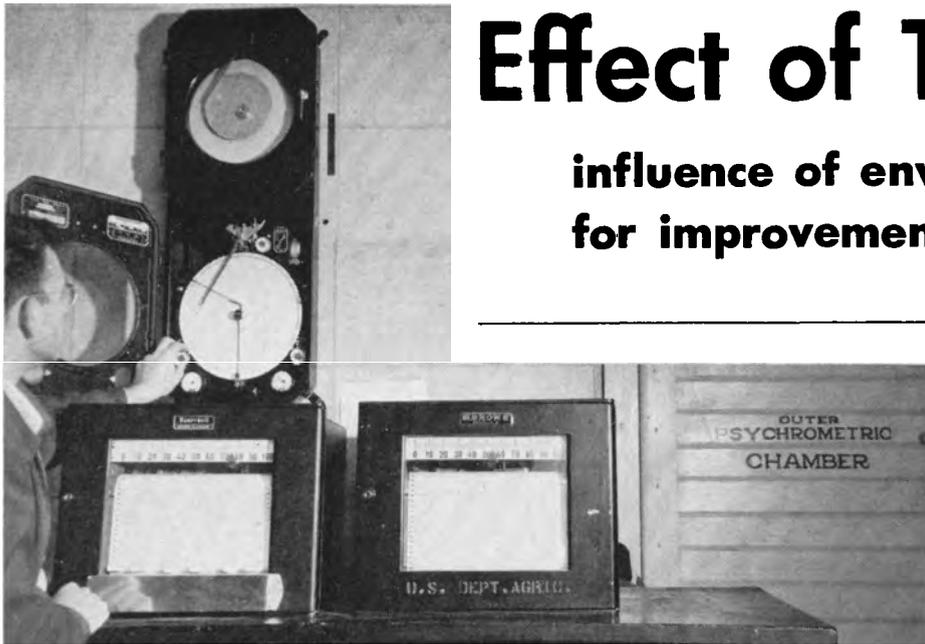


# Effect of Temperature

## influence of environment on feed utilization for improvement in efficiency of farms

Hubert He



Instruments which control and record the changes in air temperature and relative humidity in psychrometric chamber.

**Weather temperatures** have a direct bearing on the cost of livestock production and profit.

The general effects of high temperature—on swine, for instance—are easily observed. The animals become lazy and tend to lie flat on the ground or floor. As the ambient—environmental—temperature rises above a certain point, the average daily weight gain drops more rapidly than the daily feed consumption, and the amount of feed required to produce 100 pounds of gain increases markedly. It is clear that high temperatures greatly reduce feed utilization.

If the modern, well-ventilated and in-

ulated buildings—in which huge sums of money are invested every year to protect livestock from the weather—were designed with the knowledge of exactly how environment affects the efficiency of feed utilization by the animals, these structures could be more valuable and less expensive. A designer of a livestock building should also know how much heat from the animals is available for heating the structure in cold weather and how much will have to be removed by the ventilation or air-conditioning system in hot weather.

In an environmental research project carried on by cooperating agricultural engineers and livestock husbandmen, swine are being studied at Davis, where a psychrometric chamber—controlled climate room—permits the measurement of the effect on the animals of ambient temperature and relative humidity. The chamber also makes it possible to measure the amount of heat loss from the animals under various conditions.

In conducting a test of the effect of temperature on the weight gain of swine—for example—the animals are brought into the psychrometric chamber, where they are weighed and then maintained for a week or two at a constant temperature of 70°F. This gives them time to get adjusted to their new home and to become gentle enough so that their respiration and pulse rates and rectal temperatures can be measured.

The animals are handled and managed—as far as possible—just as they would be on a farm with good swine husbandry practices. Water is available at all times, at room temperature, in a specially designed waterer which records

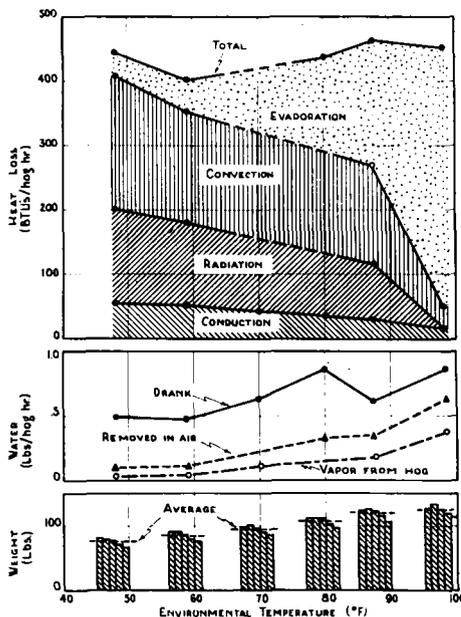
the amount drunk. The animals are hand-fed twice daily in a trough.

A careful record is kept of the amount of feed eaten and water drunk. The animals are weighed every week.

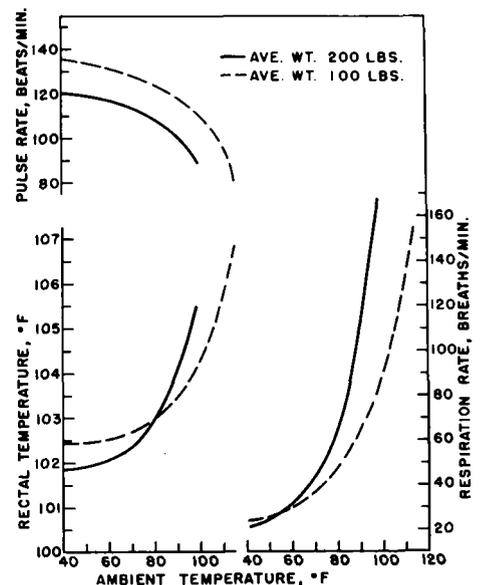
The room temperature is usually raised every week by ten-degree steps. Thus, a group of pigs might spend two weeks at 70°F, one week at 80°F, at 90°F, and at 100°F before they are brought back to 70°F for a rest period. Then they might be given the same schedule of one-week studies at 60°F, 50°F, and 40°F. This would make a total of eight or ten weeks in the chamber, during which time they would have increased somewhat in size, as from 75 to 150 pounds. The reaction of a 75-pound pig to a given air temperature is different from that of a 150-pound pig, so the tests must be duplicated a sufficient number of times to give satisfactory data for analysis. Such a procedure takes a long time but is necessary if the data is to be sufficiently accurate to be of benefit to the farmer.

In experiments where environmental conditions were constant during one-week periods—and within the limits of temperature control—there was a regular increase in respiration rate as the room or ambient temperature was in-

Effect of environmental temperature on heat loss and water relationships for hogs weighing 75 to 125 pounds.



Ambient temperature and its effect on body temperature, respiration and pulse rates.



# on Swine

## ation studied structures

man, Jr., T. E. Bond, and C. F. Kelly

creased. Body temperature increased with the rising ambient temperature, but the increase was relatively small until the higher temperatures were reached. As the temperature climbed, the pulse rate declined. The rapid and immediate rise in respiration is notable and precedes any body temperature change. As ambient temperature increases, feed consumption decreases, but—under the conditions of these studies—there was no indication of complete loss of appetite.

These studies have supplied much data on water consumption by swine, but whether it is reduced as the ambient temperature increases is still being investigated.

Average daily gain appears to reach a peak at a definite ambient temperature, above which it rapidly drops. Heavy growing fattening hogs seem to reach this peak for growth rate at a constant temperature of approximately 60°F. Lighter feeding pigs weighing around 100 pounds reach the peak at about 70°F. Feed utilization follows the average daily gain.

Wetting—by spray or other means—a hog distressed by heat produces a marked response of lowered respiration rate and finally of body temperature. Increasing the air motion around a wet hog

produces an even more rapid change in lowered respiration rate and body temperature.

High humidity also has a marked effect on swine if at the same time temperature is high. Wide-range experiments with humidity have not yet been completed.

Air motion has been studied in preliminary trials. When hogs are distressed by high temperatures, increased air motion—such as by use of an electric fan—is of no benefit. This is to be expected of a nonsweating animal—such as the hog—when the air temperature is higher than his surface temperature.

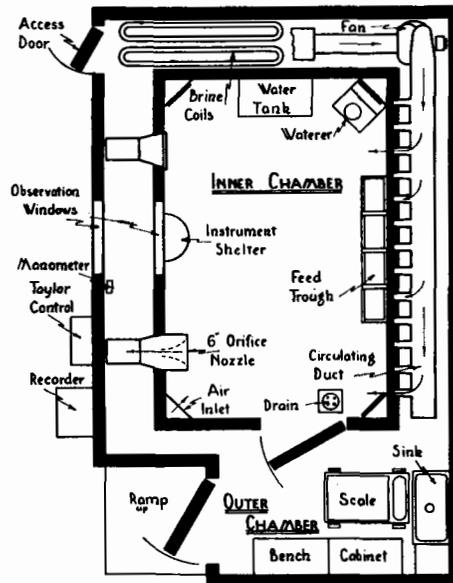
Hogs, as is true of most living organisms, have a heat-tolerance limit which depends on the weight of the hog. Work with pregnant sows demonstrated that the fetuses were relatively heat resistant and that the sow would die before abortion occurred from high ambient or body temperature.

Determinations of the heat and moisture lost by swine of various weights under different conditions are necessary before workable animal-shelter ventilation systems can be properly designed. Adequate buildings should maintain—as near as possible—the range of environment found to be most conducive to animal health, gains, and efficient feed utilization.

The primary purpose of a ventilation system in a livestock building is to remove the excess moisture given off by the animals. The heat they give off is usually expected to maintain building warmth, but part of it must necessarily be used to vaporize some of the moisture to facilitate its removal in the ventilating air.

The heat and moisture lost by the animals are highly important factors in livestock-building plans, and many tests have been made in the psychrometric chamber to study this phase of the problem.

As the ambient temperature rises, the animal's surface temperature also rises but at a slower rate. Also, it becomes increasingly difficult for the animal to lose heat by conduction, radiation, and convection. It must rely more and more on evaporation until—at an ambient temperature of around 100°F—most of its heat is lost by evaporation. In an effort



Plan view of psychrometric chamber. Pigs are maintained in the inner room and weighed in the outer room.

to keep a normal temperature, the animal cuts down on his feed intake but finally—unable to dissipate all the heat—his body temperature increases.

To the farm-structures engineer, the recorded moisture removed from the air provides a basis for the amount of ventilating air required to remove all excess moisture from the building. From the heat-loss record, he knows what animal heat will be available to warm the ventilating air and to evaporate the moisture it must remove. The engineer is then able to design an animal building to meet certain environmental requirements or to predict how those requirements can be met in existing buildings.

Findings of this nature, while not so dramatic as other types, are just as important in the improvement of our livestock management economy.

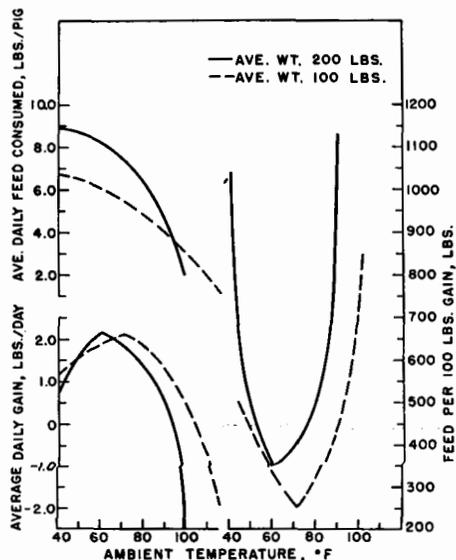
Hubert Heitman, Jr., is Associate Professor of Animal Husbandry, University of California, Davis.

T. E. Bond is Agricultural Engineer, Agricultural Research Service, U.S.D.A., Davis.

C. F. Kelly is Associate Agricultural Engineer, University of California, Davis.

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Ambient temperature and its effect on feed consumption, average daily gain and feed utilization.



Self-feeder with shades for field study of laboratory findings. Water sprays are not visible, but wet concrete in foreground is a result of the sprays.

