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A Constant-Temperature Room for Small-Scale Experiments with Young Chicks

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Under artificial conditions very young chicks must be provided with supplementary heating and protection from draughts. In the many types of commercial brooder these requirements are usually met by screens and heaters. The temperature in the screened compartment is normally kept at 95° F. for the 1st day or two after hatching and is then gradually reduced to 80° F. during the following 3 weeks, after which auxiliary heating can be discontinued provided the room temperature is not abnormally low. Commercial brooders are usually designed to house about 100 chicks in each compartment. They can, however, be subdivided into sections, and for the normal work of this laboratory with groups of about twenty chicks these brooders, slightly modified, have provided suitable accommodation. For pilot experiments, or where the test material is scarce, much smaller groups of two or three chicks can be used with advantage, but difficulties were experienced in housing such small groups satisfactorily. They did not thrive in subdivided brooders and the risk of chill was considerably increased by the absence of the body-heat generated by larger numbers of chicks.

It therefore seemed desirable to construct a room in which the inside temperature could be held sensibly uniform at any selected value within the range normally used for chick experiments. The birds could then be housed in ordinary small-animal cages and as nearly as possible would have common conditions of temperature, light and ventilation. These conditions could be altered with the age of the chicks. The essential requirements of such a room appeared to be: (1) thermostatic temperature control with a range from normal ambient temperature to 95° F.; (2) temperature variation within the room limited to ± 2° F.; (3) adequate and adjustable ventilation; (4) air velocities in the vicinity of the chicks limited to 40 ft./min.; (5) smooth and impervious internal surfaces for easy cleaning; (6) provision of uniform artificial lighting with suitable controls.

No provision was made for the control of humidity as it was assumed that close adjustment of this would not be a critical factor, an assumption justified by the recent work of Barott & Pringle (1949), demonstrating that chicks are unaffected by variations of humidity from 35 to 75 %.

EXPERIMENTAL

Design and construction of room

General construction

For general convenience, and to minimize the heating load, the room was constructed within an existing laboratory utilizing as part of its structure the existing ceiling, floor and two walls. The other two walls were made of 4 in. × 2 in. timber studding clad externally with 0·25 in. plywood, the joints being covered by 1 in. half-round timber fillets. In one of these walls a door 6 ft. 9 in. × 2 ft. 7 in. was placed. The internal dimensions of the room when finished were 7ft. 0 in. × 5 ft. 0 in. × 9 ft. 6 in. high.

The internal surface of the walls, ceiling and door was formed by 0·25 in. asbestos sheet ('Stippleglaze', Turners Asbestos Cement Ltd.) fixed directly to the studding or to 2 in. × 0·5 in. battens on the existing walls and ceiling. The joints were covered by half-round fillets secured with brass screws. A sealed air space was thus formed in the ceiling and all four walls to act as thermal insulation. Wall-to-wall and wall-to-ceiling joints were covered by angle fillets and a skirting board was fitted. All internal woodwork was finished in high-gloss white enamel.

Ventilation and air circulation

Forced circulation of air was considered necessary to maintain the temperature-variation limits imposed. To achieve this without exceeding the arbitrary maximum air velocity, three slow-speed circulating fans were used. These were placed as shown in Fig. 1, being enclosed by a protecting wire cage. An air-outlet duct was arranged with an adjustable trapdoor so that a proportion of the air could be blown to waste, fresh air inlets with adjustable slides being provided adjacent to the fan blades on the low-pressure sides. These inlets were of a size to give an area of 0·625 sq.ft. corresponding to 25 cu.ft./min. at 40 ft./min. velocity. This represents five air-changes/hr.

To prevent an excessively dry atmosphere a large open bowl of water was kept permanently in the room.

Heating requirements

The heat losses through the floor, ceiling and each wall were calculated separately, the values of the thermal transmittance coefficient varying from 0·198 to 0·404. A temperature difference of 45° F. between inside and outside was allowed for three walls and the ceiling, and of 65° F. for the other wall and the floor. This gave a total loss of 5300 B.TH.U./hr. for the room. The ventilation air, assuming an intake temperature of 50° F., accounted for 1500 B.TH.U./hr. The total estimated heat loss under these conditions was therefore 6800 B.TH.U./hr., equivalent to approx. 2 kW. It was considered that heat losses through the doorway would not exceed 3000 B.TH.U./hr. under the worst conditions: the heaters were therefore designed for a total loading of 3 kW.

In order to heat uniformly the air leaving the fans the heating elements were specially made by lacing a spiral element on an insulating ring ('Sindanyo', Turners Asbestos Cement Ltd.), one such heater being mounted directly underneath the blades of each of the three fans. The heaters were designed to run at 300° to minimize local over-heating, each element being wound from 61·8 ft. of 22 s.w.g. nickel-chrome resistance wire ('Brightray', Henry Wiggin and Co.) on a $\frac{3}{16}$ in. diam. mandrel.

Temperature control

Commercial types of room thermostat having an adequate response were not available and a differential expansion thermostat was constructed. This consisted of an aluminium tube 4 ft. long with a diameter of 1·5 in. To one end of this was fitted a bracket

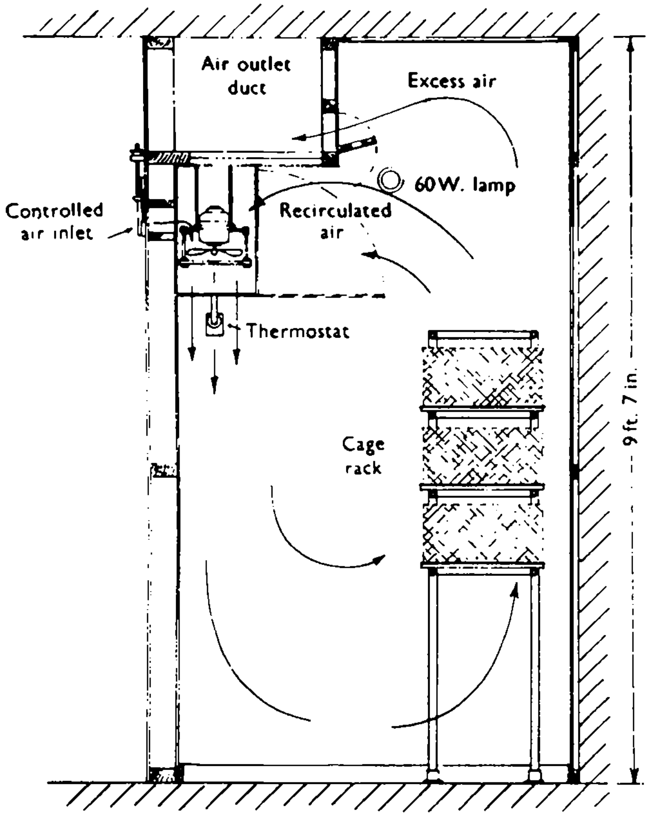

Fig. 1. Sectional elevation of constant-temperature room.

carrying a 5:1 lever movement and a microswitch. Inside the aluminium tube, freely mounted, was a Pyrex-glass rod one end of which was in contact with the lever arm. The other end was anchored to the aluminium tube through an adjusting screw having a setting wheel and index. The microswitch was connected in the control circuit of a relay (Sunvic Controls Ltd.) which controlled the three 1 kW. heaters. The fans were controlled separately and ran continuously. The thermostat was suspended under the heaters about 7 in. downstream.

Lighting

Two 60 W. tungsten lamps in batten holders were used one at each end of the room at 8 ft. height. These lights were lit for 12 hr. daily and were controlled by a time-switch with a tumbler switch in parallel to give an overriding control during the off periods.

Internal fittings

A free-standing rack made from ¾ in. tube and of welded construction was designed to take a maximum of twenty-four animal cages 12 in. wide by 18 in. deep by 9 in. high. These were arranged in staggered formation to facilitate air distribution and minimize temperature gradients.

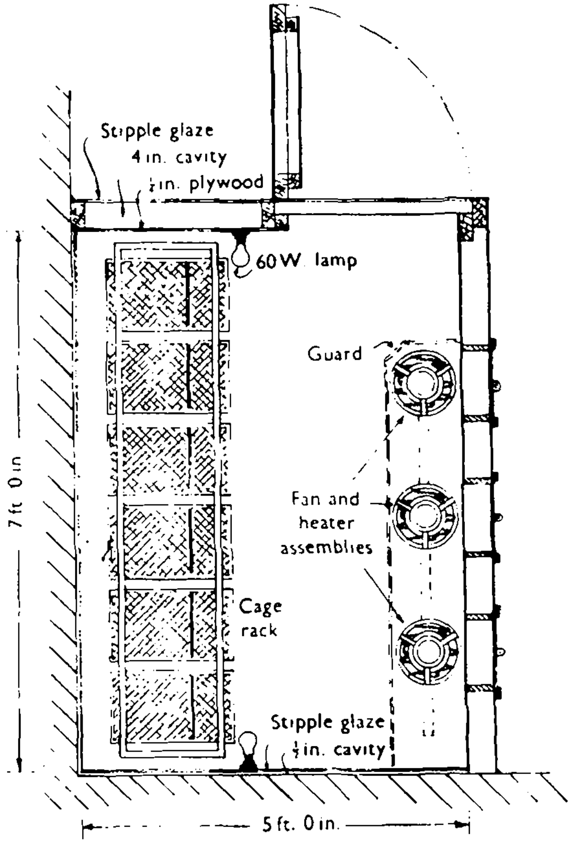

Fig. 2. Sectional plan of constant-temperature room.

RESULTS

The room has been in use for long periods since 1947. The temperature at various positions throughout the region in which the birds are situated was measured by thermocouples and found to be within $\pm 1\cdot5^\circ$ F. The arrangement of the light fittings does not give entirely uniform illumination over the whole room, and better results might be obtained with more diffuse lighting. In all other respects, however, the performance of the room complied with the specifications originally laid down. It proved suitable for the rearing of young chicks, as judged by the satisfactory growth rate and general condition of normal birds kept in it.

SUMMARY

1. The construction is described of a simple constant-temperature room for rearing young chicks used in small-scale laboratory experiments.

2. The internal dimensions were 7 ft. 0 in. × 5 ft. 0 in. × 9 ft. 6 in., and this size proved adequate to contain a rack of twenty-four small laboratory cages.

3. The temperature variation was within $\pm 1 \cdot 5^\circ$ F. throughout the room.

4. Young chicks were successfully reared in the room from hatching to 4 weeks of age.

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The Use of Chicks for the Biological Assay of Members of the Vitamin B Complex

1. Tests with Pure Substances

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During recent years rapid developments in the isolation and identification of the various B-complex vitamins have called for reliable methods of determining these factors and for some means of estimating their physiological availability. Chemical determinations have proved possible for aneurin, riboflavin and nicotinic acid, but the methods, although they may be perfectly reliable for the pure vitamins, are of questionable specificity with naturally occurring materials, as the chemical reactions may be masked, inhibited or enhanced by interfering substances or may fail to detect the vitamin if it is present in a bound form.

The advancing knowledge of the nutrient requirements of micro-organisms has presented a means of measuring certain food factors essential to them; the foundations of the present-day technique of microbiological assay were laid by Snell & Strong (1939), who used the production of lactic acid by *Lactobacillus casei* as a measure of response to riboflavin. Many procedures involving different organisms and conditions are now in current use.

The apparent simplicity of these methods has resulted in their widespread application to determinations of vitamins in a great variety of natural materials, and sometimes more confidence has been placed in the results than seemed justified. Although the methods have to some extent been checked by chemical or biological means, no consistent examination of their validity has so far been made, and it was largely to provide