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Notes upon some Kymographic Tracings of Tremor.

BY

FREDERICK PETERSON, M. D.,

Chief of Clinic, Nervous Department, Vanderbilt Clinic, College of Physicians and Surgeons, New York.

REPRINTED FROM THE

New York Medical Journal

for March 10, 1894.

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KYMOGRAPHIC TRACINGS OF TREMOR.

By FREDERICK PETERSON, M. D.,
CHIEF OF CLINIC, NERVOUS DEPARTMENT, VANDERBILT CLINIC,
COLLEGE OF PHYSICIANS AND SURGEONS, NEW YORK.

In a paper entitled A Contribution to the Study of Muscular Tremor, read before the American Neurological Asso-

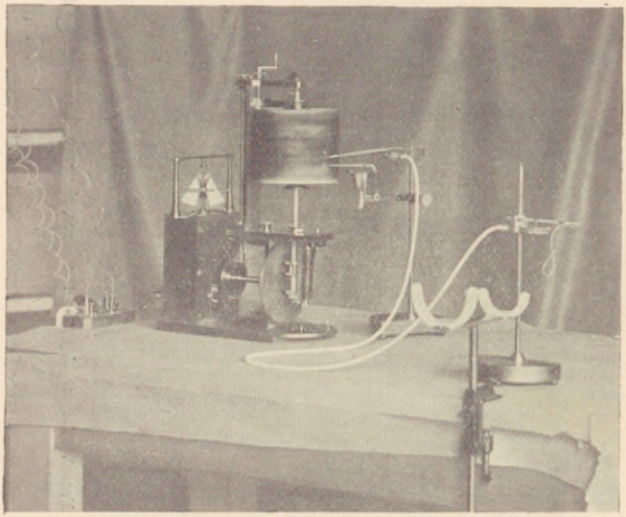

Fig. 1.—Apparatus used for taking tremor tracings. Ludwig's kymograph with electric connection for seconds. Two Marey's tambours joined together by a rubber tube. Arm-rest screwed to table.

ciation in 1888,* I gave the details of observations upon the tremors of paralysis agitans, Graves's disease, multiple

* *Jour. of Nerv. and Ment. Disease*, February, 1889.

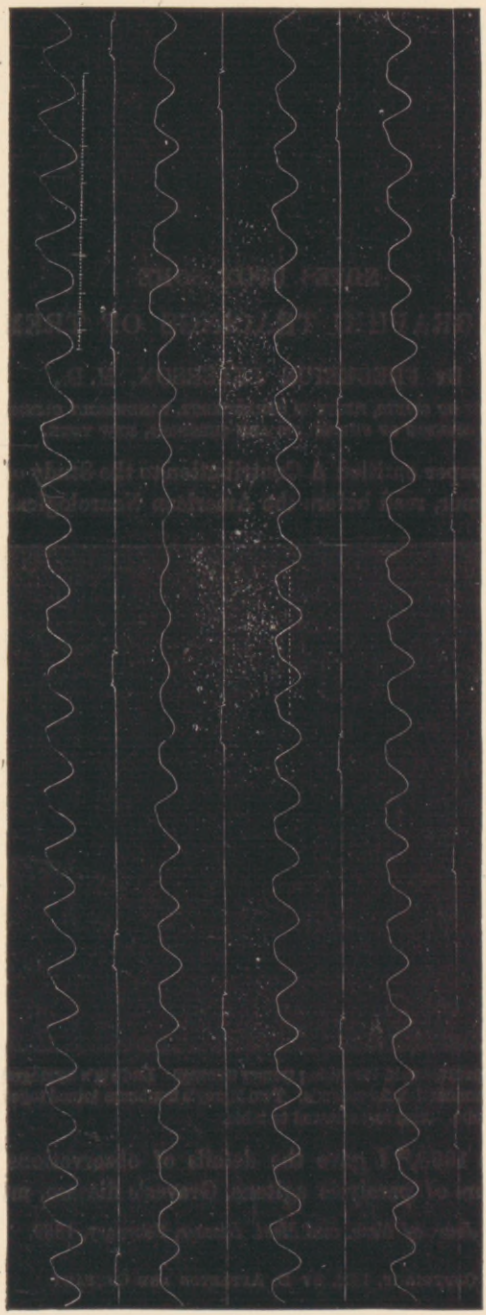

FIG. 2.—Tremor of paralysis agitans, showing dicrotism. Rapid revolution of drum of kymograph.

sclerosis, hysteria, neurasthenia, and alcoholism, the tracings of which were taken with the Edwards sphygmograph. The rate of these tremors, as determined in this way, I made out as follows:

	To the second.
Paralysis agitans	3·7 to 5·6
Morbus Basedowii	8·7 to 12
Multiple sclerosis	5·4
Hysterical tremor	7·7
Neurasthenic tremor	7·4
Delirium tremens	5.6
Chronic alcoholism	8·5 to 11·2
Ankle clonus in primary lateral sclerosis	6

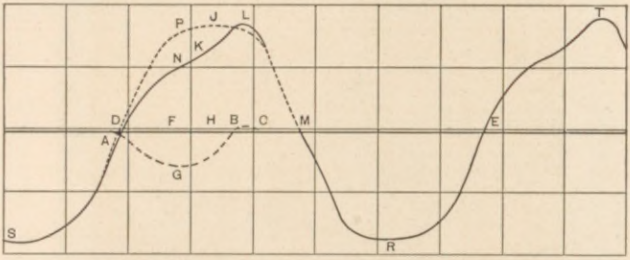

FIG. 3.—Geometrical analysis of paralysis agitans wavelet taken from upper right hand corner of Fig. 2.

While the sphygmograph does in reality serve sufficiently well for ordinary clinical purposes in the registration of these tremors, it is not satisfactory from a scientific point of view, because it is not exact in the determination of the rate. Take, for instance, the following table from my chapter on Paralysis Agitans in Starr's *Familiar Forms of Nervous Disease:*

Author.	Publication.	Rate to the second.
Marie	*Contrib. à l'étude*, etc.	5
Charcot	*Mal. du système nerv.*	4–5
Ewald	*Berl. klin. Woch.*, 1883, No. 32	5
Grashey	*Arch. für Psych.*, 1885	4·14–5·34
Huber	Virchow's *Arch.*, vol. cviii, p. 45	3·43–5·57
Gowers	*Dis. of the Nerv. Syst.*, 1888, p. 1001	4·8–7
Wolfenden and Williams	*Brit. Med. Jour.*, May 19, 1888	5·1
Peterson	*Jour. of Nerv. and Ment. Dis.*, Feb., 1889.	3·7–5·6

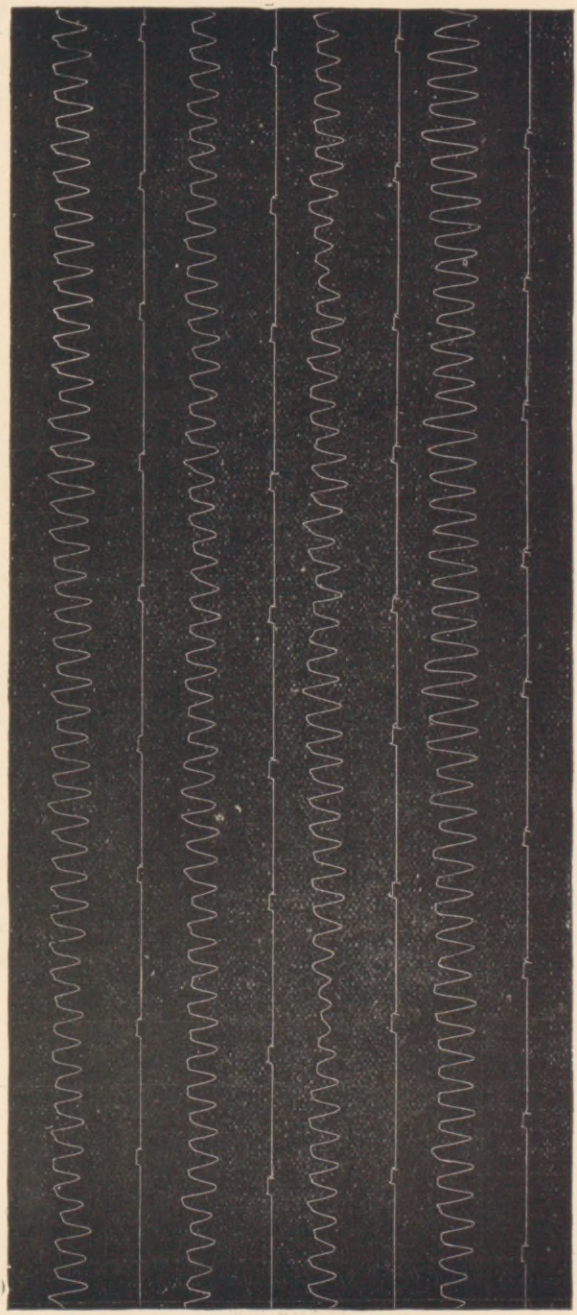

Fig. 4.—Tremor of paralysis agitans. Slower revol..tion of drum.

Most of these authors used the antiquated Marey sphygmograph, which is much more inexact than that of Edwards, employed by myself. From this table, giving the rate of tremor in paralysis agitans as noted by divers authors, it will be seen that there is great variation in the figures. Wolfenden and Williams made use of a kymograph, and approached very near to what I conceive to be the actual rate of this tremor to the second.

Quite lately Dana (*Medical News*, Dec. 17, 1892) has employed the Dudgeon sphygmograph for the same purpose, making the rate of tremor in paralysis agitans from 3 to 6·1 per second. This great variation I believe to be due rather to the instruments made use of than to differences in the rate of the tremor itself.

In Fig. 1 is shown the Ludwig kymograph, with its electric connection for seconds, and the two Marey tambours joined by a rubber tube, and also the rest for the arm while the tremor is being taken. The advantages of this apparatus are the greater accuracy of the time rates and the ability to modify the revolution of the drum so as to magnify the tremor waves. Rapid revolution of the drum magnifies the waves so that each wave may be carefully studied in all its details, and dicrotism becomes markedly visible. The apparatus was set up in the physiological laboratory of the College of Physicians and Surgeons, and patients were taken from the Vanderbilt Clinic for purposes of study. I am indebted to Professor John G. Curtis for placing it at my disposal.

In Fig. 2, on page 2, we have four tracings taken from a case of paralysis agitans, the drum being rapidly revolved so as to magnify the tremor waves. The movements represented are of the flexors and extensors of the wrist. The tendency to dicrotism is very pronounced, and the rate per second is seen to be exactly 5. Just beneath each tremor wave is the line indicating the seconds. Mr. A. E. Kennelly, of the Edison Laboratory, kindly volunteered to make a geometrical analysis of some of these waves, with a view to possibly determining some interesting features of diagnostic value. Thus, if the waves were constantly of the same character, we could always attribute a certain outline to a certain cause, and thus impulses and

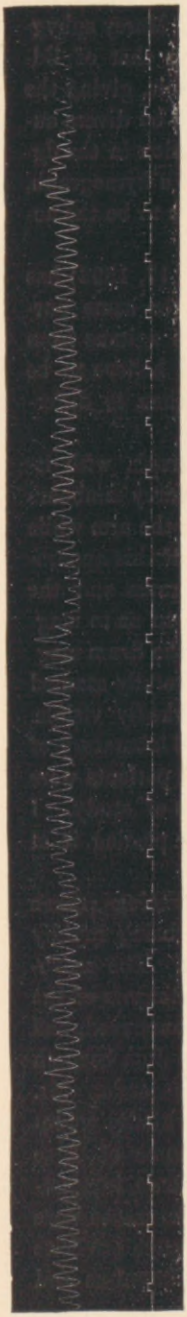

FIG. 5.—Tremor of paralysis agitans. Still slower revolution of drum.

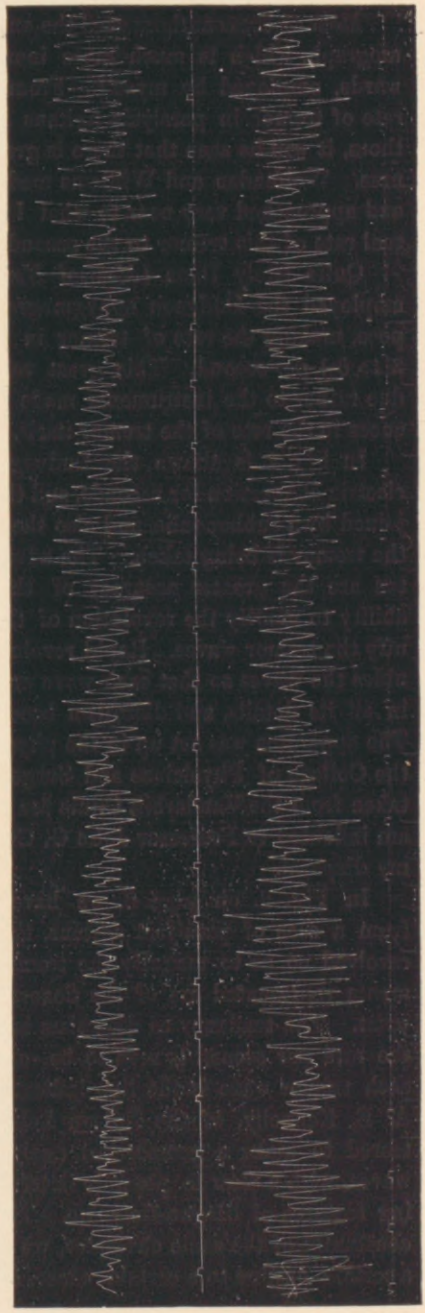

FIG. 6.—Tremor of paralysis agitans. Slow revolution of drum. Singular grouping of series of waves, each four seconds.

activities not visible in the aspect of the waves as a whole might be discovered. With a series of waves, such as liquid waves through elastic tubes (the pulse), this careful geometrical analysis would undoubtedly prove of great

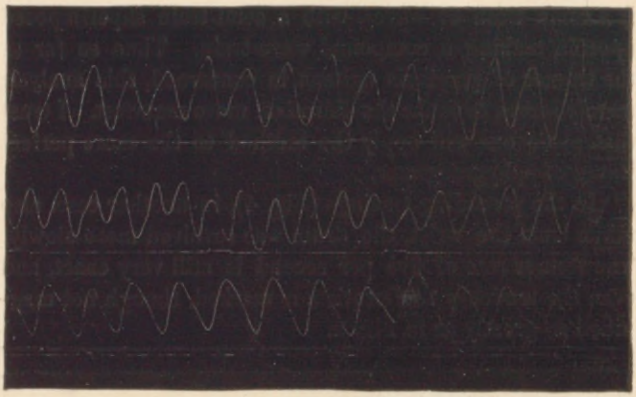

FIG. 7.—Tremor of paralysis agitans. Rapid revolution of drum.

value, for here the current velocity, the elasticity, and the resulting wave train are almost invariable. But where, as in the tremor waves above given, variation is considerable, such analysis is exceedingly difficult and must be carried

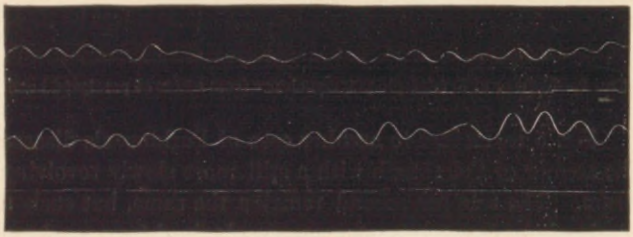

FIG. 8.—Tremor of alcoholism. Rapid revolution of drum.

through the whole series, a laborious task and enough to dishearten one who undertakes it. However, I present the results of Mr. Kennelly's work for what it may be worth. He carefully transferred by micrometer measurements a pair of waves from the upper train of Fig. 2 to large scale paper. The curve (Fig. 3) S D N K L M R E T can in its first half wave length be analyzed into components, one of which

is the second semi-wave, M R E, inverted, and the other a smaller opposite wave in dotted line, A G B. The opposite wave has two thirds of the main wave length and one third of the main wave amplitude, so that (neglecting as a possible discrepancy the wavelet B C unaccounted for) there is a main train of waves, with a semi-train superimposed upon it, making a compound wave-train. Thus, as far as the tremor of paralysis agitans is concerned, this analysis merely serves to make the dicrotism more manifest. I trust that some one will apply the method to the more perfect waves of sphygmograms.

In the preceding tracings (Fig. 4), in another case, also taken from the wrist, the drum was revolved more slowly. The tremor rate of five per second is still very exact, and even the tendency to dicrotism is marked, though not magnified so greatly as in Fig. 2.

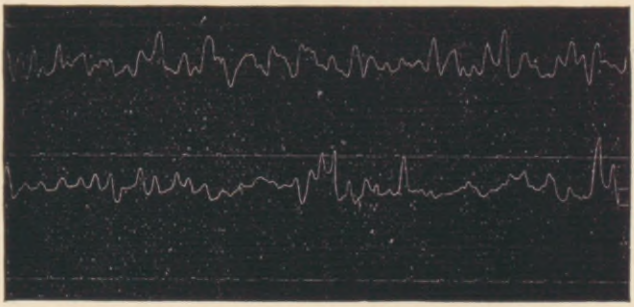

Fig. 9.—Tremor of hemiplegic polymyoclonus from whole of paralyzed hand

Fig. 5 represents in another case of Parkinson's disease the tremor of the thumb with a still more slowly revolving drum. The rate per second remains the same, but such a tracing is no improvement upon one obtained from a sphygmograph. The evenness of the tremor of paralysis agitans is the only characteristic feature.

Fig. 6 is a tracing also from the thumb, in another case where the tremor was very marked and the excursions wide. The revolutions of the drum were at the same slow rate as in the last. A remarkable feature of this tracing is a manifest tendency to a grouping of the waves about every four seconds, as if the innervation impulses were invigorated every few seconds. I could not deter-

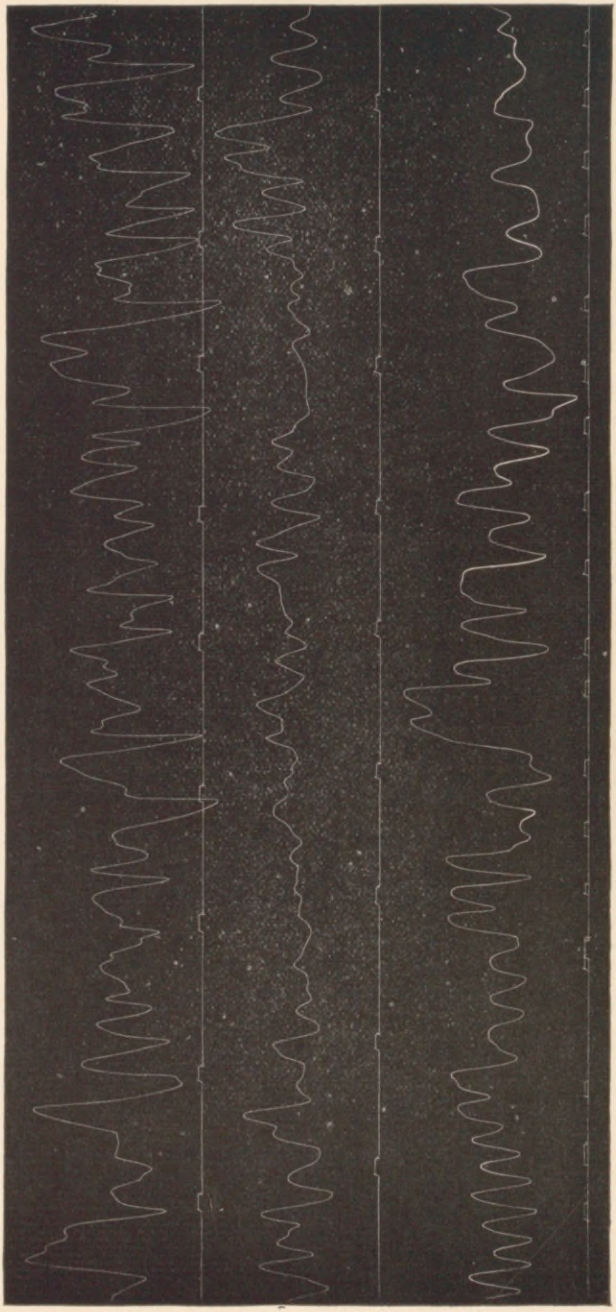

FIG. 10.—Tremor of methemiplegic polymyoclonus. Taken from the thumb only.

mine whether this was due to some respiratory influence or to some unknown factor (such as nutritional rhythm in the cortical cells?). This is certainly worthy of further study. In another group of tracings, unfortunately lost, this peculiarity was much more pronounced.

Fig. 7 is a series of ring finger tracings of the tremor of paralysis agitans with a rapidly revolving drum. While the rate of five per second is very apparent here, the greatness of the excursion prevents the development of the dicrotism, which was so marked in the cases where the wrist muscles were investigated.

In Fig. 8 we have the fine tremor of alcoholism greatly magnified by swift revolution of the drum. From a careful study of this tremor in a long series of many tracings I find the rate to be ten to the second. The above tracings show merely one or two seconds out of five or six on the same piece of paper. The uniformity of the tremor is also marked. Some tremors of Graves's disease and of general paresis were so similar in character and rate (ten to the second) that they are not reproduced.

Some time ago I called attention to a variety of post-hemiplegic movements (*Trans. N. Y. Neurolog. Soc.*, Dec. 6, 1892) following infantile spastic hemiplegia, to which I gave the name methemiplegic polymyoclonus. It is a rare phenomena, for out of over two hundred and fifty cases of infantile cerebral palsies that have come under my observation I have seen but two with this form of morbid movement. It consists of rapid and not synchronous clonic spasms in the muscles of the limbs affected. The excursions of the separate muscles are about equal to those of paralysis agitans and the rate is five to the second. Indeed, if the muscles moved synchronously, the condition would be exactly analogous to paralysis agitans. The tremor is constant, and only ceases during sleep. It would be improper to call it either athetoid or choreiform, and hence my selection of a new designation. The character of this movement is indicated by Fig. 9. Here the whole hand clasped a bulb connected with the tube leading to Marey's tambour and the delineator. The inco-ordinated and rapid movement is shown in the irregularity of the wave train. The drum revolved slowly in fifty-three seconds, and only

about a third of the completed tracings is shown. The movement in the thumb alone is shown in the three tracings of Fig. 10.

In closing I will merely say that compared with the kymograph the sphygmograph is of course crude and uncertain in the registration of these various tremors. Most tremors can, I think, be placed in two categories—one a fine and rapid tremor at the rate of ten to the second, corresponding to the normal innervation rhythm as determined by Horsley and Schafer, and one a slow tremor wherein the normal innervation wavelets are fused into groups of two, giving an apparent rate of five to the second.