controlled by a thermostat in the outside room such that the *Avena* room is maintained at 25° C (±1°). If it were necessary to thermostat the room, it could be done easily by installing in place of the small 8″ fan behind the humidifier, a blower-type electric heater in conjunction with a thermostatic control.

In the present situation when the relative humidity drops below 84%, the humidistat closes and magnetizes the solenoid which opens the valve, allowing the atomizer to begin spraying. The system cuts off at 88% relative humidity. The rate of spray is controlled by the valve in the water line. With the present valve type (normal gate valve), when the water comes through at full pressure (*ca* 45#), the spray is on a 4-min on, 20-min off cycle; with the valve cut down about two thirds the spray is on a 10-min on, 18-min off cycle. Thus, by controlling either the valve opening or the size of the spray aperture, one might obtain several humidity ranges and schedules.

The best index of the efficiency of this humidifying system, which next to the absence of light is probably the most critical factor in the construction and operation of an *Avena* room, is the response of the *Avena* seedlings and the coleoptiles in the assay itself. This has proved excellent. The plants follow the usual 3-day schedule and at the end of this period are between 20–30 mm tall and, most importantly, are not tough, fibrous, or brittle when pulled. A novice at the art of *Avena* assaying has run the test over a period of more than 12 weeks, involving more than 25 runs with about 120 plants per assay. The loss of plants due to decapitation or pulling of primary leaf has been less than 100 plants out of roughly 3,000, or about 3%. Originally, standards[4] of 25 and 50 γ/l were used, but it was found that 50 γ/l gave consistently limiting curvature (> 20°) and averaged 20°. The average of 11 standards at 25 γ/l was 16°, with 3 of these exceeding 20° curvature. It was decided then to use standards at 20 and 10 γ/l. These have proved satisfactory, giving an average of 16° for 20 γ/l and 10° for 10 γ/l. It is obvious that even 20 γ/l produces some limiting curvatures. This indicates good sensitivity of the plants. On this basis, it is probably valid to say that the conditions of the room, of which humidity is the prime control, are quite satisfactory.

[4] In all cases there are 12 single plants to a row; i.e., to each sample or concentration of auxin.

Competitive Action of 2-Thiouracil and Uracil in AAF-induced Cancer of the Liver[1]

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We have shown previously that the incidence of cancer of the liver induced in rats by feeding the carcinogen 2-acetylaminofluorene (AAF) is significantly decreased by simultaneous administration of 2-thiouracil (*1*). Kidder *et al.* have shown that in the animal microorganism *Tetrahymena geleii* 2-thiouracil acts as an antagonist to uracil and inhibits growth (*2*). Mammals differ from *Tetrahymena geleii* in their requirement for pyrimidines and purines, the latter being unable to synthesize these substances, whereas the former can (*3*).

In some respects the requirements of mammalian cancer cells resemble those of *Tetrahymena geleii* rather than those of normal mammalian tissue; certain guanine analogs competitively inhibit growth of *Tetrahymena geleii* and mammalian cancer, but not of normal mammalian tissue (*4*). It was therefore considered of interest to determine whether the action of 2-thiouracil in inhibiting AAF-induced liver tumors might be due to competition with uracil.

It was not felt desirable to incorporate uracil in the diet because the acceptance of such food by the rat is poor; the animals would therefore not receive uniform quantities of either uracil or carcinogen. Consequently the uracil was administered by stomach tube in aqueous suspension stabilized with glycerin.

Kidder *et al.* (*2*) found the uracil: thiouracil inhibition index to be 100 in *Tetrahymena geleii.* On this basis, assuming the absorption of thiouracil from pellets to be 5–10 mg per day in the rat (*5*), the daily uracil requirement would be 500–1,000 mg. This amount of uracil proved to be too toxic, but 250 mg daily was tolerated by some animals, although the mortality was high even at this dosage level.

Four groups of male rats (Wistar descendants) were studied; all animals received AAF, incorporated in a cornmeal diet in a concentration of 0.03% (*6*). Group I received no additional treatment. Group II received one pellet (214 mg) of thiouracil,[2] implanted subcutaneously, every 2 weeks (*5*). Group III received 250 mg uracil by stomach tube once daily, 6 times per week. Group IV received both thiouracil pellets and uracil. This regime was continued for 90 days, after which time all animals were transferred to a stock laboratory diet (Purina dog chow). It is known that exposure to this carcinogen for 90 days is sufficient to induce carcinoma (*7*). Animals were sacrificed and examined at various intervals up to 415 days.

In a second experiment, two groups of male rats received thiouracil in drinking water (0.05%). One half the animals received 250 mg uracil by stomach tube once daily, 6 days per week; all animals received a stock laboratory diet (Purina dog chow). All were killed after 35 days, the thyroid was dissected and weighed rapidly on a Roller Smith torsion balance, fixed in Bouin solution, and examined histologically.

Animals receiving AAF alone (Group I) showed severe liver changes (Table 1). The previously reported protective influence of thiouracil (*1*) was evidenced by the occurrence of hepatoma in only one of 16 animals (Group II). Simultaneous administra-

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[2] The thiouracil pellets were supplied by the Lederle Laboratories through the courtesy of St. M. Hardy.

TABLE 1

LIVER CHANGES INDUCED BY AAF; INFLUENCE OF URACIL AND THIOURACIL

	No. animals	Duration (days)	Liver changes (hepatomas and cholangiomas)	Mean liver wt* (g/100 g body wt)
Group I AAF	9	310–409	9	6.6 ± 0.71
Group II AAF and thiouracil	16	385–415	1	3.7 ± 0.23
Group III AAF, thiouracil, and uracil	5	407	3	6.5 ± 1.98
Group IV AAF, and uracil	5	385–409	5	8.2 ± 1.41

* Standard error = $\sqrt{\frac{\Sigma(\bar{x})^2}{n(n-1)}}$.

tion of uracil appeared to overcome this protection, 3 of 5 animals so treated showing marked liver changes (Group III). The protective action of thiouracil is reflected also in the liver weights, which indicate roughly the extent of liver changes induced by AAF. The mean liver weight of animals receiving uracil and thiouracil simultaneously (Group III) was the same as that of the animals treated with the carcinogen alone (Group I). Those given uracil and AAF (Group IV) exhibited the highest liver weights, suggesting that uracil intensifies the effect of the carcinogen on the liver.

The thyroid hyperplasia induced by thiouracil was not inhibited by simultaneous administration of uracil (Table 2). The thyroid weight and the histologic picture did not differ in the two groups.

TABLE 2

THYROID WEIGHT OF RATS TREATED FOR 35 DAYS WITH THIOURACIL, AND WITH THIOURACIL PLUS URACIL, RESPECTIVELY

	No. animals	Mean thyroid wt (mg)	Mean thyroid wt (mg/100 g body wt)
Group I Thiouracil	9	32.7	14.2
Group II Thiouracil and uracil	11	30.3	14.4

In a previous communication (*1*) the question was discussed as to whether the effect of thiouracil in counteracting the hepatic carcinogenic effect of AAF might be dependent upon the induced hypothyroidism. The present observation that uracil, in the dosage employed, does not prevent the thyroid hyperplasia induced by thiouracil, whereas it almost completely overcomes thiouracil protection against the hepatic carcinogenic action of AAF, lends additional support to the view that this "anticarcinogenic" action of thiouracil is not due to the induced hypothyroidism.

The findings suggest the possibility that uracil may be utilized by, and be a nutritional requirement for, liver cells exposed to the carcinogenic action of AAF, and that thiouracil may act as an antimetabolite under these circumstances, as it does in *Tetrahymena geleii* (*2*). Further experiments based on this working hypothesis are in progress.

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Homologous Mechanism of Bactericidal Action and Gram-Staining

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As has recently been shown (*1*), a positive correlation exists between the affinity to wool of water-soluble substances and their antibacterial effect. Further experiments (*2*) have specified this correlation as follows: the higher the affinity to wool of a water-soluble substance at pH 7, the higher is its bactericidal action. This correlation can be demonstrated for chemically different compounds within the anion-active and the cation-active series, respectively. Finally, comparative study of 18 chemically different compounds (*3*) has led to the conclusion that the affinity to wool of a water-soluble substance is a measure of the bactericidal action against gram-positive bacteria. Some examples are given in Table 1.

Thus it is possible to predict the bactericidal effect against gram-positive bacteria of water-soluble, thermostable compounds by the determination of their affinity to wool. This determination (*3*) is carried through by treating one g of wool with 50 ml of a neutral aqueous solution of 0.2 g of the compound in question at 90° C for 10 min and weighing the wool sample before and after treatment to 10^{-4} g.

If wool is degraded with 0.15 *N* Na_2CO_3 at 80° C, first there is a diminution of the basic groups, followed by a "neutralization" of the wool proteins, and finally there is a prevalence of the acid groups. In accordance with these steps of degradation, anion-active (acid) compounds show a decrease in their affinity to wool, whereas with cation-active (basic) compounds an increase in their affinity is found.

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