vided an immediate basis for further cooperative work has already been demonstrated, as extended calculations on several questions have already been undertaken by several theoretical physicists, and the Physics Seminar at one university will be devoted next year to geophysics.

Representatives from a total of twenty-four universities, research organizations and governmental bureaus took part in this conference. Among those attending the conference from outside of Washington were: Professors J. Bardeen, H. A. Bethe, F. Bitter, G. Breit, W. H. Bucher, W. M. Elsasser, E. Fermi, D. T. Griggs, B. Gutenberg, D. R. Inglis, I. I. Rabi, J. C. Slater and J. H. Van Vleck.

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SPECIAL ARTICLES

COENZYME I AND RIBOFLAVIN CONTENT OF LIVERS OF RATS FED BUTTER YELLOW

KINOSITA[1] and co-workers have shown that liver cancer can be produced in rats by the oral administration of dimethylaminoazobenzene (butter yellow). The chemical is fed (20 cc of 3 per cent. solution in olive oil to 1,000 grams of diet) in a diet of brown rice supplemented with carrot. Nakahara, Fujiwara and Mori[2] reported that beef liver added to the diet will prevent cancer production and Ando[3] published evidence that yeast also is protective.

We have investigated the *in vitro* respiratory rate as well as the Coenzyme I and riboflavin contents of the livers of rats fed various diets, as follows: (1) normal diet, (2) basal diet without butter yellow, (3) basal diet with butter yellow and (4) the same with 15 per cent. of dried brewers' yeast (No. 2040 Fleischmann Laboratories) added.

The Qo_2's were measured in a Warburg respirometer. The Coenzyme I content was measured by means of the fermentation technique of Myrback,[4] which was standardized in our laboratory by Dr. S. O. Dexter. The riboflavin was measured by a modification of the method of Hodson and Norris.[5]

We have found that the riboflavin and the Coenzyme I contents of the livers decrease markedly, whereas the Qo_2's of the liver slices do not change. Nakatani, Nakano and Ohara[6] also found no difference in the Qo_2's of the liver slices throughout similar experiments.

Table 1 shows the results obtained from the study of livers of animals which had been on their respective diets between 50 and 110 days.

TABLE 1

	Normal diet		Basal diet		Basal diet and butter yellow		Basal diet and butter yellow and whole yeast		Butter yellow tumor		
Qo_2	8.8	(8)	9.0	(14)	9.5	(12)	9.0	(8)	9.5	(8)	
Ribo-flavin	170	(8)	124	(12)	70	(17)	170	(8)	33	(8)	gammas per gm dry wt.
Co I	1390	(8)	1370	(12)	500	(21)	1400	(8)	150	(8)	gammas per gm wet wt.

NOTE: Numbers in parentheses refer to number of animals.

The Coenzyme I content of the kidneys of the same animals was not decreased in any group, a fact which serves as a check of the precision of the method:

CoI 1410 (8) 1400 (12) 1490 (16) 1380 (8) gammas per gram wet weight

The measurement of either flavin or Coenzyme I content of the liver serves as a useful index of the protective effect of dietary supplement.

Experiments are now in progress to determine whether or not the administration of nicotinic acid and riboflavin in large amounts will protect against the action of dimethylaminoazobenzene in the rat. Nakahara and coworkers have reported that the administration of 3 mg per rat per day of nicotinic acid and 20 gammas of riboflavin does not protect.[2b]

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BOVINE PSEUDORABIES OR "MAD ITCH" VIRUS

SINCE Shope[1] described "mad itch" in cattle in Iowa and subsequently[2] set forth the immunological relation of this disease to pseudorabies as described by Aujeszky[3] in Hungary, an occasional effort has been

1 Kinosita, *Trans. Jap. Path. Soc.*, 27: 665, 1937.
2 Nakahara, Fujiwara and Mori, (*a*) *Gann*, 33: 57, 1939; (*b*) *Gann*, 33: 406, 1939.
3 Ando, *Gann*, 32: 252, 1938.
4 K. Myrback, *Ergeb. Enzymforschung*, 2: 139, 1933.
5 Hodson and Norris, *Jour. Biol. Chem.*, 131: 621, 1939.
6 Nakatani, Nakano and Ohara, *Gann*, 32: 240, 1938.
1 R. E. Shope, *Jour. Exp. Med.*, 54: 233, 1931.
2 *Ibid.*, *Proc. Soc. Exp. Biol. and Med.*, 30: 308, 1932.

made to determine the relation, if any, of "mad itch" virus, to a rarely occurring but fatal bovine pruritic syndrome in Illinois. Pursuant to this inquiry, tissues from suspected natural cases have been examined for the presence of a filtrable virus. Notwithstanding the clinical resemblance of the disease reported by Illinois veterinarians to the "mad itch" syndrome in cattle, the virus of the disease was only recently identified in Illinois.

In February, 1940, a well-nourished Hereford steer (24333) weighing approximately 1,000 pounds, displaying a syndrome resembling that of pseudorabies, was brought to the university laboratory for examination. Twenty-four hours later, the animal, in a moribund condition, was sacrificed for autopsy. No gross pathologic lesions were noted other than self-inflicted lacerations of the skin and subcutaneous tissue in the left dorso-lumbar region.

Anaerobic and aerobic cultures of the heart blood, brain and dorsal spinal cord proved negative. Physiological sodium chloride suspensions of the brain and spinal cord as well as urine collected aseptically from the bladder were injected subcutaneously into a series of 12 rabbits and 12 guinea pigs. All inoculated rabbits and guinea pigs, with the exception of those receiving the dorsal spinal cord tissue, remained healthy. Both rabbits and one of the two guinea pigs receiving subcutaneous injections of the spinal cord tissue succumbed in 80 to 108 hours. Preceding death, the inoculated rabbits and guinea pig showed markedly increased respirations and evidence of intense pruritus near the point of inoculation. A filtrable agent (Berkefeld N) which reproduced the disease in rabbits and a calf, was demonstrated in the combined spinal cord tissue of the steer and the spinal cord tissue of rabbits that succumbed following inoculation. In further confirmation of the nature of the filtrable agent the chorioallantoic membrane of twelve-day chick embryos inoculated (Goodpasture method[4]) with the bacteriologically sterile spinal cord tissue suspension resulted in abundant gross lesions similar to those reported by Glover.[5] Serum neutralization tests of the steer spinal cord virus (24333) were conducted by Shope.[6] The results of his immunological tests support the preliminary deduction that the virus is that of pseudorabies or "mad itch."

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[3] A. Aujeszky, *Centr. Bakt. I. Abt.*, 32: 353, Orig., 1902.

[4] E. W. Goodpasture, A. M. Woodruff and J. G. Buddingh, SCIENCE, 74: 371, 1931; *Amer. Jour. Path.*, 8: 271, 1932.

[5] R. E. Glover, *British Jour. of Exp. Path.*, 20: 150, 1939.

[6] R. E. Shope, personal communication.

INHIBITION OF BACTERIAL METABOLISM BY SYNTHETIC DETERGENTS[1]

THE bactericidal and lytic action of soaps and certain naturally-occurring detergents such as bile salts has been recognized for some years. Recently, the demands of industry for wetting agents and detergents to meet a variety of special purposes have led to a very rapid commercial development of these compounds. More than a thousand wetting agents and detergents have been patented in the past decade. In 1935 Domagh[2] reported that the quaternary ammonium detergent, Zephiran [alkyl (C_8 to C_{18}) dimethyl benzyl ammonium chloride], possesses germicidal properties, and he recommended its use for disinfection of skin surfaces. Katz and Lipsitz[3] found that one cationic and three anionic synthetic wetting agents inhibited the growth of Mycobacterium smegmatis. Cowles[4] and Birkeland and Steinhaus[5] made the interesting observation that alkyl sulfates selectively inhibit the growth of gram-positive organisms.

A very marked inhibitory action of Zephiran on the respiration and glycolysis of pure cultures of microorganisms associated with dental caries has been demonstrated by Miller, Baker and Harrison.[6] Also, as shown by Miller, Muntz and Bradel,[7] this compound penetrates the dense matrix of human dental plaque material both *in vitro* and *in vivo*, and inhibits the metabolism of the mixed flora.

In the present communication we report some results obtained in a study of the effects of a variety of synthetic wetting agents and detergents on bacterial metabolism. The metabolism of freshly prepared suspensions of microorganisms was measured in the usual manner in the Warburg manometric apparatus in the presence of either phosphate or bicarbonate buffer at pH 7.3. The vessels contained 15 to 25 billion cells in a volume of 3 cc. Six gram-positive and six gram-negative organisms were studied. The detergents and wetting agents have been classified as *cationic* or *anionic*. Thus Zephiran, typical of the cationic compounds, ionizes with the long-chain hydrophobic group in the cation:

$$[(R_1R_2R_3R_4)N]^+ + (Cl^-)$$

Sodium cetyl sulfate, typically anionic, ionizes with the hydrophobic group in the anion as follows: $(C_{16}H_{33}\text{–}O\text{–}SO_3)^- + (Na)^+$.

Several types of *cationic* detergents have been investigated. These may be grouped as follows: (a) *quater-*

[1] From the Walter G. Zoller Memorial Dental Clinic and the Department of Medicine, University of Chicago.

[2] G. Domagh, *Deutsche Med. Wochenschr.*, 61: 829, 1935.

[3] J. Katz and A. Lipsitz, *Jour. Bact.*, 30: 419, 1935; 33: 479, 1937.

[4] P. B. Cowles, *Yale Jour. Biol. Med.*, 11: 33, 1938.

[5] J. M. Birkeland and E. A. Steinhaus, *Proc. Soc. Exper. Biol. and Med.*, 40: 86, 1939.

[6] B. F. Miller, Z. Baker and R. W. Harrison, *Proc. Soc. Exper. Biol. and Med.*, 42: 705, 1939.

[7] B. F. Miller, J. Muntz and S. Bradel, in press.