Professor Samuel Eilenberg, of the University of Michigan, an address on "Topological Methods in Abstract Algebra," and Professor Witold Hurewicz, of the University of North Carolina, an address entitled "Some Aspects of Ergodic Theory."

THE eleventh Chapter of Sigma Delta Epsilon, Graduate Women's Scientific Fraternity, was installed at the University of Minnesota on May 26. The installing officer was Dr. Dorothy Day, research associate in the Division of Plant Pathology and Botany of the University of Minnesota, who was national president of the fraternity in 1941 and 1942. The speaker of the evening was Dr. Margaret Sloss, of the department of veterinary pathology of Iowa State College. The local officers for 1945–46 are Jane Leichsenring, professor of nutrition, *President;* Violet Koski, teaching assistant in botany, *First Vice-president;* Kathleen Cummings, research assistant, Dight Institute of Human Genetics, *Second Vice-president;* Eloise Newcomb, teaching assistant in chemistry, *Treasurer;* Agnes Hansen, senior laboratory technologist in the department of botany, *Secretary.*

THE Chicago Dental Society, to encourage continued scientific research in all phases of dentistry, offers a cash prize of $500 to the author of the most meritorious essay reporting an original investigation and containing new and significant material of value to dentistry. The winner of the award will be invited to present his essay at the eighty-first midwinter meeting of the Chicago Dental Society to be held next year in February. Application forms and contest rules may be obtained by writing to the Chicago Dental Society, 30 N. Michigan Avenue, Chicago 2, Illinois. All applications must be filed by October 1.

THE compilation of the eighth edition of the National Research Council directory, "Industrial Research Laboratories in the United States," is now under way. The 7th edition appeared in 1940 and contained information concerning the industrial research laboratories of 2,264 companies and their subsidiaries. Although effort was made in 1940 to reach as large a number of laboratories as possible, no doubt some in each field have been inadvertently omitted. It is important that contacts be made with these laboratories in compiling the forthcoming edition. The term "research" for the purpose of the directory is construed as including investigations looking toward the improvement of products or the reduction of cost of manufacture as well as fundamental research and applied research. It does not apply to laboratories concerned only with commercial testing. Research men should inquire of the directors of their laboratories whether questionnaires have been received. If not, one will be sent upon request to the Library, National Research Council. The directory is issued by the National Research Council with no expectation of profit. There is no charge for the inclusion of a statement regarding a laboratory in the publication and no obligation is incurred in furnishing data.

ON June 1, the United States Patent Office put into operation a new service to industry and inventors. Its purpose is to bring to the attention of the nation patented inventions under which the owners are willing to grant licenses on reasonable terms; it is hoped that such information will lead to greater employment opportunities in the reconversion period, as well as to permit industry to become acquainted with what is being done in various fields. To accomplish these purposes a Register of Patents Available for Licensing is now being established, and will be maintained in the United States Patent Office. Patents recorded on this register will be available to the public for inspection in Washington, D. C. Lists of such patents will be published in the *Official Gazette* of the Patent Office.

THE Aluminum Company of America has announced a grant of $200,000 to the endowment fund of the Carnegie Institute of Technology for the establishment of a professorship of light metals in the department of metallurgical engineering. It is reported that the institute is endeavoring to raise a fund of $4,000,000 by July 1, 1946, when, if it is successful, the Carnegie Corporation of New York has agreed to contribute $8,000,000 to the permanent endowment funds of the institution.

SPECIAL ARTICLES

THE HEMOAGGLUTINATIVE PROPERTIES OF AMNIOTIC FLUID FROM EMBRYONATED EGGS INFECTED WITH MUMPS VIRUS[1]

IN a previous report[2] it was stated that in spite of many attempts no evidence could be obtained which indicated that the virus of mumps was capable of multiplication within the tissues of the embryonated hen's egg. Since that time experiments have shown

[1] These investigations have been carried out as a project of the Commission on Measles and Mumps, Board for the Investigation and Control of Influenza and other Epidemic Diseases in the Army, Preventive Medicine Service, Office of the Surgeon General, United States Army.

[2] J. F. Enders, L. W. Kane, S. Cohen and J. H. Levens, *Jour. Exp. Med.*, 81: 93, 1945.

that under certain conditions virus from the gland of the infected monkey may be propagated in this milieu with ease and regularity. The results, which are presented here in a preliminary manner, serve in general to confirm Habel's[3] recently published findings.

Habel, however, noted that the yolk sac provided an abundant and reliable source of complement fixing antigen following its inoculation with the virus. Our experience is quite otherwise, since in many instances we have been unable to demonstrate the antigen in that membrane, although it was present in large amounts in other tissues. Moreover, amniotic fluid of infected eggs has been found to agglutinate fowl's erythrocytes in a manner analogous to that of certain other viruses.[4,5,6,7] This reaction may provide under certain circumstances a diagnostic method more rapid and convenient for detecting increases in antibody concentration than complement fixation.[8]

Fertile eggs which were previously incubated at about 39° C for 6 to 7 days were employed. Demonstration of complement fixing antigen[2] in the constituents of the egg has been regarded as evidence of infection. Inoculated eggs were incubated at 35° C for 8 or 9 days when the quantity of antigen has been found to be maximal. The original inocula in 4 series of egg passages consisted of saline emulsions of parotid gland from infected monkeys.[2]

Complement fixing antigen has been demonstrated irregularly in the yolk sac following its inoculation with monkey virus when only a relatively large volume of fluid, *i.e.*, 1 cc, has been used as inoculum. In our previous experiments volumes of inoculum from 0.1 to 0.3 cc were employed. It is possible that these earlier failures in which the yolk sac was studied were in part due to this difference in the physical size of the inocula. The effect of such differences is illustrated in the data included in Table 1.

In contrast to the yolk-sac, as shown in Table 1, the amniotic membrane has with much regularity yielded high concentrations of antigen. Results of titrations of pooled materials from 8 serial passages of the virus inoculated via the yolk sac have also demonstrated the value of the amniotic membrane as a dependable source of antigen and have shown it to be a more sensitive indicator of infection than the yolk sac. Of 28 pools composed of materials

TABLE 1

EFFECT OF VIRUS CONCENTRATION AND SIZE OF INOCULUM ON THE DEVELOPMENT OF COMPLEMENT-FIXING ANTIGEN AND ITS DISTRIBUTION IN EMBRYONATED HEN'S EGGS

C.F. titer inocula	monk. glands	Vol. inoc. cc	No. eggs pooled	Titer C.F. antigen—1st passage: Yolk sac	Amn. membr.	Amn. fluid	Ch. al. membr.	Ch. al. fluid
240	(1)	1.0	4	45	600	10	40	0
240		0.1	5	0?	1200	15	40	0
24		1.0	5	180	600	30	75	0
120		1.0	5	0?	600	30	20	0
120		0.1	5	0?	150	30	0?	0
12		1.0	4	0?	300	10wk (2)	0?	0
15		1.0	1	0	300	30	75	0
			3	0	75	10	0	0
15		0.1	4	0	150	30wk	0?	0
			5	0	0	?10wk	0	0

(1) Titers expressed as reciprocals of final dilution of antigen giving "++" or "++++" fixation with at least one of the 2 specimens of antiserum used in tests.
(2) Wk = "++" fixation.

obtained from 107 eggs, 18 yielded amniotic material containing antigen, whereas it could not be detected in the corresponding yolk-sac suspensions. In the remaining 10 pools antigen was found in both the yolk sac and the amnion. The titer of the amnion, however, was in every case significantly greater. Antigen was likewise almost always present in the amniotic fluid, as might be expected in view of the large quantities associated with the amnion. It has not, however, yet been discerned in the chorioallantoic fluid following yolk-sac inoculation, although in some instances it has been found in low concentration in suspensions of the chorioallantoic membrane. The irregularity of its presence here as well as in the yolk sac may have been due to an incomplete separation of the amniotic from other extra-embryonic membranes. Unless great care is taken to separate the amnion from both the yolk sac and the chorioallantois, clearcut results may not be obtained. In a few tests antigen was not detected in the tissues of the embryo itself or in the yolk deprived of the membrane.

A comparative experiment has been done in which yolk-sac virus of the 7th egg passage was inoculated into the amniotic sac, the chorioallantoic sac, the yolk sac, and on to the chorioallantoic membrane. Titrations of the various materials from the eggs inoculated into the 3 sacs gave essentially the same results, *i.e.*, in all instances the amnion yielded the most antigen. On the other hand, the chorioallantoic membrane contained the largest quantity following inoculation onto this tissue. This last observation suggests that under these conditions the chorioallantois may also furnish a reliable and abundant source of antigen.

Although the amount of amniotic membrane ma-

[3] K. Habel, *Pub. Health Reports*, 60: 201, 1945.
[4] G. K. Hirst, *Jour. Exp. Med.*, 75: 49, 1942.
[5] D. Lush, cited by E. Clark and F. P. O. Nagler, *Austral. Jour. Exp. Biol. and Med. Sci.*, 21: 103, 1943.
[6] F. M. Burnet, *Austral. Jour. Exp. Biol. and Med. Sci.*, 20: 81, 1942.
[7] F. P. O. Nagler, *Med. Jour. Austral.*, 1: 281, 1942.
[8] L. W. Kane and J. F. Enders, *Jour. Exp. Med.*, 81: 137, 1945.

terial obtainable from the egg is small compared with the yolk sac, its high concentration of antigen, its lack of anticomplementary effect and its freedom from the undesirable constituents of the yolk not only appear to render it more suitable as antigen in the complement fixation test, but also characterize it a priori as a more suitable material for use in skin testing[9] and vaccination.[10] These same advantages, together with that of increased yield, would be shared by the chorioallantoic membrane provided further investigation reveals it to be a reliable source of potent antigen.

The infectivity of the amniotic sac material for the egg is considerable. When inoculated via the yolk sac, a suspension of amnion induced infection in dilutions of 10^{-4} and 10^{-6} respectively. A discrepancy was noted in that none of the eggs inoculated with 10^{-5} dilution apparently became infected.

The predilection of mumps virus for the amnion suggests that a similar tropism may be characteristic of other viral agents. So far as we are aware, the capacity of amniotic tissue itself to support the multiplication of virus has been little studied, although the viral content of amniotic fluid has been much investigated. Possibly, therefore, certain viruses which hitherto have not been adapted to the embryonated egg may be found to multiply within this structure.

It was noted that embryonic erythrocytes included by chance in a pool of amniotic fluid from the 7th passage of mumps virus showed a tendency to clump on standing at room temperature for one half hour. Accordingly, an experiment was done, employing Hirst's technique,[4] to determine whether amniotic fluid of the 7th and 8th serial passages contained a hemoagglutinative factor.

The results presented in Table 2 show that this fluid was indeed agglutinative for fowl's corpuscles and that the concentration of the mumps factor was comparable to that usually found in fluids of eggs infected with influenza A. The agglutinative principle operates most efficiently at either room temperature or at 4° C, and at these temperatures is complete at the end of 1 and 1½ hours respectively. At 37° C agglutination is indefinite or the titer is lower. Supernatant fluids from centrifuged suspensions of amnion, chorioallantois and yolk-sac prepared from the same eggs from which the active amniotic fluid was obtained exhibited no definite agglutinative properties. Slight agglutination was noted in the chorioallantoic fluid of the 8th passage. Since the titer of complement-fixing antigen in the amniotic membrane is greater than that of the homologous amniotic fluid, the antigen and the agglutinative factor possibly may be distinct entities. Amniotic fluid, chorioallantoic fluid and suspensions of chorioallantois, yolk-sac and amnion from uninoculated eggs maintained under the same conditions failed to agglutinate red cells.

Hemoagglutination is inhibited by the sera of man and the monkey convalescent from mumps. On the other hand, sera taken during the early stage of the disease in man or from the normal monkey are only slightly inhibitive (Table 3). Rabbit antisera against the viruses of influenza A and B did not significantly inhibit the agglutination. Accordingly, the hemoagglutinative factor is not to be identified with the influenza viruses which are also being studied in this laboratory. Hemoagglutination by amniotic fluid, then, seems specifically dependent upon infection with the virus of mumps.

Earlier experiments[2] in which monkey-gland virus was mixed with suspensions of the red cells of many of the common domestic animals and man gave no indication of hemoagglutination. The failure of the monkey virus to cause agglutination, although the titer of complement fixing antigen may be high, has been recently confirmed in this laboratory. Apparently, therefore, this attribute becomes manifest following adaptation to the egg. To determine whether or not the virus is hemoagglutinative during the earliest passages in the egg or whether the property

TABLE 2

AGGLUTINATION OF HEN'S ERYTHROCYTES BY AMNIOTIC FLUID FROM EGGS INFECTED WITH MUMPS VIRUS

Amniotic fluid	Dilution of amniotic fluid									
	4(1)	8	16	32	64	128	256	512	1,024	2,048
	(2)									
7th passage	++++	++++	++++	++++	++++	+++	++	++	+	nd(3)
8th passage	nd	nd	nd	++++	++++	++++	++++	++	+	0
Normal	0	0	0	0	0	nd	nd	nd	nd	nd

(1) Reciprocal of final dilution of amniotic fluid.
(2) Degree of agglutination as read by comparison with Hirst's standard r.b.c. suspensions.
(3) Not done.

[9] J. F. Enders, S. Cohen and L. W. Kane, *Jour. Exp. Med.*, 81: 119, 1945.

[10] J. Stokes, Jr., J. F. Enders, E. P. Maris and L. W. Kane, *Am. Jour. Dis. Child.*, 69: 327, 1945.

TABLE 3

INHIBITION OF HEMOAGGLUTINATION BY HUMAN AND SIMIAN CONVALESCENT MUMPS SERUM

		Dilution of serum									
		4(1)	8	16	32	64	128	256	512	1,024	2,048	Virus control
Conval. monk.	(4)	0	0	0	0	0	0	tr?	tr?	++	++	++++
Normal monk.	(4)	+(2)	++	+++	+++	+++±	+++±	nd(3)	nd	nd	nd	
Conval. human	(5)	nd	0	0	++	++	+++	++++	++++	++++	nd	++++
Before dis. "	(5)	nd	++	+++	++++	++++	++++	++++	++++	nd	nd	
Conval. human	(6)	nd	0	0	0	+	+	+	++	++	nd	
Acute human	(6)	nd	+++	+++±	++++	++++	++++	++++	nd	nd	nd	

(1) Reciprocal of final dilution of serum.
(2) *Cf.* table 2, footnote 2.
(3) *Cf.* table 2, footnote 3.
(4) Sera from different monkeys.
(5) Sera from same individual; one specimen taken before exposure to mumps; the convalescent 7 days after onset of symptoms.
(6) Sera from same individual; convalescent specimen taken 15 days after onset.

is only gradually acquired must await further experimentation.

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DISTRIBUTION OF RADIOACTIVE ARSENIC FOLLOWING INTRAPERITONEAL INJECTION OF SODIUM ARSENITE INTO COTTON RATS INFECTED WITH LITOMOSOIDES CARINII[1]

INTRODUCTION

IT has been shown[2, 3] that adult *Dirofilaria immitis* in naturally infected dogs show a specific uptake of antimony following treatment with trivalent antimony compounds. These adult parasites appeared to be normal at the autopsies of the treated dogs, but microscopic examination of the uteri by Ashburn *et al.*[4] revealed significant alteration of the ovaries and uterine contents.

We have found[5] that the adult filarids of dogs have a specific uptake for trivalent arsenic as reported for the trivalent antimony. Having established the fact that both antimony and arsenic in the trivalent form were localized in the adult filarids of dogs in concentrations greater than the majority of the tissues of the hosts and certainly greater than the concentration gradient of the blood, it was believed important to ascertain if the actual location of the parasite in the host would be a factor in this specific uptake. The adult *Litomosoides carinii* are in the pleural cavity, whereas the adult *Dirofilaria immitis* are in the right side of the heart.

METHODS

The radioactive arsenic was prepared by the bombardment of germanium metal with deuterons in the 60-inch cyclotron at the Department of Terrestrial Magnetism, Carnegie Institution of Washington. This arsenic had a sufficiently long half life (16 days) to enable great precision to be obtained in the final measurements.

A chemical separation of the arsenic from the other radioactive and non-radioactive contaminants was made by a procedure recently described by Ness.[6] The arsenic was converted to sodium arsenite, $NaAsO_2$, as outlined in the above reference. Six cotton rats naturally infected with *Litomosoides carinii* were injected intraperitoneally with 1.6 milligrams of arsenic, as sodium arsenite, per kilogram of body weight. Twenty-four hours later the animals were sacrificed and twelve tissues removed, carefully weighed, and then dried *in vacuo* over phosphorus pentoxide. After sixteen hours of drying, the tissues were re-weighed, ground, and the arsenic content determined by means of suitable Geiger-counters, scaling and counting circuits. Each sample was measured in a lucite cup of standard dimensions, each cup being carefully tested for radioactive contamination before being used and no cup was used twice during any experiment. Conversion of the counting data for each determination of the radioactive samples to micrograms of arsenic was made by preparing from the solution of sodium arsenite to be injected a standard solution containing one microgram of arsenic per milliliter. This was treated in the same manner as the unknown tissue

[1] From the Zoology and Chemistry Laboratories, National Institute of Health, and the Department of Terrestrial Magnetism, Carnegie Institution of Washington.

[2] Frederick J. Brady, Alfred H. Lawton, Dean B. Cowie, Howard L. Andrews, A. T. Ness and Glen E. Ogden, *Am. Jour. Trop. Med.*, 25(2): 103–107, 1945.

[3] Dean B. Cowie, Alfred H. Lawton, A. T. Ness, Frederick J. Brady and Glen E. Ogden, *Jour. Wash. Academy Sci.*, 35(6): 192–195, 1945.

[4] L. L. Ashburn, T. Perrin, Frederick J. Brady, Alfred H. Lawton (in press, *Arch. Path.*).

[5] Unpublished data.

[6] A. T. Ness, "Separation of Radioactive Arsenic from Copper and Germanium" (in manuscript).