the meeting and displayed effectively a new device for the detailed study of the surface of the sun. It is a birefringent light-filter, similar to those in use at Harvard's station at Climax, Colorado, but with a narrower transmission band (0.8 A) which permits the high resolution of solar features and the study of finer details.

(4) Grants-in-aid were made for a dozen international projects in Poland, Denmark, Italy, France, England, and the United States. (The Union's expenses are borne by levies on the participating member-nations.) The three grants to Americans were made to assist in (1) publication of a table of wave lengths prepared at the National Bureau of Standards, (2) revision and publication of the Yale Catalogue of Stellar Parallaxes, and (3) operation of a bureau in the Cincinnati Observatory for special studies on the minor planets.

The most serious difficulty in holding such international meetings at the present time is associated with monetary exchanges. Swiss francs could not be obtained by many members who otherwise would have attended. Thanks to a grant from UNESCO and to private gifts, mostly from American astronomers, a number of German and Austrian astronomers were able to attend. More than 50 Americans were present.

TECHNICAL PAPERS

Variation Induced by Uranium Nitrate in Corn Smut and the Cultivated Mushroom

E. C. STAKMAN, J. M. DALY, M. L. GATTANI, and I. WAHL

University of Minnesota (General Research Fund, Graduate School), St. Paul, Minnesota

The addition of uranium nitrate, $UO_2(NO_3)_2 \cdot 6H_2O$, to potato-dextrose agar at the rate of 0.5–1.0 gm/liter has stimulated mutation in the cultivated mushroom, *Agaricus campestris*, and both mutation and an unusual type of dissociation in the ordinary corn smut fungus, *Ustilago zeae*.

The experiments on *Ustilago zeae* were made with two monosporidial haploid lines, designated as 10A4 and 17D4, and with several monosporidial diploid lines resulting from crosses between the two and designated as 410qq and 410n. Line 10A4 is very stable under a normal range of conditions, and 17D4 is moderately mutable. As these lines are haploid and unisexual, neither will cause infection when inoculated singly into corn plants. When corn is inoculated with a combination of the two, however, infection results, and galls containing morphologically normal chlamydospores are formed. On germination, however, a high percentage of the promycelia produced by the chlamydospores undergo partial or complete autolysis at various stages of development because 10A4 carries a dominant factor for this character, which is associated with a tendency for sporidia to be diploid instead of haploid.

Monosporidial diploid lines, like haploid lines, can be propagated on artificial media but can cause normal infection when inoculated singly into corn plants, with consequent production of normal galls and chlamydospores. The diplophase may persist for several successive chlamydospore generations and usually has persisted indefinitely when diploid lines are grown on artificial media. Numerous attempts to induce reduction division or dissociation into haploid parental types on artificial media had failed until uranium nitrate was added to the medium.

Diploid line 410qq, intermediate in cultural characters between its parents, 10A4 and 17D4, but resembling the unstable 17D4 somewhat more closely, produced an unusually large number of mutants when grown on potato-dextrose agar containing 1 gm/liter of uranium nitrate. This was true of 17D4 also. Some of the mutants of 410qq resembled 17D4 and some of its mutants closely in cultural characters; they failed to cause infection when inoculated singly into corn plants but caused normal infection when combined with 10A4. It appears, therefore, that uranium nitrate induced reduction division or some other type of nuclear change that resulted in the dissociation of the 17D4 factors for cultural characters, sex, and pathogenicity from their combination with those of 10A4. No lines were obtained that resembled the 10A4 parent closely. The results are definite, but precise explanation for them is lacking.

Extensive experiments were then made on the effects of uranium nitrate on frequency of mutation in 10A4, 17D4, and diploid lines 410n, which resembles 10A4 in cultural characters, and 410qq, which resembles 17D4. In the relatively unstable lines 17D4 and 410qq, 3–9 times as many mutants appeared on the medium containing uranium nitrate as on that without it, the ratio varying with the line of smut, the concentration of uranium nitrate, and the temperature at which the cultures were grown. With the relatively stable lines 10A4 and 410n, the effect of uranium nitrate was even more pronounced, although their mutants have not yet been studied thoroughly. There is evidence also that the number of mutants produced in liquid media containing uranium nitrate may be even greater than on agar.

Primary and secondary mutants of 17D4 have been studied extensively, primary mutants being those derived directly from 17D4 and secondary ones, those

derived from the primary ones. The most noteworthy facts about the 180 mutants studied are that all 10 of the primary ones grew better than 17D4 on uranium nitrate medium, that none of the 180 have lost any essential growth factors, and that some of them exceed 17D4 in certain characters such as color and rate of growth.

Studies with monosporous isolates of the cream variety of the common cultivated mushroom, *Agaricus campestris*, have yielded similar results. Uranium nitrate and other uranium salts have induced mutants whose growth on artificial media is from 5 to 7 times that of the original lines, as determined by dry weight of mycelial mats. Moreover, spawn of some mutant lines has produced mushrooms earlier than that of the checks, and the color was white instead of brownish.

The agar containing uranium nitrate is mildly radioactive, as determined by Dr. Alexander Hollaender, Oak Ridge National Laboratory.

It is suggested that the addition of uranium nitrate, or other similar salts, to nutrient media may be a simple and useful means for inducing desirable mutations in at least some microorganisms.

Changes in the Blood Following Exposure to Gaseous Ammonia

FREDERIC C. SCHMIDT and DORIS C. VALLENCOURT

Department of Chemistry, Indiana University, and *Putnam Memorial Hospital, Bennington, Vermont*

The use of ammonia as a solvent and as a reagent has opened a new field, and many chemical industries are using anhydrous liquid ammonia in large quantities. Because of leaks in reactors and the transfer of ammonia, the concentration of gaseous ammonia in the air can be of such amounts as to have definite physiological effects upon long exposure. Such has been the case in these laboratories, where investigations utilizing anhydrous liquid ammonia have been carried out over a period of 15 years. Students have noticed such physiological effects as initial exhilaration and increased frequency of respiration with subsequent exhaustion lasting several hours after exposure. There seems to be no lasting detrimental effect, however.

It was thought that it would be interesting and profitable to collect some data pertaining to the accumulation of ammonia by the blood through breathing as a by-product of these investigations.

It has been known for some time that inhalation of ammonia lowered the blood pressure, but no quantitative data pertaining to this are available. A study has been made to show how the blood pressure varies with time when breathing a constant concentration of the gas. In this paper is also presented the change in the NPN (non-protein nitrogen) and the carbon dioxide-combining power of the blood plasma.

In these studies the air in the room was kept at a constant concentration of ammonia, varying less than 30 ppm over 4 hrs. The ammonia concentration was determined twice during this time, at the beginning and at the end. Samples of air were drawn into an evacuated flask, the volume computed to 760 mm, 25 ml of water added, and the solution titrated with 0.1 normal acid. The concentrations of ammonia in the air varied between 530 and 560 ppm.

TABLE 1

1. VARIATION OF NPN AND AMMONIA WITH TIME OF BREATHING GASEOUS AMMONIA

Time of breathing (hrs)	NPN (mg %)	NH_3 (mg %)	Urea (mg %)	Creatinine (mg %)
Normal	27.0	00.0	15.0	1.5
1	37.0	12.1	15.0	1.6
2	45.0	21.9	15.0	1.6
3	50.0	27.9	15.0	1.6
4	57.0	36.4	15.0	1.6

2. CHANGE IN THE NPN AND AMMONIA WITH TIME AFTER CESSATION OF BREATHING GASEOUS AMMONIA FOR 3 HRS

Normal	27.0	00.0	13.0	1.5
1	47.5	24.9	13.0	1.5
2	40.5	16.4	13.0	1.5
3	32.5	6.6	13.0	1.5

The subject, the senior author, remained in contact continuously with the air-gas mixture. Samples of his blood were drawn at regular intervals from a vein in the

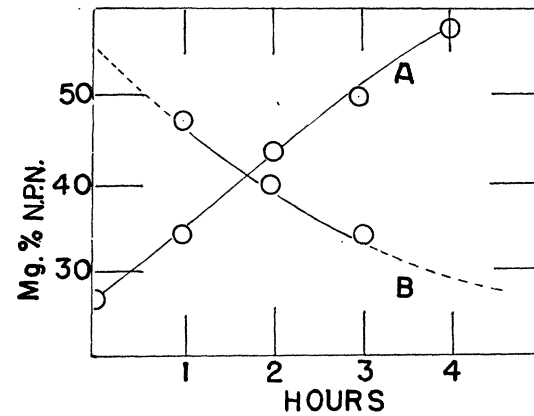

FIG. 1. Rate of change in the blood NPN upon exposure to ammonia: (A) absorption of ammonia by the blood, (B) elimination of ammonia by the blood.

arm and were analyzed for NPN, urea, and creatinine according to the method of Folin and Wu (*1*). The carbon dioxide-combining power of the blood was determined by the method suggested by Van Slyke and Cullen (*2*). pH determinations of the whole blood were made before and after breathing ammonia for 3 hrs, by means of a quinhydrone electrode. No significant change was noticed (7.35; 7.29).

As shown in Table 1 and Fig. 1, the NPN and ammonia vary regularly with time, while the urea and creatinine content of the blood show no variation what-