disappears and the typical caffeine rigor results. Thus caffeine and picrotoxin are mutually antagonistic in the sea-star, either drug being capable of reversing the effect of the other. When one considers that both of these drugs act primarily on the anterior portion of the central neuraxis of vertebrates even as low as the amphibians their mutual antagonism in the sea-star is the more mysterious.

Moore[1] has stated that injection of 1% caffeine solution into starfish is without effect. Had he placed the animals in a solution of caffeine no doubt he would have observed the characteristic early excitement followed by rigor. He also found[3] that starfishes placed in nicotine (1:50,000) underwent a strong ventral flexure until the animals became compact masses. If then they were transferred to a strychnine solution he observed that the effect of nicotine was reversed resulting in dorsal flexure. However, if the procedure were reversed, *i.e.*, strychnine followed by nicotine, no ventral flexure occurred which he explained by a difference in the chemical constitution of the two sets of nervous elements supplying the antagonistic muscles. Since the nervous system of the sea-star lacks the typical synaptic junctions and in view of modern concepts of action of neurotaxic drugs the effects of the above drugs must be due to direct influence on the neuraxons, the receptor substance, or the effector end organs themselves. Thus it appears probable that the physiological properties of the nerves or their end organs are more responsible than their morphological architecture for the loss of reciprocal inhibition in the sea-star, *Asterias*.

Conclusions. 1. Atropine causes excitement in the sea-star resulting in protraction of the tube feet and flexure of the rays. 2. Caffeine produces two types of effects, an early excitement followed by muscular rigor. 3. Picrotoxin causes acceleration of locomotion accompanied by active waving of the tube feet. 4. Caffeine and picrotoxin are mutually antagonistic in the sea-star, either drug being capable of reversing the effects of the other. 5. The effects of atropine, caffeine, strychnine, and picrotoxin are reversible in the sea-star because the animals will readily return to a normal state when placed in running sea water, showing no apparent muscular damage resulting.

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A Comparison of the Incubation Period of Poliomyelitis in Mice of Different Strains.*

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A remarkable variation has been reported in the incubation time of the disease produced in white mice by the Lansing strain of the virus of poliomyelitis. According to Armstrong,[1] symptoms are usually apparent from 2 to 10 days following inoculation of the virus but intervals from 24 hr to 93 days have been observed. Harford and Bronfenbrenner[2] observed incubation periods ranging from 2 to 59 days in young Swiss mice all of exactly the same age. In our experience a similar wide variation in incubation time has occurred in a stock of Swiss mice obtained from one dealer. In addition, the susceptibility of these mice to the virus has not been entirely uniform. Hammon

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1 Armstrong, C., *Am. J. Pub. Health*, 1941, **31**, 228.

2 Harford, C. G., and Bronfenbrenner, J., PROC. SOC. EXP. BIOL. AND MED., 1941, **47**, 211.

TABLE I.
Survival of Mice of Different Strains Inoculated with the Lansing Strain of Poliomyelitis Virus.

		No. of animals dying on days following inoculation with a 10^{-2} dilution of infected brain and cord											
	No. of animals	Days 2 to 5	6 to 10	11 to 15	16 to 20	21 to 25	26 to 30	31 to 35	36 to 40	41 to 45	46 to 50	51 to 56	† X
Swiss controls	10/12*	1	2	4	1	2							1
Akh	9/12	3	1	3	1			1					3
Swiss controls	9/12	1	1		2	2	1	1				1	
Rfi	9/12			1			1		1	2	3	1	
A	10/12		1	1	4	2	1		1				
Swiss controls	18/20	1	6	8	3								2
Swiss CFW	19/20	5	5	7	2								1
Black C 57	20/20	11	5	2	1			1					
dba	20/21	12	2	3	2	1							
Old Buffalo	12/13	6	2	1	1	1			1				
Swiss controls	14/20	4	2	1	2	4		1					2
Bagg Albino	17/20	4	3	2	4	1	1		1				3

*Numerator = No. of deaths attributed to the virus.
Denominator = No. of mice inoculated.
†X = Fatalities not attributed to the virus.

and Izumi[3] have reported that a change of approximately 100-fold in virus-content is required to effect a change from 5% to 95% in the mortality of Swiss mice. The latter authors[4] found that the Rockefeller strain of Swiss mice, presumably the CFW strain, showed less variability than other Swiss mice in their reaction to the virus.

To determine whether the constitution of the host is responsible for the extreme variation in the incubation period observed with the Lansing strain of poliomyelitis virus we compared 9 strains of mice in their reaction to this virus. The strains compared were the CFW Swiss, the Old Buffalo, our stock Swiss mice, and 6 closely inbred strains of mice resulting from brother-sister matings. The 6 closely inbred strains were the Akh, Rfi, A, dba, Bagg-albino and C57 black.† If the variation in reaction were dependent upon the constitution of the mice used, closely inbred strains of mice would be expected to react to the virus in a more uniform manner.

Not all of the strains of mice were inoculated at the same time but in each experiment our stock Swiss mice were included as controls. The inoculum consisted of .03 cc of a 10^{-2} dilution in broth (pH 7.6) of infected mouse-brain and spinal cord. The injections were made in as uniform a manner as possible into the left cerebral cortex. In some of the experiments 12 mice of a strain were used, and in others 20 mice. All the mice were approximately the same age, 6-8 weeks. The inoculated animals almost without exception died within 2 days after the time when paralysis was first observed. Therefore the time of survival of the mice as recorded in the tables also indicates the approximate incubation periods. The time of survival and the total number of deaths of the injected mice is recorded. All except one of the strains of mice which were compared

[3] Hammon, W. M., and Izumi, E. M., *J. Immunol.*, 1942, **43**, 149.

[4] Hammon, W. M., and Izumi, E. M., PROC. SOC. EXP. BIOL. AND MED., 1941, **48**, 579.

† The stock of Swiss mice which have been used as controls were purchased from the Tumble Brook Farm, Brant Lake, N.Y., the CFW Swiss strain from the Carworth Farms, New City, New Jersey. The Old Buffalo strain was obtained from Dr. Leo Loeb and has been cage-bred in this laboratory for several years. The closely inbred strains Akh, Rfi and A came from the laboratory of Dr. Jacob Furth, the C57 black, Bagg-albino and dba strains from the Roscoe B. Jackson Memorial Laboratory. The 6 closely inbred strains were procured as inbred stock but were not pedigreed. Breeding had been carried on by repeated brother-sister matings.

with the stock Swiss mice showed incubation periods with approximately the same range of variation. (Table I). The one exception, the Rfi strain, also showed variable incubation periods but in a greater number of this group the period was exceedingly long. Eight of 12 mice of this strain died between 30 and 54 days after inoculation. Although some of the Swiss control mice used in the experiment with mice of the Rfi strain showed more prolonged incubation periods than the control mice in the other experiments, the average incubation period of the mice of the Rfi strain in comparison with that of the control mice appeared to be significantly longer (Table I).

It is also noteworthy that a greater proportion of mice of the C57 and dba strains became paralyzed and died during the first few days after inoculation. With the relatively small number of animals used there were no significant differences in the percentage of deaths among the several strains of mice.

Conclusions. It is concluded from these observations that, although strain differences are found, other factors than constitution are important in determining the variable incubation periods observed with the Lansing strain of poliomyelitis virus within strains of white mice.

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Demonstration of Murine Poliomyelitis Virus in Blood and Spleens of Mice Shortly Following Inoculation.*

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A few positive results have been obtained in attempts to demonstrate the virus of poliomyelitis (M V strain) in the blood of Rhesus monkeys. Clark, Fraser and Amoss[1] demonstrated the virus in the defibrinated blood of monkeys for 72 hr following the intracerebral and intraspinal inoculation of overwhelming doses of virus, and for 24 hr after the intravenous injection of the virus. Flexner and Lewis[2] produced the disease when large quantities of blood (25 cc), withdrawn from infected monkeys at the height of the disease, were injected intravenously. However by intravenous inoculation Gordon and Lennette[3] were unable to demonstrate the virus in large amounts of the blood of Rhesus monkeys obtained at various stages of the experimental disease. Others[1,4] have reported the occasional demonstration of the virus by the intracerebral injection of smaller amounts of defibrinated blood withdrawn from monkeys after the onset of paralysis. The virus of poliomyelitis was demonstrated inconstantly by Lennette[5] in the emulsions of perfused spleens removed from paralyzed monkeys which had been infected by the intracerebral route.

The demonstration of the Lansing strain of poliomyelitis virus in the blood or spleen of mice following the intraperitoneal or intracerebral inoculation of the virus has not been reported. The present studies were carried out to gain further knowledge of the behavior of this virus in mice.

Experimental. In these experiments the Lansing strain of poliomyelitis virus (Armstrong virus) was used. One group of 50 Swiss mice, 6 to 8 weeks of age, was inocu-

* Sponsored by the National Foundation for Infantile Paralysis, Inc.

1 Clark, P. F., Fraser, F. R., and Amoss, H. L., *J. Exp. Med.*, 1914, **19**, 223.

2 Flexner, S., and Lewis, P. A., *J. Exp. Med.*, 1910, **12**, 227.

3 Gordon, F. B., and Lennette, E. H., *J. Inf. Dis.*, 1939, **64**, 97.

4 Leiner, K., and Von Wiesner, R., *Wien. Klin. Wchnschr.*, 1909, **22**, 1698.

5 Lennette, E. H., *J. Exp. Med.*, 1937, **66**, 549.