

in the individual series progressively decreases, having, on the average, some six-sevenths as much speed during the last five seconds as in the first five, the curve following the form usual to fatigue curves. For the more thoroughly studied individuals the practice curve is everywhere gradual in ascent, not most rapid at the beginning, the opposite of what we usually expect. The practice curve of the left hand does not ascend more rapidly than the right. And variations from a parallel course seem to be due to the fact that each hand does relatively better if tested after rather than before the other. This suggests that the effects are of a general nature. Practice increases the effect of the warming-up tendency, which therefore shows itself much more in the later experiments than in the earlier. The intermissions of two weeks or less have no unfavorable effect on the practice gain beyond at first increasing fatigue sensations.

There is only a slight tendency to positive correlation in the fatigability of the different hands. The right hand is ordinarily more immune to fatigue than the left; but there are individual exceptions. Practice tends to affect the average 'index of fatigue' of the left hand more favorably than that of the right. Initial rate and fatigability are negatively correlated, a fast initial rate being usually accompanied by a high fatigue loss. Fatigue tends in all respects to decrease variability. No consistent effect on variability due specifically to 'warming-up' or practice can be traced. The mean variation in the right hand tends to be larger than that for the left hand.

The subjective condition as estimated by an individual practiced in introspection bore no traceable relationship to the gross rate; it seemed, however, that the susceptibility to fatigue was greater when the grade assigned was good than when it was poor. Subjective condition and initial rate are more closely correlated.

Practice decreases the ratio of the period during which the key is held down to that during which it is released.

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## FATIGUE AND DRUGS.

*The Influence of Alcohol and Other Drugs on Fatigue.* W. H. R. RIVERS. The Croonian Lectures, 1906. London, Arnold, 1908. Pp. viii + 136.

Although primarily undertaken to demonstrate the pharmacological action of drugs on the neuromuscular apparatus, the present work of Rivers is of considerable psychological interest because it shows con-

clusively a preponderating influence of suggestion in the actions of certain drugs. In the introductory lecture the author says that in selecting such a topic one of his objects was to show that experimental psychology has a practical side and that it may be of service to medicine. That he has succeeded in establishing this fact there can be no doubt. Beyond noting the occurrence of idiosyncrasies for certain drugs the individual differences in the actions of drugs have not hitherto been carefully considered by pharmacologists. The work of Rivers clearly shows that in such a comparatively simple mechanism as the neuromuscular apparatus the divergencies of drug effect are quite marked and the differences are such as we expect in other work of a non-pharmacological but of a more strictly psychological nature.

The lectures take up the actions of the following drugs: caffeine, alcohol, tobacco, cocaine and strychnine. The method used by Rivers for testing neuromuscular fatigue is a modified form of the Mosso method. In one series of experiments three sets of fatigue curves were made, at intervals of thirty to sixty minutes, each set comprising six fatigue curves. The individual curves were made at intervals of two minutes, and the separate contractions were made every two seconds. The curves on any one day were carefully compared with those of the other days, but on each day before a drug was given one normal fatigue curve was recorded as a control. A comparison was then made between the five following curves and the normal. The amounts of work in the successive fatigue periods, the average heights of the contractions, and the numbers of contractions were used as the basis on which to estimate the action of the special drug under investigation. Three methods of estimating mental fatigue were employed: the multiplication of four numbers mentally and writing the final figure of the product; the amount and the accuracy of typewriting; fatigue of attention.

An important, and in previous work almost neglected precaution to obviate the suggestive effect of the drug was that on the normal days mixtures were given similar in taste to the drug mixtures. In carrying on the series of experiments in this way the subject did not know when the drugs were given, excepting tobacco, and the factor of suggestion was minimized. It is probably for this reason that Rivers' results do not generally confirm the results of previous investigators. From a pharmacological standpoint the differences are interesting and perhaps important, but it must be remembered that, therapeutically, the physician is aided as much, if not more, by the suggestion of drug action as by the real action of the medicine.

Caffeine was found to have a decided action upon the amount of work performed, when it was taken in doses of 0.3 to 0.5 gram. It was found to stimulate the capacity for muscular work; in one subject this increased ability continued throughout the series of experiments, in the other subject there was found an initial increase in amount, followed by a decided decrease and even a fall below the normal level. The effects on the neuromuscular apparatus can be said to be independent of suggestion, interest, etc., as has been noted above, and the differences in action on the two subjects can be explained only by assuming a difference in physiological action, in one case as an accelerator of fatigue, in the other as a supporter of the nerve-muscle. In the typewriting experiment there was an increase in the amount of work on the caffeine days, and on these days there was about the same number of errors as on the normal days. The decidedly greater effect on neuromuscular work is taken to indicate a peripheral action of the drug as well as a central action.

The effect of small doses of alcohol — 5 to 20 c.c. — reported by previous workers was not confirmed by Rivers. The absence or the slightness of differences between his results on the alcohol and on the control days and the apparently marked effects found by other investigators are explained by the author to be due to the interest aroused in the previous experiments and to the stimulation obtained from swallowing the drug. The previous work in which alcohol is reported to have decreased the amount of work is dismissed by Rivers in his conclusion that all these workers have been influenced by suggestion. Observation tends to support this conclusion, for even in individuals habituated to alcohol small doses of whisky or brandy, containing not more than 5 to 10 c.c. of absolute alcohol, are found to be very efficacious in producing sleep and other effects which cannot be due to the action of alcohol alone. In the use of such small doses the author did not find any of the immediate effect which has been so prominent a finding of others, and it should also be noted that an immediate effect was not found even with the larger doses, 40 c.c. absolute alcohol, used by him.

Larger doses of alcohol were found to be followed by an increase in the amount of work, and "there was no trace of any decrease following the increase which other workers have found, although the experiment was continued much longer than in any previous research." This result is the more noteworthy, since on the days on which the large doses of alcohol were taken the subjects experienced giddiness and other symptoms. An objection to the conclusion of Rivers, which the reviewer believes to be correct, may be made by the anti-alcoholic ex-

perimenters, viz., that Rivers was aware of the nature of the drug because of the giddiness, etc., and that this fact made him and his other subject more anxious to work harder. The effect of the alcohol on the fatigue curve was found to be on the number of the contractions and not upon the height of the contractions.

On mental work the effect of alcohol is in the direction of decrease in working capacity. This was particularly noticeable when the records for a period of eight days were examined. Throughout this period there was a falling off in the amount of work, although practice should have given an increase. The lessened ability was found to exist during the succeeding five days on which no alcohol was taken, and was further increased on two succeeding days on which further doses of alcohol were given. It should be noted that these results are not constant for all individuals, and in fact "even the large dose of 100 c.c. failed to show any effect in some persons."

No personal work is recorded in the section dealing with the effects of cocaine; strychnine effects are reported from the experiments of Jones, which show a rapid rise in the amount of work on the days when large doses were taken, with small rises in the curve when small doses were taken. A peculiarity of all the strychnine experiments is that the rise, which comes early, is followed by a reaction of decrease in amount of work.

The method of taking tobacco could not be disguised, or rather no control experiments have been reported, and any mental influence must have had full sway. Smoking was followed by a decrease in ability, although the amount of the decrease is well within the limits of normal variability.

The book closes with five appendices giving discussions of the following: form of the curve representing the course of fatigue; new apparatus for studying mental fatigue; general effects of caffeine; effects of alcohol; and the multiplication method.

On the psychological side the work gives some accurate results regarding fatigue phenomena, but the reviewer believes the main value of the book and the lectures is that there has been demonstrated the applicability and importance of psychological methods in pharmacological research. In other words, the main value of the work is that it gives a new method or a new viewpoint for the future work on the action of different medicinal agents on man. It has placed in the hands of the pharmacologist a means whereby 'the hidden nature of the objects with which he experiments' may be discovered. It makes possible the accumulation of data of practical and theoretical value by many, and

the value of the present work is not to be measured by the small amount of results and theoretic conclusions which are drawn from the experimental findings. In this connection the reviewer may be pardoned for emphasizing the point since he was prominently criticized for it on another occasion (see *PSYCHOLOGICAL REVIEW*, 1908, Vol. XV., pp. 6-7), and since he believes many philosophers and introspective psychologists may hold the same view of the matter as his critic. In all sciences, for the increase of knowledge, to attain something more than a mere accumulation of discrete facts, ways of looking at the facts are necessary, methods of discovering them are essential and plans required. Given a method or a plan or a viewpoint, many are able to collect facts with some definite purpose for the understanding of the intimate structure of nerve cells, for example; or for the understanding of the world, in a pragmatic way; or for a dynamic interpretation of mental processes. This method, not necessarily the individual piece of apparatus, is what is needed in psychology as in other sciences, so that we may "look beneath the superficial, in search of the more fundamental."

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### SLEEP AND HYPNOSIS.

*An Experimental Study of Sleep.* BORIS SIDIS. *J. of Abnormal Psychol.*, III., 1-32, 63-96, 170-199.

Sleep and hypnosis can both be produced by monotony, by limitation of voluntary movements, limitation of the field of consciousness and inhibition. In hypnosis there is fixation of the attention and suggestibility, and an increased facility of reactions to external stimulations. In sleep there is relaxation of the attention, absence of suggestibility and almost complete suppression of the more complex reactions associated with mental processes.

Sidis, by the method which he terms hypnoidization, induces states which are allied to sleep on the one hand, and to hypnosis on the other. He thus utilizes conditions favorable to both sleep and hypnosis, with the exception that the subject is asked to fixate his attention instead of relaxing it. After a time the patient's pulse and respiration are somewhat lowered. He is often cataleptic and is in an unstable condition that falls now into sleep, then into wakefulness and again into hypnosis. These facts were the basis of experiments made on frogs, guinea pigs, cats, dogs, children and adults. The same methods were used with all of the animals. The condition induced in frogs was not typical sleep as observed in human beings.