it may even fall during bubbling or stirring. A large apparent Q_{10} results, but with negative sign; a higher respiratory rate correlates with a lower P.D. and *vice versa.*

Other conditions facilitate large temperature effects. 5 to 10% CO_2, mixed with air and bubbled through sea water, depresses the P.D. of *Halicystis*, probably by raising the protoplasmic acidity. The CO_2 tension at which this occurs is a function of temperature. A similar situation holds for dilute ammonia, which causes reversal of P.D.[9] At 15° the threshold for this lies around 0.002 M NH_4Cl in sea water; the threshold concentration is increased by cooling the sea water, and decreased by warming (probably by altering the dissociation and solubility of ammonia). As a result, a 10° change may alter the P.D. by 100 to 150 mv., giving very large apparent Q_{10} values. The sign is negative, warming causing more negative values, cooling more positive ones (*cf., Valonia*[8]). Temperature also facilitates the reversal of P.D. by vacuolar perfusion of alkaline sea water[2]; this occurs in *H. ovalis* at 25° but not at 15°. Possibly other large temperature effects are similarly conditioned by physiological alterations of O_2, CO_2, ammonia, and pH.

Time curves of these effects, as well as those of other agents influencing metabolism and P.D., will be reported elsewhere.

9037 P

Zinc Sulphate as a Chemoprophylactic Agent in Experimental Poliomyelitis.*

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In earlier notes[1] we reported observations on the prophylactic action exercised by picric acid and certain other compounds. In this note we are reporting results which indicate that zinc sulphate applied to the nasal mucosa is even more effective than picric acid. These observations are set forth in Table I, in which the relative efficiency of the respective agents is compared in terms of the ap-

[9] Blinks, L. R., *J. Gen. Physiol.*, 1933, **17**, 109.

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[1] Schultz, E. W., and Gebhardt, L. P., PROC. SOC. EXP. BIOL. AND MED., 1936, **34**, 133; *Calif. and West. Med.*, 1936, **45**, 38.

TABLE I.

Exp.	Type of Experiment	No. of monkeys treated	% treated animals protected 1 mo.	No. of controls	% infection
1	1% picric acid; 3 intranasal irrigations; successive days; virus (a)	16	62	30	80
2	1% picric acid; 3 intranasal sprays*; virus (b)	30	37	20	100
3	1% picric acid; 6 sprays*; virus(b)	10	25	12	100
4	.5% picric acid; 6 sprays*; virus(b)	8	12		
5	.5% picric acid plus .5% alum; 6 sprays*; virus (b)	19	71	10	100
6	.5% picric acid plus .5% zinc sulphate; 6 sprays*; virus (b)	20	86	21	100
7	.5% zinc sulphate; 6 sprays*; virus (b)	9	100		
8	1% zinc sulphate; 5 sprays†; virus (c)	5	100	22	90
9	1% zinc sulphate; 4 sprays†; virus (c)	5	100		
10	1% zinc sulphate; 3 sprays†; virus (c)	12	92		
11	1% zinc sulphate; 2 sprays†; virus (c)	5	80		
12	1% zinc sulphate; 1 spray†; virus (c)	3	100		
13	1% zinc sulphate; 3 intranasal irrigations successive days; virus (c)	14	100		

*The chemical solution was applied to the nasal mucosa on successive days as indicated, and once a week thereafter. Applications were made with a de Vilbiss atomizer attached to nitrogen tank and under 6 lbs. pressure. Solution warmed to 38°C.

†Same as described under*, but not "once a week" after the initial daily applications indicated.

(a) Virus instilled intranasally 3 times on same day, each instillation preceded by acid phosphate lavage. Instillations 2 to 6 days and again 4 weeks after application of chemicals.

(b) Virus instilled intranasally 5 successive days each week for 3 to 4 weeks.

(c) Virus instilled intranasally on 5 successive days beginning one month after chemical was applied to mucosa; no preliminary washes with acid phosphate solution.

proximate per cent of animals which were protected for at least one month against repeated intranasal instillations of poliomyelitis virus.

While the number of animals in individual experiments and the mode of treatment and the intensity of the subsequent virus inoculations are not all strictly comparable, certain experiments are sufficiently alike to reveal important differences in the degree of protection. For example, in Experiment 4, in which 8 monkeys were treated with 0.5% picric, and in Experiment 7, in which 9 monkeys were treated with 0.5% zinc sulphate, but otherwise were dealt with in the same way, there is a difference amounting to 88% in favor of $ZnSO_4$. Furthermore, the addition of zinc sulphate to picric acid (Experiment 6) enhanced its protective value somewhat

more than did the addition of alum (Experiment 5). Of significance also is the fact that zinc sulphate when used alone has afforded over 95% protection in a total of 53 animals (Experiments 7 to 13). Thus far, only 2 animals treated with zinc sulphate alone have succumbed to poliomyelitis. Six animals have survived repeated virus instillations for 3 months.

It will be noted that the protection afforded by picric acid is distinctly greater in Experiment I than in Experiments 2, 3, and 4. This is accounted for by the fact that in the latter experiments, virus was instilled intranasally almost daily during the entire month; an exposure which brought down 100% of the controls. Even under these drastic conditions, none of the 9 monkeys treated with 0.5% $ZnSO_4$ (Experiment 7) developed the disease.

Studies are in progress to determine the lowest dilutions of zinc sulphate which will protect monkeys for at least one month and to determine the factors which influence the effectiveness and duration of the protection.

In presenting these observations, we do not wish to imply that any of the agents described thus far will necessarily prove effective in the prevention of poliomyelitis in man. The results, however, lay a foundation for similar studies in man during an epidemic period.

9038 P

Complement Fixation Test Differentiating 3 Strains of Equine Encephalomyelitic Virus and the Virus of Lymphocytic Choriomeningitis.

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Although most of the attempts to apply the complement fixation test in the field of filterable viruses have either been negative or inconclusive, within recent years a few favorable reports have lent more encouragement. The work of Craigie[1] and his coworkers has been of especial value in suggesting a new method of attack. Based on their reports, work was undertaken to extend the test for the differentiation of strains of equine encephalomyelitic virus, representing the so-called eastern and western American types and that

[1] Craigie, J., and Tulloch, W. J., *Sp. Rep. Ser. Med. Res. Coun. London*, No. 156, 1931; Craigie, J., and Wishart, F. O., *Can. Pub. Health J.*, 1936, **27**, 371.