total doses of 4 mg. of fresh rabbit anterior lobe could be shown to stimulate the thyroid of the immature guinea pig.

In only 36.8 ± 9.11% of the pairs of guinea pigs receiving male anterior lobe, a greater thyroid-stimulation was caused by the anterior lobes of thyroidectomized rabbits. On the other hand, in 71.5 ± 9.85% of the paired guinea pigs receiving female anterior lobe, the thyroid-stimulation was greater in the guinea pigs receiving anterior lobe from thyroidectomized rabbits. The difference appears to be significant (34.7 ± 13.42%). However, thyroidectomy in the rabbit commonly causes a hypertrophy greater in the anterior lobe of the male than in that of the female (in our series: male, 166% of control; female, 133% of control); therefore, the *relative* dose, in terms of the control rabbit's pituitary, was greater in the case of the female group when the same absolute doses of anterior pituitary from control and thyroidectomized rabbits were used. In 5 groups of litter-mate male rabbits and 3 groups of litter-mate females, the doses of anterior pituitary were based on anterior pituitary weights. In 45 ± 15.0% of the paired guinea pigs, the male thyroidectomized rabbits' anterior lobes caused the greater stimulation, whereas in 72 ± 17.0%, the female thyroidectomized rabbits' anterior lobes caused the greater stimulation. The difference between these groups (27 ± 22.7%) is not significant. Whether or not thyroidectomy brings about an increase in the total amount of thyroid-stimulating principle greater in the anterior lobe of the female than in that of the male can only be decided by additional experiments which are under way.

7734 C

Further Studies on the Effect of Supersonic Waves on Bacteria.

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We have shown[1] that exposure to supersonic waves brings about killing and dissolution of certain bacteria. The question as to whether these effects are due to the mechanical waves motions in the medium or cavitation of the dissolved gases remained unan-

[1] Yen, A. C. H., and Liu, S. C., PROC. SOC. EXP. BIOL. AND MED., 1934, **31**, 1250.

swered. The observations of the present study on the effect of supersonic waves on *B. dysenteriae* Shiga and *B. coli* suspended in gas-free solutions and in solutions saturated with air or hydrogen seem to indicate that the killing and dissolution of the bacteria is due to the cavitation of the dissolved gases.

The apparatus used for the generation of the supersonic waves at the rate of 1.5×10^6 times per second was the same as described by Wu and Liu.[2] One cc. of the bacterial suspension to be exposed was placed in a pyrex tube (20 mm. in diameter) containing a glass cooling coil through which cold water circulated. The temperature of the bacterial suspension throughout the entire experiment was always below 20°C., thus eliminating the possibility of destruction of bacteria by heat. Twenty-four-hour cultures of *B. dysenteriae* Shiga and *B. coli* on agar slant were washed and suspended in saline. To make the suspension gas-free, it was placed in the test tube and subjected to suction with a vacuum pump until the mercury manometer showed a constant minimum reading of 18 to 20 mm. The rubber tubing connecting between the test tube and pump was clamped and disconnected from the pump. The test tube containing the gas-free suspension under vacuum was then exposed to supersonic waves. To obtain hydrogen saturated suspension, hydrogen gas was allowed to pass through a sterile glass tubing with a cotton plug into the gas-free suspension under vacuum until one atmospheric pressure was reached. The tube was then shaken for 2 minutes to assure complete saturation with the gas, and the rubber tubing at the mouth of the test tube was clamped. The hydrogen saturated suspension thus prepared was then exposed to supersonic waves. The number of viable bacteria per cc. and the relative opacity of the suspensions before and after a 90-minute exposure to the supersonic waves were determined. The number of viable bacteria per cc. was determined by counting colonies in poured plates, while the relative opacity was determined with a Pulfrich photometer and expressed in per cent of the standard opacity glass NO_4. The results are summarized in Table I.

It will be noted from the table that the exposure of the bacterial suspensions to supersonic waves was followed by a reduction in number of viable bacteria and a decrease in opacity only when the suspension was saturated with air or hydrogen gas. These effects were more marked when the suspension was saturated with air than with hydrogen gas. We are not certain whether this difference is merely due to the larger quantity of the dissolved gases or the oc-

[2] Wu, H., and Liu, S. C., PROC. SOC. EXP. BIOL. AND MED., 1931, **28**, 782.

TABLE I.

Number of viable bacteria per cc. and relative opacity of *B. dysenteriae* Shiga and *B. coli* suspensions before and after exposure to supersonic waves under different gaseous environments.

		Air saturated		Gas-free		Hydrogen saturated	
		Colony per cc.	Opacity %	Colony per cc.	Opacity %	Colony per cc.	Opacity %
B. dysenteriae Shiga	Initial	50.0×10^4	28.9	48.0×10^4	28.9	46.0×10^4	28.5
	90 min. control	48.0×10^4	28.9	41.0×10^4	28.1	42.0×10^4	28.2
	90 min. exposed	0	15.6	*55.0×10^4	28.2	96.0×10^2	21.4
B. coli	Initial	47.8×10^7	31.3	51.0×10^7	31.5	48.7×10^5	31.4
	90 min. control	46.3×10^7	31.3	48.0×10^7	31.5	44.8×10^7	31.2
	90 min. exposed	16.9×10^4	14.4	*58.0×10^7	31.3	24.0×10^5	18.8

*These 2 numbers are definitely higher than their corresponding initial or control colony counts. We interpret that this apparent increase is due to a more thorough shaking rather than actual multiplication of the bacteria in the suspensions.

currence of oxidation in case of air saturated suspension, but it is clear that cavitation of dissolved gases are essential in bringing about killing and dissolution of bacteria.

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Photometric Study of Bacteriophage Action.

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Krueger and Northrop[1] were the first to undertake the study of bacteriophage action from a quantitative point of view. Based on extremely elaborate technical procedures, involving frequent and separate enumeration of bacteria and of bacteriophage throughout each experiment, they concluded that production of phage was proportional to a power of bacterial growth and that lysis set in almost explosively at the moment when phage/bacteria ratio attained a definite critical value. It would appear that according to their result the time required for lysis of a given bacterial concentration is proportional to the dilution of phage. Other conditions being constant, the strength of any 2 phages can be compared by noting the relative length of time necessary for reduction of a constant concentration of bacteria to an arbitrary end point.

The present paper is not intended to add anything new to the mechanism of bacteriophage action, but rather to present an accurate though considerably simpler device for attacking the problem from the same viewpoint. The apparatus used is a Pulfrich photometer which works on the principle of the Tyndall phenomenon, so that for a given bacterium, the number of organisms per cc. can be read off directly and quickly and is expressed in terms of percentage of a given standard. Very minute particles, namely, phage or protein particles, liberated during the process of dissolution of bacteria present a very weak Tyndall phenomenon and do not, therefore, affect the readings. Provided the bacterial suspension is not so thick as to interfere with penetration of light, the accuracy of readings obtained approached $\pm 0.5\%$ of the given standard, disregarding slight variations in the size and thickness of the tubes used.

[1] Krueger, A. P., and Northrop, J. H., *J. Gen. Physiol.*, 1931, **14**, 223, 493.