mr. Swendsen: Thank you very much, Dr. Wheeler. It was very interesting, I am sure.

Have any of you any questions you would like to ask the Doctor?

Dr. Murdoch: We certainly have reason to be indebted to Dr. Wheeler and Dr. McBroom for their ingenuity in collecting and recording the data which Dr. Wheeler has so ably presented.

(Adjourned)

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