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# On the Application of a Performance Test in Cats with Experimental Chronic Epilepsy* **

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*Summary.* A report is presented on a *test in cats* for the examination of animals with *chronic epileptic processes* (Kopeloff-method). It is based on a material of 11 epileptic animals. 9 of them suffer from frequent spontaneous fits (more than 5 seizures per month), which were induced at a very early age. A deterioration closely connected with the frequency of seizures is presented both digitally and with cumulative records. These clearly show the deterioration which may lead to an ultimate failure of performance. These results are discussed and an outlook is given on the possibilities of the method: 1. a scientific testing of antiepileptic substances, 2. the avoidance of the high cost of such tests and 3. the avoidance of a risky testing of toxic substances in individual cases still resisting treatment.

*Key words:* Chronic Alumina-Epilepsy — Performance Tests — Epileptic Cats — Digital and Analogue Data — Measurable Behaviour Anomalies.

*Zusammenfassung.* Es wird über einen Test berichtet, mit dem es möglich ist, *chronisch epileptische Tiere*, mit (Kopeloff's Aluminiumcreme — Krampfherden) zu untersuchen. Ausgehend von 11 Katzen mit chronischen epileptischen Prozessen wird über die auftretenden Veränderungen berichtet, die von einem zahlenmäßig belegbaren Leistungsabfall in einem Leistungstest bis zum Leistungsverfall reichen. Diese Veränderungen werden mit reproduzierbaren Zahlenwerten und Kurven dokumentiert, einzelne Tiere bildlich dargestellt. In einer Diskussion der Ergebnisse wird auf die sich ergebenden Vorteile und Möglichkeiten der Methode verwiesen: 1. Wissenschaftliche Testung von Antiepileptika, 2. eine wesentliche Verbilligung der bisher kostspieligen Untersuchungen und vor allem 3. das Vermeiden des risikoreichen Austestens hochpotentieller Drogen am Menschen.

*Schlüsselwörter:* Chronische Katzen-Epilepsie — Leistungstests — Digitale und analoge Daten — Meßbare Verhaltens-Anomalien.

## Introduction

Ever since Merrit and Putnam's [6] discovery of hydantoin for the treatment of epilepsy, the testing of new substances with possibly simi-

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lar effects has become a problem. But, although epileptic reactions following electrical stimulation have been used as a test-method for a long time, the reservation has to be made, that the seizures thus provoked may not necessarily be compared with fits arising in man. This makes Swinyard's [12] request, for new and better laboratory methods for the selection of drugs, all the more understandable. Although electroconvulsive treatment in psychiatry induces many seizures by electrical stimulation, spontaneous after-seizures or even an epileptic illness are extremly rare. Another method that lowers the seizure threshold by drugs can hardly stand by itself in the examination of antiepileptic substances (Steinmann [11]). But, in spite of this, such tests were also used with Kopeloff's technique [3] by Chusid and Kopeloff [1] in order to reduce the waiting period for an occasional animal seizure, which otherwise may or may not arise at an appropriate time (Kopeloff and Chusid [4]). These authors show, that they provoke seizures by such additional lowering of threshold. Otherwise they had to expose their experimental animals to severe physical stresses, which can hardly be regarded as physiological such as "prodding with a stick".

In our search for an improvement of the available test methods and with studying very young animals (Fleischhauer and Schmalbach [2]) the importance of maturation at the time of the receipt of an epileptogenic focus became clearer to us. We then carried out a further investigation on very young kittens [9] and finally succeded in inducing epileptic processes, which appeared to be more suitable material for testing antiepileptic drugs.

But still no test was in our hands for the psychological examination of such animals.

Another procedure, the performance test, has been used by authors like Masserman [5] for a long time. But until now it has mainly been applied in examinations of alcohol and psychopharmacological drugs, in studies of animal neuroses etc. In our knowledge no examination on epileptic animals using this test has so far been published.

The problems involved in instructing epileptic or prospectively epileptic animals was reduced considerably through the use of "autodidaxis" (Schmalbach [8]), which enabled us to employ kittens in the desired manner.

In this paper we shall report our results obtained after a year of testing such animals in 1200 experiments.

## Material and Methods

For this investigation we employed both kittens and young adult cats of our own breeding. They had all received an alumina cream focus when they were still under the protection of their mothers, i.e. before the 28th day of their lives. At

this stage we report on 11 cats with chronic epileptic processes. Table 1 provides a picture of the material used for this paper:

Table 1. *Material for this investigation with indications when epileptic seizures started in the individual cases*

| Serial No. | Animal No. | learner | performer | since |
|---|---|---|---|---|
| 1 | 103 | + | | 19. 11. 1971 |
| 2 | 813 | + | | 7. 6. 1971 |
| 3 | 829 | | + | 5. 10. 1971 |
| 4 | 838 | | + | 12. 1. 1971 |
| 5 | 839 | | + | 9. 2. 1971 |
| 6 | 840 | | + | 17. 12. 1970 |
| 7 | 846 | | + | 13. 6. 1970 |
| 8 | 869 | | + | 11. 8. 1971 |
| 9 | 871 | | + | 23. 8. 1971 |
| 10 | 872 | | + | 11. 7. 1971 |
| 11 | 880 | | + | 27. 9. 1971 |

Autodidaxis [8] was made use of in all young animals below the age of three to four months thus shortening the length of training time considerably. By it we avoided sham-rage reactions or other aggressive animal behaviour in training after the outbreak of epileptic fits. Adult cats—no longer suitable for autodidactic learning—were trained by both manipulation and acoustic support to press a lever in a Skinner type box. All cats received a continuous reinforcement in the form of a reward of 0.5 ml $^2/_3$ milk in a small cup for each correct performance. The procedure has been described in another paper (Schmalbach and Müller [10]). No punishement was ever given.

In order to overcome difficulties of an objective measure of behavioural disturbances, definite constant deficiencies had to be found and recorded. For this purpose we employed

I. Cumulative records of the cats' performances.

II. On the same record their drinking activity was recorded by pressing a button each time the drinking occured.

III. We tried to objectify the cage behaviour of the animals concerned but could only find unclear disturbances like reduced grooming, reduced cleanliness and, in contact with both those who conducted the experiments and animal care-taker, touchiness and agression. But these phenomena were not regarded sufficiently clear for a scientific recording.

IV. The animals, when deteriorated by epilepsy often missed the lever, a fact, which could be visually recorded and counted and

V. other mistakes could also be found, recorded and counted, for instance, so-called "empty licking" after ineffective, futile lever-pressing.

VI. As a final stage, the complete loss of understanding of the test, once acquired, could be noted but no longer be enumerated. It was, however, of importance to record it, as normal cats even after weeks of inactivity did not appear to forget their performance-test activity and were still able to work as before.

If the behavioural disturbances described under IV. and V. were put in proportion to the actual working effectivity, a clear fraction could be established for good and bad work of the animals.

We have employed quite a number of older epileptic cats for training and testing purposes but only 2 of these, namely No. 1 and No. 2 are listed in this context. There are no clear behavioural differences between these animals, which had only rare fits—not more than 5 per month. Great care was taken to record all individual behavioural differences including the general cage behaviour of the animals.

## Results

As mentioned before we have tried in vain for a number of years to elaborate clear and demonstrable differences between the cage behaviour of normal and epileptic cats. We found this to be completely unsuccessful unless one had a long personal experience with individual animals. Strangers, collaborators without continuous close contact with the cats were, of course, able to have the same opinion about an animal as oneself. But especially such statements were mostly tinged subjectively according to sympathy or antipathy for or against an animal. For this reason they had to be abandoned totally for a scientific evaluation.

But apart from this, behavioural disturbances like severe aggressions or extreme timidity could only be described subjectively and not objectively except by comparing film strips. Besides, an epileptic cat may sit quietly in its cage, suddenly develop a fit of sham rage and then squat down quietly again. Such attacks can only be recorded by the video-recording technique, then be reproduced later, but they still remain of limited value.

The situation changed drastically with the introduction of the performance test for the examination, in which a clear task was given to the animals. Animals like cats No. 4, 5, 9, 10, 11, who had suffered from many seizures and who also had lived through epileptic states showed a clear reduction of their working capacity in the performance test. Now, this could be recorded and counted. With this test we tried, first of all, to get a clear and reproducable picture of the course of an epileptic process and to establish the influence of the seizures upon the working capacity of the animals so afflicted. We soon found out, that the epileptic fits could reduce the performance before and after the seizures, the animals seemed to be inhibited. In the course of time this phenomenon became still clearer. The 2 record-synopses (Figs. 1 and 2) convey a good impression of the situation at the beginning of the well-established processes of animals 838 and 839. The seizure-days with observed fits have been marked by arrows. Both the deficient performance and the return to normal function, typical for the initial stages of a process, become clear.

On the following Table 2 the figures recorded about the same time are put in comparison with those recorded from a normal young adult male cat. The values of both animals recorded at a later stage will be found

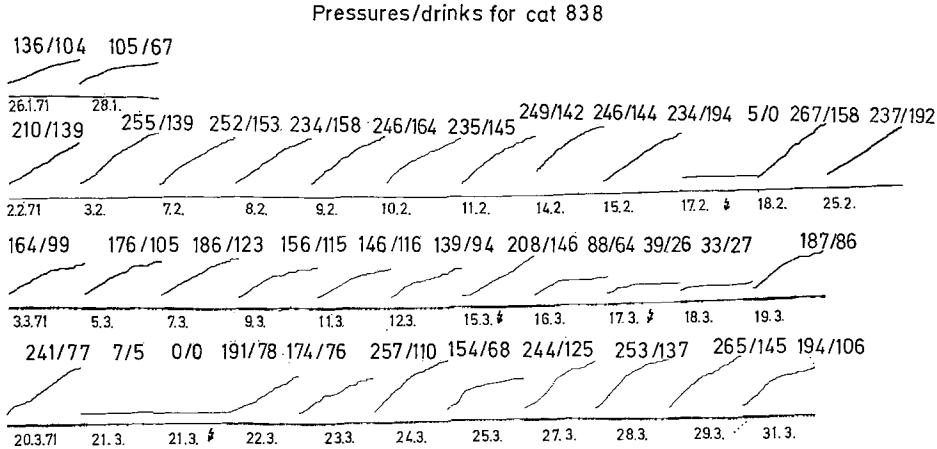



Fig.1. Cumulative records of animal 838. The functional loss on seizure days can be recognised. Seizure days are marked by darts. Pressures/drinks are indicated above each record. The actual recording-dates can be found below the recordings

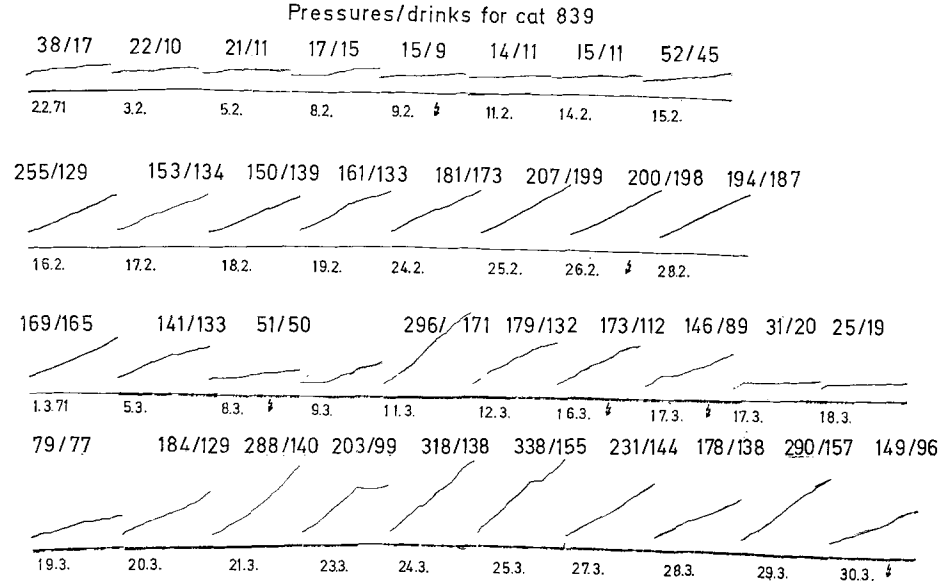



Fig.2. Synopsis of cumulative records of cat 839. The functional deficiency is visible but not yet as clear as with cat 838. Seizure days are marked by darts. Pressures/drinks are indicated above each record. The actual recording-dates can be found below the recordings. (The values for the 9th 3rd are 85/79)

Table 2. *Cat performance expressed in numbers*

Pr = pressure; Dr = drinks ↯ = seizure ↯ = sham-rage → = critical days S = single D = double T = triple Qua = quadruple Qui = quintuple S = six pressures P = pause

811 normal male cat

| Date | Pr | Dr | S | D | T | P |
|---|---|---|---|---|---|---|
| 8. 3. | 203 | 184 | 173 | 15 | — | 1 |
| 12. 3. | 174 | 167 | 160 | 7 | — | 1 |
| 15. 3. | 243 | 239 | 235 | 4 | — | — |
| 16. 3. | 123 | 117 | 115 | 4 | — | 1 |
| 18. 3. | 175 | 170 | 165 | 5 | — | — |
| 22. 3. | 263 | 259 | 255 | 4 | — | — |
| 24. 3. | 173 | 140 | 137 | 18 | — | 1 |
| 26. 3. | 191 | 181 | 172 | 8 | 1 | — |
| 29. 3. | 186 | 178 | 170 | 8 | — | — |
| 31. 3. | 110 | 102 | 94 | 8 | — | 3 |
| 2. 4. | 180 | 172 | 164 | 8 | — | — |
| 5. 4. | 166 | 165 | 164 | 1 | — | — |
| 6. 4. | 136 | 128 | 122 | 7 | — | 1 |
| 8. 4. | 194 | 184 | 174 | 10 | — | — |
| 13. 4. | 246 | 241 | 236 | 5 | — | — |
| 15. 4. | 77 | 67 | 57 | 10 | — | 3 |
| 21. 4. | 135 | 128 | 119 | 8 | — | 1 |
| 27. 4. | 171 | 167 | 163 | 4 | — | — |
| 29. 4. | 180 | 165 | 158 | 11 | 2 | — |
| 4. 5. | 180 | 172 | 167 | 5 | 1 | — |

839 epileptic cat

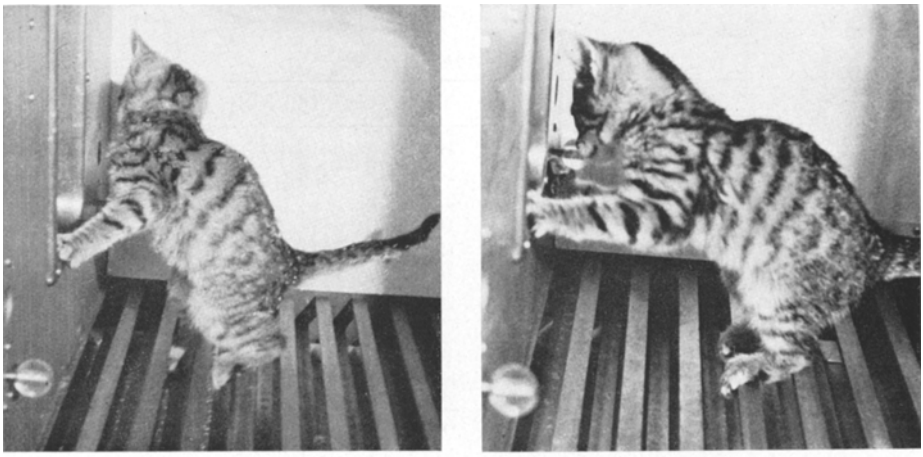
| Date | Pr | Dr | S | D | T | Qua | Qui | P | Fit |
|---|---|---|---|---|---|---|---|---|---|
| 25. 3. | 338 | 155 | 103 | 71 | 31 | 3 | 1 | 4 | |
| 27. 3. | 231 | 144 | 85 | 55 | 12 | — | — | 3 | |
| 28. 3. | 178 | 138 | 117 | 29 | 1 | — | — | — | |
| 29. 3. | 290 | 157 | 80 | 59 | 19 | 5 | 3 | 3 | |
| →30. 3. | 149 | 96 | 49 | 41 | 6 | — | — | 1 | ↯ |
| 31. 3. | 282 | 142 | 63 | 53 | 35 | 2 | — | 1 | |
| → 1. 4. | 93 | 68 | 70 | 11 | — | — | — | 4 | ↯ |
| 3. 4. | 79 | 79 | — | 60 | 4 | — | — | 5 | |
| 4. 4. | 169 | 127 | 98 | 35 | 2 | — | — | 1 | |
| 5. 4. | 231 | 148 | 84 | 54 | 5 | 2 | 2 | 2 | |
| → 7. 4. | 183 | 122 | 60 | 43 | 11 | 2 | — | 1 | ↯ ↯ |
| 8. 4. | 205 | 113 | 43 | 50 | 20 | 1 | — | 2 | |
| 13. 4. | 186 | 122 | 72 | 42 | 7 | 3 | — | 2 | |
| 14. 4. | 63 | 52 | 46 | 9 | — | — | — | 4 | |
| 15. 4. | 83 | 54 | 23 | 20 | 6 | — | — | 5 | |
| →16. 4. | 19 | 15 | | | | | | 3 | ↯ |
| →19. 4. | 101 | 60 | 30 | 22 | 16 | — | — | 3 | ↯ |
| 21. 4. | 96 | 60 | 33 | 26 | 1 | 1 | — | 3 | |
| → 3. 5. | 156 | 78 | 14 | 48 | 9 | 3 | — | 3 | ↯ |
| 4. 5. | 375 | 155 | 21 | 62 | 48 | 4 | 1 | — | |

Table 2 (Continued)

838 epileptic tom-cat

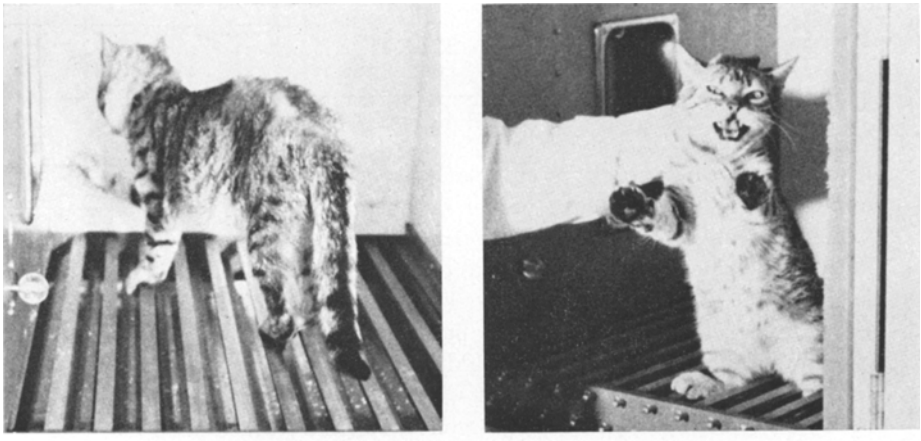
| Date | Pr | Dr | S | D | T | Qua | Qui | S | P | Fit |
|---|---|---|---|---|---|---|---|---|---|---|
| 25. 3. | 154 | 68 | 52 | 10 | 10 | 4 | 6 | — | 4 | ↯ |
| 27. 3. | 244 | 125 | 129 | 21 | 17 | 12 | 5 | — | 4 | |
| 28. 3. | 253 | 137 | 51 | 49 | 21 | 9 | 1 | — | 6 | |
| 29. 3. | 265 | 145 | 79 | 50 | 18 | 3 | 4 | — | 7 | |
| 31. 3. | 194 | 106 | 64 | 28 | 19 | 3 | 1 | — | 13 | |
| → 1. 4. | 238 | 116 | 75 | 27 | 26 | 7 | 1 | — | 7 | ↯ |
| 3. 4. | 183 | 94 | 31 | 23 | 16 | 11 | 3 | — | 8 | |
| → 3. 4. | 47 | 20 | 8 | 4 | 7 | 1 | 1 | — | — | ↯ |
| 5. 4. | 172 | 67 | | | | | | | | |
| → 6. 4. | 273 | 87 | 11 | 24 | 12 | 6 | 15 | 4 | 3 | ↯ |
| 7. 4. | 217 | 67 | 15 | 8 | 23 | 11 | 6 | 6 | 10 | |
| → 8. 4. | 65 | 62 | 15 | 7 | 8 | 2 | 1 | — | 4 | ↯ |
| 13. 4. | 301 | 107 | 12 | 31 | 25 | 15 | 9 | 5 | 5 | |
| →14. 4. | 265 | 99 | 20 | 23 | 38 | 13 | 4 | 2 | 9 | ↯ |
| 15. 4. | 94 | 44 | 12 | 20 | 11 | 3 | — | — | 6 | ↯ |
| →16. 4. | 107 | 38 | 12 | 19 | 7 | 10 | 1 | — | 6 | ↯ |
| 21. 4. | 178 | 55 | | | | | | | 5 | ↯ |
| 1. 5. | 90 | 51 | 21 | 13 | 14 | 2 | 1 | — | 6 | |
| 3. 5. | 216 | 89 | 23 | 26 | 24 | 13 | 1 | 1 | 8 | |
| → 4. 5. | 124 | 65 | 24 | 27 | 11 | 2 | 1 | — | 3 | ↯ |

again on another table, the cumulative records of animal 838 will reappear in Fig. 6 and then a proper decay of performance will become visible, not only a changing reduction in activity. Unless influenced for the better the former good performances do not return. The diseased animals have become—after months of seizures—deteriorated epileptics. Although the running off of motions in the performance test is best shown in a cinematographic sequence, we would like to present a few pictures of the afflicted animals. Fig. 3 shows cat 838, still relatively healthy, performing actively. He has not yet gone through a status epilepticus and has had only few fits. He performs with "pleasure", jumps into the Skinner box without any prompting and starts his activity without delay. Months later, things have changed after epileptic states (Fig. 4a): his attitude to the test has altered, he seems disgruntled, insecure and on the picture this may be recognised by his impractical stance too far away from the levers, which he misses frequently. Sham rage attacks often appear without any reason but specially if he is carried. On Fig. 4b he is held very lightly and reacts furiously. The sham rage increased further after the picture in the chamber. On the Fig. 5 another animal, cat 839, looks stupidly at the lever, as if uninformed, although she used to be an excellent worker at an earlier, healthier phase. She



a b

Fig. 3a and b. Active animal in performance test



a b

Fig. 4a. Same animal desorientated after status epilepticus. The insecure approach to the lever may be recognised from the different distance of the cat from the functional panel

Fig. 4b. Same animal in a state of sham-rage

has altered completely. Now, after many attacks, she has deteriorated and has given up grooming. In her numerous fits she has constantly lesioned her nose, a typical injury in our cats with many fits in steel wire cages.

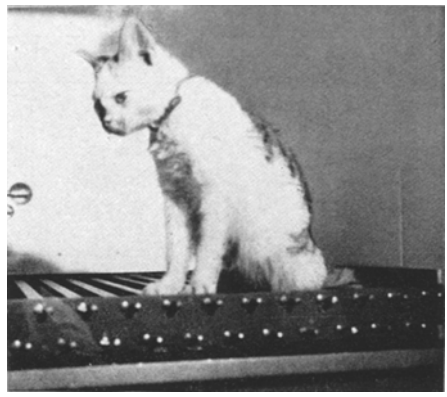


Fig. 5. Animal with scarification on its nose, after many fits. Looks at lever dumbfoundedly

Table 3

| | Pr | Dr | M | R | Pr | Dr | M | R | Pr | Dr | M | R |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| animal No. | 869 | | | | 871 | | | | 872 | | | |
| 1 | 103 | 94 | 15 | 3 | 117 | 52 | 7 | 3 | 2 | 1 | 14 | 4 |
| 2 | 161 | 121 | 14 | 1 | 213 | 51 | 14 | 5 | 3 | 2 | 42 | 17 |
| 3 | 247 | 151 | 3 | 0 | 467 | 108 | 4 | 2 | 12 | 8 | 46 | 10 |
| 4 | 202 | 156 | 7 | 0 | 164 | 53 | 11 | 11 | 23 | 11 | 51 | 9 |
| 5 | 197 | 156 | 35 | 0 | 201 | 53 | 8 | 6 | 66 | 6 | 54 | 3 |
| 6 | 241 | 157 | 21 | 0 | 66 | 27 | 5 | 3 | 3 | 4 | 37 | 4 |
| 7 | 218 | 185 | 7 | 0 | 73 | 19 | 3 | 4 | 27 | 6 | 25 | 5 |
| 8 | 238 | 189 | 20 | 0 | 133 | 35 | 6 | 4 | 65 | 7 | 24 | 1 |
| 9 | 201 | 181 | 12 | 4 | 222 | 63 | 8 | 5 | 66 | 14 | 34 | 2 |
| 10 | 231 | 219 | 5 | 0 | 178 | 48 | 4 | 3 | 87 | 21 | 28 | 5 |
| Sum: | 2039 | 1609 | 139 | 8 | 1242 | 509 | 70 | 46 | 354 | 80 | 355 | 60 |
| animal No. | 880 | | | | 839 | | | | 838 | | | |
| 1 | 44 | 43 | 35 | 13 | 107 | 40 | 28 | 17 | 43 | 35 | 43 | 0 |
| 2 | 44 | 37 | 19 | 7 | 74 | 39 | 12 | 13 | 26 | 23 | 32 | 0 |
| 3 | 8 | 8 | 39 | 15 | 31 | 17 | 23 | 19 | 51 | 51 | 41 | 0 |
| 4 | 20 | 9 | 14 | 20 | 11 | 6 | 8 | 11 | 0 | 1 | 8 | 0 |
| 5 | 15 | 2 | 13 | 2 | 71 | 38 | 19 | 8 | 67 | 53 | 28 | 0 |
| 6 | 26 | 7 | 15 | 16 | 131 | 40 | 33 | 9 | 131 | 40 | 42 | 0 |
| 7 | 18 | 1 | 5 | 10 | 9 | 5 | 28 | 9 | 4 | 0 | 0 | 0 |
| 8 | 1 | 2 | 23 | 5 | 9 | 5 | 22 | 7 | 26 | 27 | 71 | 5 |
| 9 | 8 | 3 | 1 | 1 | 11 | 7 | 15 | 11 | 41 | 42 | 70 | 0 |
| 10 | 3 | 0 | 14 | 1 | 81 | 28 | 20 | 6 | 70 | 60 | 80 | 3 |
| Sum: | 187 | 112 | 178 | 90 | 535 | 225 | 208 | 110 | 468 | 332 | 415 | 8 |

Explanation of signs: Pr = lever pressure, Dr = drink, M = mistake, R = running one round in box.

Table 4. *Simplified sums of table 3 for quick evaluation*

| No. | Pr | Dr | M |
|---|---|---|---|
| 1 | 20.4 | 16.1 | 1.4 |
| 2 | 18.4 | 5.1 | 0.7 |
| 3 | 3.5 | 0.8 | 3.6 |
| 4 | 1.9 | 1.1 | 1.8 |
| 5 | 5.4 | 2,3 | 2.1 |
| 6 | 4.7 | 3.3 | 4.2 |

Signs: Pr = lever pressing, Dr = drinking, M = mistakes.

On the Table 3 we have compiled the figures of 60 recent experiments, which were performed on 6 of the animals. They were primarily put together in the following sequence: No. 1 was the most normal, and number 6 the most abnormal. The purpose of these experiments was to find out whether the degree of deterioration could be figuratively documented and proved. For this purpose individual values gained in the tests were listed and summed-up. The sums were then divided by 100, which left us with small figures, these were then simplified.

For the evaluation of these figures one other fact must be known: the animals' mode of performance. Therefore, this is indicated below. An animal, which works the lever by biting it, called a biter, will often perform less economically: it bites more often and drinks less often. Their records are not as smooth as the ones of the "lever pushers", who use their feet. The six animals perform as follows:

1) 869: uses foot, 2) 871: bites and occasionally uses foot, 3) 872: bites and uses foot, 4) 880: uses feet and bites, 5) 839: pushes lever with mouth and 6) 838: only uses foot.

On Table 3 one finds all digits elaborated in the 60 experiments and they confirm our assumption to a large extent. Only the cat 880, No. 4 is obviously worse than originally thought. But this animal suffered from status epilepticus during the time of experiments and has lost its capacities almost completely through it.

From the indicated figures (the running of "rounds" will not yet be assessed in detail) it can be said, that the proportion of leverpressing—drinking to the number of committed mistakes changes in the course of epileptic deterioration from about 20:1.5 to 4.7:4.3.

This makes the influence of the epileptic process very clear. It should be mentioned again, that by this procedure the assessement becomes relatively simple.

On the last figures some of the cumulative records are put together showing, on the one hand, a record of animal No. 838 before its deter-

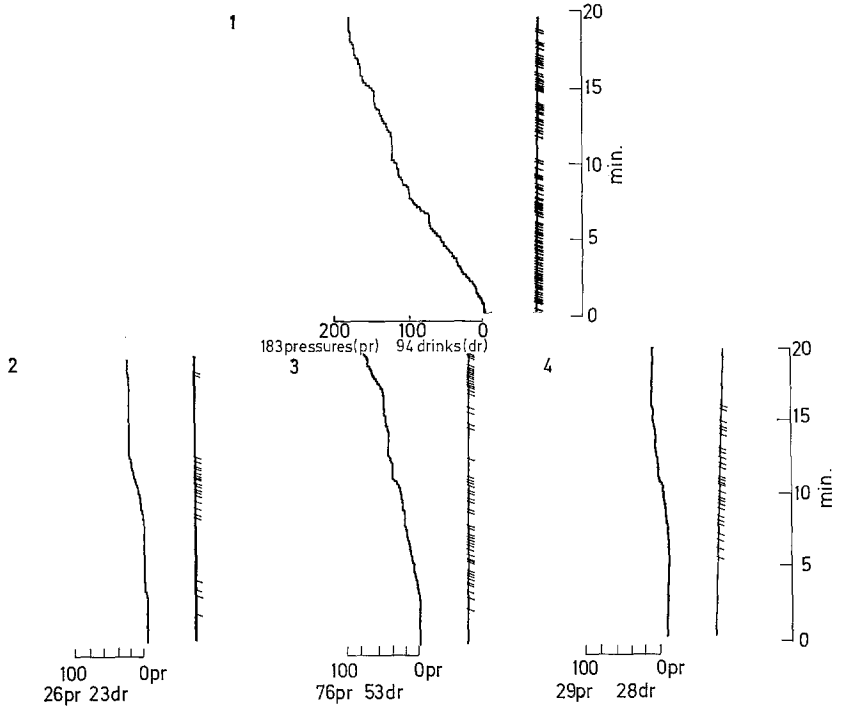



Fig. 6. Cumulative records of male cat 838, born on 23rd Sept. 1970; focal lesion: 0.03 ml $Al_2OH_3$ on left temporal cortex on 12th Oct. 1970. Record 1 of 3rd April 1971: sample of his normal performance. Record 2 of 10th Sept., record 3 of 16th Sept., and record 4 of 20th Sept. 1971 are random samples recorded between the 2nd and the 20th of Sept. 1971

Explanation of signs: *Pr* lever pressing, *Dr* drinking of 0.5 ml of $^2/_3$ milk (2 parts milk and 1 part water), side marking: drinks

ioration and then three recent records, recorded in September of last year. They show the very reduced performance of the animal in its state of deterioration (Fig. 6).

## Comment

Within the framework of this paper the following questions may be answered:

1. Is there a basic difference between the results of this method and those used so far for the examination of experimental epilepsies? What, if any, are these?

2. Does it offer any advantages in comparison with other methods?

3. May any improvements be realised through its application for either the protection or the treatment of human epileptics?

*Ad 1.* The described method allows one to abstain from electroconvulsive stimulations for the production of epileptic seizures in experimental epilepsy, especially in drug-testings limiting their use to prescreening in smaller mammals. At the same time the place of pentylentetrazol stimulation ought to be redefined as a scientific method but not useful for the examination of antiepileptic drugs. With the method described in this paper, it should be possible to experiment on animal epileptic deteriorations more freely and under better control, as the results may be demonstrated both digitally and on analogue records. Thus a scientific study of epilepsy in a gyrencephalic animal should be possible.

*Ad 2.* The second question may also be answered positively for the same reason. But in addition it should be taken into account that, as Servit stressed at the 1971 meeting of the Czech League against Epilepsy, the cost for a systematic examination of one drug as antiepileptic is too high—\$ $7^1/_2$ million—to permit industry to undertake it. With the method described it should be possible—after a starting-time—to reduce the necessary sum to a mere fraction.

*Ad 3.* Through this simplified method of finding new and potent antiepileptic drugs the method of prescreening such substances in human epileptics should become obsolete. Thus chronic epileptics would no longer have to be semi-intoxicated to find out the effectivity of drugs for an individual drug-resistant case. These sentences may sound futuristic. But they may perhaps be permitted in the interest of patients, for whom it is so far still necessary to spend their lives in institutions for epileptics.

I am indebted to Herr Franz Fahlbusch for his excellent work in animal caretaking.

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