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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28 June 1955

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).

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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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.

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.

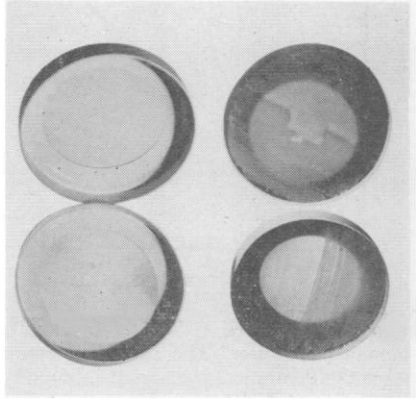

Fig. 1. Disposable petri-type dish.

Agar media are prepared and poured into the dishes in the conventional fashion. After use, the dishes may be sterilized by the use of chemical disinfectants, by incineration, or by autoclaving and then discarded.

The disposable dishes have been employed for routine work in this research laboratory and in the bacteriology section of the clinical laboratories at the Latter Day Saints Hospital, Salt Lake City, Utah. Comparative tests have shown that results similar to those obtained with the usual glass product are obtained with the paper dishes.

Certain advantages of the disposable paper and plastic petri dish are significant; for example, the problems accompanying accumulations of dirty dishes are relieved; experiments involving the use of larger than usual numbers of dishes can be carried out without burden to the budget or inventory.

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Sterile Microdissection and Isolation of Malarial Oocysts

In connection with the study of the growth of malarial oocysts *in vitro* (*1*), the following technique was developed for sterile dissection and successive transfer of the oocysts in hanging drops (*2*).

A chamber of dimensions 35 by 40 by 22 cm (Fig. 1) was made with three walls of sheet metal, a plastic sleeve in front for insertion of one's hands, and a Lucite top with an opening for the body of a dissecting microscope (*3*). This opening was sealed by an elastic rubber membrane.

In addition to the fluorescent light in the chamber, two study lamps were used on the outside, each with a water-filled 50-ml flask on the Lucite top to focus the light on the object. A little ammoniated copper sulfate was added to the water for better contrast.

The illumination of the object was further strengthened by replacing the glass-plate stage of the dissecting microscope with a piece of Bakelite, in the center of which a hole was drilled that corresponded in place and size to the visual field of the low-power objectives. With this device, good contrast and a well-defined outline of the object were obtained.

Micro dissecting instruments were made from fine steel wire with ends ground into a point or a cutting edge. A pair was held by soft copper wire sheathed in plastic, one member being

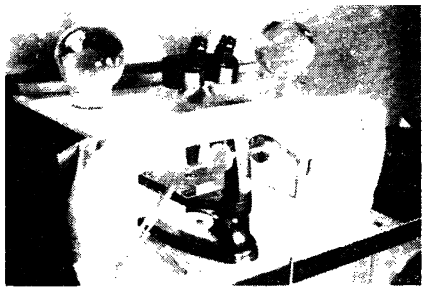

Fig. 1. Chamber equipped for sterile microdissection.

fastened through the slit provided for an arm rest at either side of the stage. The handle, made from glass rod, was held by many turns of the wire, which was looped at the base so that the instrument could be directed to any position or else bent down under the stage while it was not in use.

A foot-pedaled focusing device was provided in order to free the operator's hands for dissection. This device was composed of a ring fastened by a screw to the focusing knob and hinged to a steel rod, which was in turn hinged to the foot pedal.

The chamber was first sprayed with 75-percent alcohol and then equipped with all necessary sterile articles and materials so that it would be self-sufficient after the operation was under way. These articles were a dropping bottle of Ringer's solution, a test tube fitted with a medicine dropper and containing the culture medium, a covered dish of hexylresorcinol (1:1000), petri dishes with glass slides and coverslips, dissecting instruments, and depression slides ringed with petrolatum.

A previously sterilized covered jar containing petrolatum and a section of glass tubing with a diameter slightly larger than the circle of the depression slide was heated until the petrolatum melted. The jar was then sprayed with alcohol and placed quickly in the chamber. Rings of petrolatum were made by setting the glass tubing on the depresison slides, which were then placed upside down on a rack in the petri dish.

The chamber was also provided with sterile tissue paper contained in a small box taped against the side wall. The slit opening of this box was covered by a glass plate hinged above with adhesive tape. Pieces of paper to wipe off the tips of the dissecting instruments could be easily pulled out from the slit; the glass plate served as a protection against contamination.

After the afore-mentioned articles had been placed in the chamber, the chamber was sprayed with alcohol a second time and the operation proceeded as follows. The mosquito to be dissected was immobilized by carbon dioxide and then brushed free of scales. Both the oral and the anal openings were sealed by touching them to a fresh surface of Duco cement. After the cement had hardened, the insect was placed in the chamber and dipped for a few seconds in hexylresorcinol. It was then washed through 8 or 9 drops of Ringer's solution on slides and was ready for dissection.

The Duco cement not only prevented contamination of the Ringer's solution by the contents of the digestive tract but also kept the insect from floating; thus it made the dissection easier. In dissection, care had to be taken not to cut through the digestive tract. Usually, two operations could be made on a single stomach, which nevertheless continued to contract hours after it had been cut provided that the Ringer's solution was changed frequently.

Neither a micropipet nor a microspatula was successful in transferring oocysts. But by means of a "ferry," the oocysts were transferred successfully from drop to drop of Ringer's solution for washing, and from drop to drop of medium for culturing. The "ferry" was a fragment of broken No. 1 coverslip about 1 mm^2 in size. Such fragments were made beforehand in great numbers and only those with straight edges were chosen, since good straight edges alone could assure a sure grip with the fine points of the forceps. These selected glass fragments were sterilized in a small petri dish and kept inside the chamber.

After an oocyst had been cut out under the high power of the microscope, it was observed with low power and pushed by a microspatula to the center of the ferry. A slide was placed on the stage, and then a coverslip was placed on the slide. One or two drops of Ringer's solution and a drop of medium were placed on the slide for washing, and a drop of medium was put on the coverslip for culturing.

The ferry was picked up by a pair of fine forceps and washed in the drops of Ringer's solution and medium on the slide and was finally placed in the culture medium on the coverslip. It was then handled with the usual hanging drop technique. All of these steps had to be carried out without losing sight of the oocyst. By the techniques outlined here, oocysts of the size of 20 μ have been dissected and transferred successively to fresh medium for culturing.

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References and Notes

1. G. H. Ball, *Exptl. Parasitol.* 3, 358 (1954).
2. This work was aided by grant No. 1857 from the U.S. Public Health Service and was suggested by Gordon H. Ball.
3. Thanks are due to Thomas W. James for the design of the chamber.

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