found in Willapa Bay oysters, a consumption of this seafood at the rate of 100 lb/week would be necessary to produce a maximum permissible concentration of Zn^{65} (6 μc total body burden). Although this concentration of radiozinc is higher than that reported in other human foods in the United States [for example, 0.32 $\mu\mu c/g$ in beef liver from Nevada (*16*), 0.18 $\mu\mu c/g$ in Atlantic coast oysters (*6*), and 11 $\mu\mu c/g$ in beef grazed on land irrigated with Columbia River water (*8*)], it is substantially below levels that would produce a maximum permissible concentration in man even if oysters were the sole source of animal protein in the diet (*17*).

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High-Rate Laboratory Filtration with Büchner Funnels

Abstract. A method is described for greatly increasing the efficiency of Büchner funnels by utilizing a much larger fraction of the filter paper surface. The method also makes it possible to use Millipore filters efficiently on Büchner funnels.

Büchner funnels, as commonly used, have the disadvantage that filtration is limited to those areas of the filter paper which lie directly over the holes in the porcelain plate. When these areas, which represent only a small fraction of the paper surface, become clogged, filtration stops. The filter paper disk studded with mounds of residue is a familiar sight.

A very simple but extremely effective way of fully utilizing the total area of the filter paper has been devised in this laboratory. It consists of interposing a disk of screening (Fiberglas window screening is good because it will not ravel) between the paper and the pierced porcelain plate of the funnel. The paper is centered over this disk (which is about ¼ to ½ in. smaller in diameter than the paper), is wet, and its edge is smoothed onto the porcelain surface. Thus the main portion of the paper is kept off the porcelain plate and rests instead on a surface having many openings. The holes in the porcelain serve only to carry off the filtrate.

The result is that the rate of filtration is speeded up greatly, the quantity of suspension which can be filtered by a single sheet of paper is increased markedly, and, instead of the paper surface being covered with mounds of residue, the whole surface is uniformly coated (Fig. 1).

Typical results include the filtering with an 11-cm funnel, of 500 ml of a turbid, opalescent bog water in 5 min by using the screen, compared with 42 min for the usual procedure; and the filtering of 1 liter of a silica suspension (5 g/lit.) in 2 min by using the screen, compared with 9 min for the usual procedure. On one occasion 900 liters of lake water were filtered with a 24-cm Büchner funnel, a feat which we would not even have contemplated earlier because of the time it would have taken.

Filtering efficiency in terms of removal of suspended matter is not substantially affected by the screen. A sample of turbid bog water (51 percent transmission of blue light) exhibited about the same degree of clarification when filtered with No. 42 Whatman

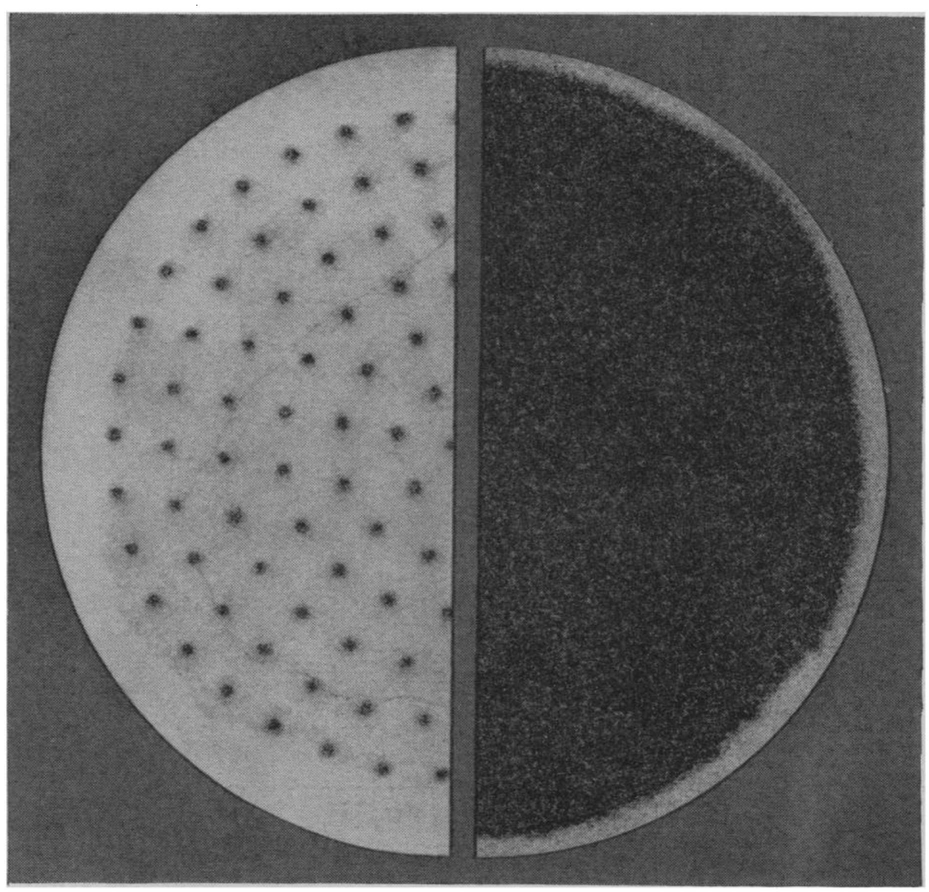

Fig. 1. Filtration of bog water with a Büchner funnel. Left, usual procedure; right, improved procedure.

paper by the usual procedure (73 percent transmission) as by the improved method (72 percent transmission).

The method, while devised initially for paper filters, is equally applicable to Millipore filters which thus can be used without the need of special holders. The 900 liters referred to above were subsequently filtered on the same funnel through Millipore filters cut to the appropriate size.

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Instrumental Conditioning of Jugular Self-Infusion in the Rhesus Monkey

Abstract. A technique is described for self-infusion of pharmacologic agents in solution through a permanently indwelling jugular catheter in the rhesus monkey. The results of an experiment utilizing this technique demonstrate that an instrumental lever response can be conditioned, extinguished, reconditioned, and brought under stimulus control and reward-schedule control with saline self-infusion as the reinforcing stimulus.

Relatively few psychopharmacological studies have focused upon a systematic analysis of the reinforcing properties of chemical compounds with known behavioral effects (*1*). Technologically, the many problems associated with drug administration and the arrangement of appropriate contingent relationships involving behavioral indicators have made experimental investigations in this area difficult to conceive and carry out. It is the purpose of this report to describe the development of a technique of potential value for investigating the reinforcing properties of drugs in laboratory animals and to present the results of an experiment designed to demonstrate its methodological feasibility. Specifically, the present report is concerned with the development of a technique for self-infusion of pharmacologic agents in solution through a permanently indwelling jugular catheter in the rhesus monkey and describes several aspects of the conditioning of an instrumental lever-pressing response with saline self-infusion as the reinforcing stimulus.

Two rhesus monkeys, restrained in chairs, served as subjects. Crackers were continually available to them. After surgical implantation of permanently indwelling catheters in the internal jugular vein of each monkey, continuous recordings of operant levels of responding on a lever switch (a modified telegraph key mounted on the chair within easy reach of the monkey's paw) were taken for both animals during an 8-day period (4 days of water available alternated with 4 days of no water available). After this operant level determination under both satiated and water-deprived conditions (Fig. 1*A*), the water bottle was removed and each lever response was programmed to activate an infusion pump and produce an injection of saline through the indwelling catheter. Under this condition of continuous reinforcement, each lever response during a 4-hour daily session delivered 1.95 ml of saline at the rate of 1 ml/min. Lever responses which occurred during a saline infusion were recorded, but otherwise had no consequence. A house light was on during each test session and off at all other times. With both animals, introduction of the saline infusion reinforcement contingency produced a significant increase in the lever-pressing response rate which remained consistently above operant levels (Fig. 1*B*) and which exhibited the typical characteristics of behavior under continuous reinforcement conditions. The subjects self-infused a daily average of 65 ml of saline during this phase of the experiment.

Extinction of the instrumental lever-pressing response was observed in both monkeys after discontinuation of the saline infusion (Fig. 1*C*). With only the tube from the pump to the catheter disconnected and all other aspects of the circuit in operation, a typical lever-pressing extinction curve was generated by both monkeys with a concomitant return to operant level response rates. After reconditioning of the self-infusion behavior by replacing the pump connection (Fig. 1*D*), both monkeys were provided with an *ad libitum* supply of water through an easily accessible bottle and mouth spout. Under these conditions of free access to water by way of the normal oral ingestion route, a marked decline in the self-infusion response rate was again observed for both monkeys (Fig. 1*E*). This finding indicates that the reinforcing properties of normal saline infused in this manner are at least partially sensitive to variations in "drive" level.

In the final phase of this experiment an attempt was made to bring the instrumental self-infusion behavior under exteroceptive stimulus control. Lever responses were reinforced with saline infusion only in the presence of a dim light stimulus presented on a panel in front of the monkey. Responses in the absence of the light were not reinforced. Five-minute periods of dim light were alternated with 5-minute periods of no light during each 4-hour daily session. After several days of exposure to these conditions, the response rates and volume of self-infused saline recorded during the dim light condition approximated levels obtained during the previous continuous reinforcement sessions. The response rates in the absence of the light approximated the operant level (Fig. 1*F*). Preliminary observations have also indicated that such self-infusion responding can be brought under reinforcement schedule control by requiring a fixed ratio of lever responses to produce each saline injection. Introduction of such a ratio requirement produced a marked increase in the response rate over both operant and continuous reinforcement levels (Fig. 1*G*).

These findings indicate quite clearly that the self-infusion of a chemical compound in solution can serve as a

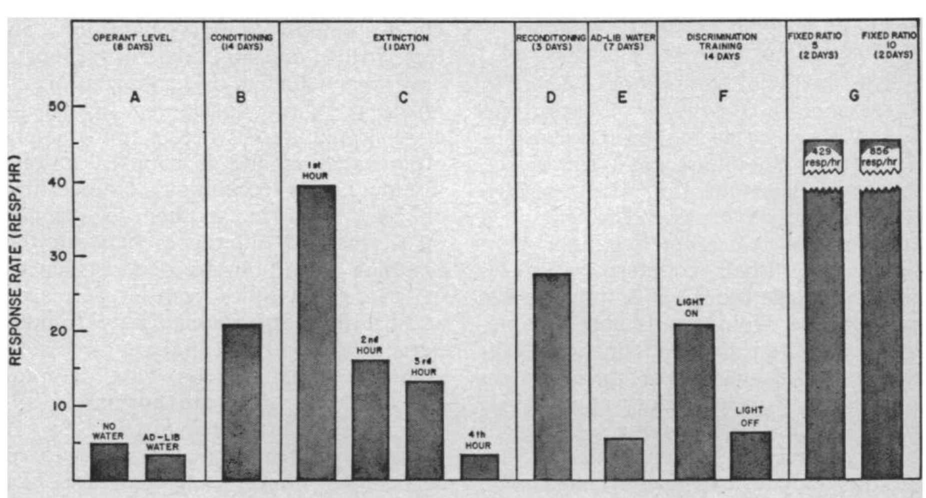

Fig. 1. Average response rate, in responses per hour, during the various phases of the experiment.