voir E, 1 cm of oil will be equivalent to about 1 mg of water. When the temperature of the apparatus has reached equilibrium, as indicated by a constant pressure, the manometer reading is recorded. The apparatus is readied for the next determination by opening stopcock *F* and trapping the water in a condenser placed in the vacuum line to the pump.

This apparatus can also be used to determine the pressure within the container before it is opened and can constitute the first step in the moisture determination. To do this, stopcock *F* is closed before the connection between the sample and the apparatus is completed (step 2). The total pressure within the sealed bottle is directly related to the observed pressure and can be obtained from an appropriate conversion graph similar to that used to obtain the amount of water.

Some time after the method had been in use in this laboratory, Beckett (*3*) described an apparatus for measuring moisture that is similar in function and principle to that described in this report. However, the unit described here differs in design and permits easier and more reliable operation. One important feature is the design of the manometer, which makes it convenient to degas the oil *in situ*. Another advantage in the construction is that, even though an error is made in manipulating the stopcocks, there is no possibility of sucking oil either into the pump or into other portions of the apparatus. A third advantage is that if the stopcock *H* is left closed the manometer can serve to check the operation of the instrument, obviating the use of a separate vacuum gage.

By exposing the bottle or ampule directly, temperature equilibrium between the sample and water bath can be achieved rapidly. Most of the procedures described in the literature use temperatures above 60°C but at relatively high pressures, that is, 50 to 100 mm of mercury. Because of the higher vacuum employed in this apparatus, comparable results may be obtained at lower temperatures. Since the temperature of the sample can be easily controlled, procedures are readily standardized to yield results comparable to those obtained by any other method.

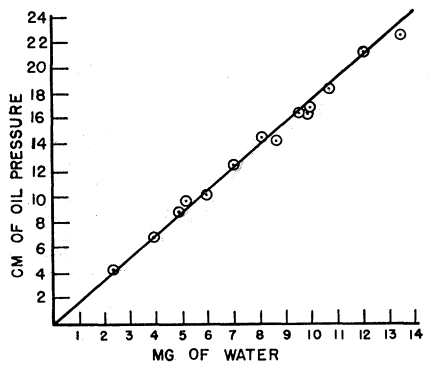

Fig. 2. Observed pressure of known amounts of water. The solid line represents the theoretical curve that is based on the volume of the apparatus; the points represent individual observations.

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References and Notes

1. This work was supported by a contract between the University of California department of bacteriology and the Office of Naval Research. The opinions contained in this report are not to be construed as reflecting the views of the Navy Department or the Naval Service at large (article 1252, U.S. Navy Regulations).
2. A. W. Anderson, personal communication, 1950.
3. L. G. Beckett, in *Biological Applications of Freezing and Drying*, Ed. R. J. C. Harris (Academic Press, New York, 1954), p. 285.

* The assistance of Melvin N. Klumpp is gratefully acknowledged.

9 May 1955

Desiccator Cover Remover and Sleeve Wrench

The removal of desiccator covers (particularly glass desiccators) that have become tightly adhered has always been a problem. Use of desiccators in low temperatures, for long periods under vacuum, and with improper grades of seal grease, and so forth, are some of the common reasons for the tightly adhered covers. The ordinary means of removing the sticking covers can be hazardous because of the possibility of breaking the lid or desiccator jar; there is also the chance of spilling the samples in the desiccator during the operation. The use of glass desiccators that have a ground glass external collar with turbulature presents a similar problem. Occasionally these sleeves or collars are very difficult to turn, particularly if the desiccator is being used in low temperatures. When grasping the sleeve in an effort to turn it, and using the tabulature or side arm as a means of leverage, one is apt to break the tabulature; this often results in a serious injury to the operator. The following paragraphs describe a desiccator cover remover and a sleeve wrench that have been designed in our laboratory for performing the afore-mentioned operations in a safe and easy manner.

The cover remover is shown at bottom of Fig. 1. On the bottom jaw of the hand lever *A*, two tapered hard rubber rollers *B* are mounted on a ¼-inch pin through the jaw. A slot *C* is cut at an angle in the top jaw to receive the cross pull links *D*. The pull links are fastened through the openings of opposite sections of parallel brass sash chain *E*. The chain is drawn through rubber tubing that keeps it from becoming tangled and still allows flexibility. The cross pull links are made of ⅛-inch stainless steel rod threaded on both ends. Nuts on both sides of each chain section provide proper spacing between the chains and secure the pull links to the chain. The pull links are set at intervals along the chain to accommodate each size of desiccator cover. The ends of the chains are fastened to a hook that consists of an approximately 2-inch square brass plate *F* that is bent slightly to conform somewhat to the curvature of the cover. A ¼-inch square brass rod *G* bent slightly to conform to the outer circumference of the largest cover is soldered to the bottom along one end of the brass plate, forming the hook. Rubber tubing is placed over the handle of the lever to provide a better grip.

In operation, the proper pull link is engaged in the jaw slot and the end plate is placed so that the square rod is over the edge of the lip of the cover. The lever is then placed so that the chains pass over each side of the top of the cover and the rollers are under the flange of the desiccator proper. If the pull links are spaced properly, the handle of the lever should now be in a position slightly below horizontal. By holding down on the brass plate hook with one hand and pressing down on the lever handle with the other, the cover may be drawn across the desiccator far enough for easy removal.

The sleeve wrench is illustrated at top of Fig. 1. It consists of a pair of pivoted levers *A* the handles of which are bent slightly to bring them closer to parallel when they are in use. Rubber tubing *B* is placed over the handles to provide a better grip. One end of a piece of brass sash chain *C* is securely attached to the end of one of the levers. Pure gum rubber tubing is placed over the sash chain allowing a lip *D* of the tubing to cover the point where the chain is attached to the lever. Single extra chain links *E* are attached to the chain at proper intervals through holes cut in the rubber tubing. The extra links are attached in such a way that the loop end may be slipped over a pin *F* that is fastened in the end of the opposite lever. The locations of the extra links are determined by the diameters of the glass sleeves of the desiccators in use. The ex-

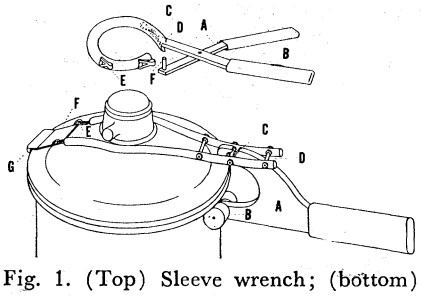

Fig. 1. (Top) Sleeve wrench; (bottom) cover remover.

tra link attached to the chain to accommodate the largest diameter sleeve should be placed one link from the end of the chain so that the rubber tubing extends beyond the extra link, thus providing complete rubber contact with the glass sleeve.

In use, the rubber covered chain is looped around the sleeve and the appropriate projecting link is slipped over the pin. Pressure on the handles clamps the chain around the desiccator sleeve, and the rubber tubing affords a good grip on the glass. The sleeve can then be turned in either direction.

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Germicidal Activity of Electric Heaters

Relatively little information is available concerning the possible secondary effect of various heat sources on the microbial population of room air. It appeared reasonable that a reduction in numbers might be induced by electric heaters, particularly those of a type in which a considerable amount of the heat generated is distributed by convection currents through the heater rather than by radiation. The higher temperature of the air in the immediate vicinity of the heater element, as well as inactivation or incineration of the biological agent on striking a hot surface, could be effective in reducing the numbers of air-borne organisms. Wesix heaters were selected for the tests since they are of a type (*1*) through which air circulates quite rapidly through and around a ceramic chimney (900 to 1200°F) supporting the heating element (1100 to 1500°F).

Table 1. Effect of electric heaters on the microbial population of air in various rooms of a home under normal conditions of use. Temperature range of 69° to 72°F.

Location	Air sample (liters)	Colony counts		
		Hours		
		0	1	2
Bedroom	40	88	44	8
Bedroom-study	35*	188	99	
Dining room	50	25	11	7
Dining room	100	74	43	31
Dining room	†	54	23	8
Dining room	100	16	8	3
Dining room‡	100	66	19	6
Dining room	†	68	21	14

* Millipore filters used for assay.
† Numbers settling on agar in petri dish in 15 minutes.
‡ Wall-type heater instead of floor-model heater.

Tests (*2*), to be reported in detail elsewhere, were conducted to determine (i) the direct germicidal action exerted when suspensions of bacteria, bacterial spores, or bacteriophages were nebulized in such a manner that a continuous stream of the aerosol passed through the heater core; (ii) the effect of the heater in an experimental room in which the population could be controlled; and (iii) the influence of a heater on the air-borne microbial population in rooms of my home.

Results of tests of type one and two indicated that the heaters did exert rather marked bactericidal, sporicidal, and viricidal activity. For example, direct passage of aerosols through the heater indicated a reduction in numbers of viable spores of the order of 50 to 75 percent, of around 90 percent for bacteria, and around 99 percent for a bacteriophage.

Tests of type three are of more general interest because they were designed to determine the reduction in numbers of air-borne microorganisms during normal operation of a heater in the home. Representative samples of air were passed through broth in an impinger flask (*3*), the numbers of viable spores and bacteria collected therein being determined by ordinary dilution and plating techniques. In some tests, the air was also sampled with the aid of Millipore filters. The two methods yielded similar results, but dilution and plating were better adapted to wide variations in numbers of organisms sampled.

The tests were carried out on different days and in different rooms under normal conditions in the home; the numbers of bacteria, therefore, showed considerable variation. Counts made on replicate samples of air, however, agreed quite closely with each other—for example, 73 and 75 colonies developed from 100 liters of air sampled 1 and 2 hours before the heater was used. Results of a number of tests are summarized in Table 1. The percentage reductions (including higher fungi developing during incubation for 72 hours) noted after 1 hour ranged from 46 to 56 percent and in the following hour from 30 to 80 percent. Plate counts of organisms settling out from the air indicated similar reductions. Different patterns of air circulation in the room and through the heater are responsible in part for the marked variations noted over longer test periods. Similar tests carried out with a wall-type heater rather than a floor model gave results of the same general nature (see Table 1).

The results of this study indicate that in addition to their primary heating function, electric heaters of the type described do exert germicidal activity during the time they are in operation in experimental chambers or in rooms in a home. In the latter case, rates of reduction of air-borne microorganisms were in the general range of 50 percent per hour.

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References and Notes

1. J. C. Beckett, *Am. Inst. Elec. Engrs. Applications and Industry* 73, part 2, 161 (1954).
2. Grateful acknowledgment is made to A. P. Krueger and J. C. Beckett for helpful advice.
3. T. Rosebury, *Experimental Air-borne Infection* (Williams and Wilkins, Baltimore, Md., 1947).

22 August 1955

Disposable Petri-Type Dish

It has been possible to have fabricated a petri-type dish from paper and plastic materials. This dish is fully reliable for usual bacteriological uses and is inexpensive enough to be discarded after it has been used once.

Figure 1 shows the appearance of the currently available (A. S. Aloe Co., St. Louis, Mo.) disposable petri dish. The left portion of the illustration shows an opened dish. The top stands on edge above the bottom dish. The right portion shows two streaked plates.

Dimensions are approximately those of the standard 90-millimeter diameter glass petri dish. Walls are constructed of heavy paper and tops and bottoms consist of cellophane or similar transparent plastic material. The plastic bottoms and tops are sealed in their marginal portions to the walls by adhesives applied under pressure.

The assembled dishes, which need not be washed, can be sterilized in the autoclave (115 to 120°C for 15 minutes or longer); the sterilization does not cause any discernible change or distortion in shape or composition of the materials employed in manufacture of the dishes. Dry air sterilization cannot be employed because the plastic is unstable at high, dry temperatures and is destroyed.

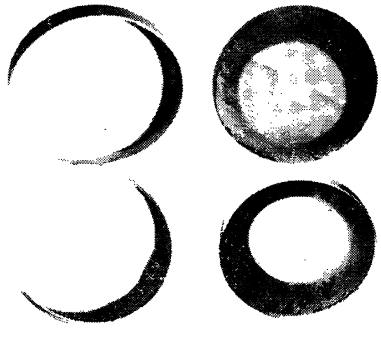

Fig. 1. Disposable petri-type dish.