of virus to infect the same animal when previously administered by stomach without mouth contamination gives some support to such a concept.

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A VIRUS OBTAINED FROM A PNEUMONIA OF CATS AND ITS POSSIBLE RELATION TO THE CAUSE OF ATYPICAL PNEUMONIA IN MAN

A RESPIRATORY tract infection in cats—variously called nasal catarrh, influenza or distemper—has been observed frequently within the past year or so in the Northeastern United States. The main characteristics of the disease are its highly infectious nature, debilitating effects and long course of about a month. Its respiratory nature is recognized by sneezing and coughing, which is accompanied by a mucopurulent discharge from the eyes and nose. The existence of a pneumonia is not determined by the usual clinical examination unless the animal is markedly affected, but an autopsy reveals grayish, densely consolidated areas in the anterior lobes of the lungs.

Suspensions of lungs from cats showing typical clinical symptoms and pneumonia were inoculated intranasally into mice. The mice became sick in the first passage, and those inoculated with two of the strains died in 3 to 5 days. In another attempt to isolate the agent, the mice appeared sick but survived the inoculation. At autopsy all inoculated mice presented a definite pneumonia with more than half the lung substance consolidated. Serial passage reduced the time interval to a point where death occurred in 2 to 3 days following the intranasal inoculation of a 10 per cent. suspension of infected lungs. Similar serial passages from uninoculated mice from the same source were entirely negative.

The agent was easily transferred to eggs, which had been incubated for 5 days, by inoculation into the yolk sac. The embryos died consistently within 2 to 3 days in serial passage, even when relatively large amounts of infectious material were inoculated.

When suspensions of lungs of inoculated mice or of yolk sac membranes of inoculated eggs were given intranasally to normal kittens the typical disease was produced. From these inoculated cats the disease went by contact to normal kittens.

Cultures from the lungs of naturally infected cats and of infected mice showed few bacteria and were frequently negative. All attempts failed to demonstrate a cultivable agent from infected eggs on blood agar plates and on a variety of special media designed for the culture of anaerobes and pleuropneumonia-like forms. These findings suggest that the agent is a virus, yet attempts to pass the agent through Berkefeld filters gave irregular results. The nature of the agent, however, became apparent when sections of the yolk sac membrane stained with Giemsa, or films from lungs of mice or yolk sac membrane treated by Machiavello's method, revealed numerous elementary bodies similar to those of psittacosis.

Centrifugation of infected mouse lungs and yolk sac suspensions at 10,000 r.p.m. for 30 minutes removed much of the infective agent from the supernatants and concentrated it in the sediments. This is added evidence that the observed elementary bodies are the etiological agent.

A number of instances of contact between sick cats and people who subsequently developed atypical pneumonia have been brought to our attention. For example, Dr. Francis G. Blake (personal communication), of Yale University, observed an atypical pneumonia in a rural family in Connecticut which occurred where cats were sick with a pneumonia. Dr. C. W. Barber, of the New York State Veterinary College, noted the reverse, where a child sick with atypical pneumonia played with a kitten that later became sick. It may be of epidemiological interest that the disease in man and in cats is occurring simultaneously.

Complement fixation tests have been made, using antigens of partially purified and concentrated elementary bodies prepared from infected mouse lungs. Sera obtained from cats before infection and again after they had recovered were tested. All the 6 cat sera obtained before infection failed to fix complement when 0.1 cc or less was mixed with 0.1 cc of the antigens. Using the same amount of antigen and testing at the same time, the convalescent cat sera fixed complement when from 0.02 to 0.0025 cc was used. Five sera drawn from man during the acute and convalescent stages of atypical pneumonia were obtained from Miss Catherine Grenci and Dr. Norman Moore, Cornell Infirmary, Ithaca, New York, and 7 more similar sera from Dr. Frank Horsfall, of the Hospital of the Rockefeller Institute. Eight of these sera drawn during the acute illness fixed complement; and the convalescent sera from 5 of these cases showed a definite increase in this property, while 3 showed a questionable increase and 4 no increase.

Sera from 9 presumably normal individuals were examined for controls. 0.1 cc of 2 specimens failed to fix complement, while the same amount of 4 others fixed more or less completely; 2 specimens fixed with 0.05 cc and 1 with 0.025 cc. As controls in this test, one serum drawn during the acute stage of the disease fixed in an amount of 0.0125 cc, while the convalescent serum fixed in $\frac{1}{4}$ this amount, or 0.0031 cc. Another serum drawn during the acute stage failed to fix when 0.1 cc was used, whereas 0.0125 cc of the convalescent serum fixed.

SUMMARY

Evidence is produced that a respiratory disease in cats is due to a virus that forms elementary bodies and that this virus is the same as or closely related to the one causing some of the so-called atypical pneumonias in man. Further work is in progress, and a detailed report of the cat disease and of additional complement fixation tests will be made later.

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CAPILLARY EMBOLI AS A LETHAL FACTOR IN BURNS[1]

IN the course of an extensive series of experiments on shock following thermal trauma in anesthetized cats,[2] it was noted that a small proportion of the animals succumbed with extreme rapidity within a few minutes of burning. In these cases, respiration stopped suddenly, the heart was slow and irregular and the blood pressure fell precipitately. Artificial respiration usually did not result in recovery, although the heart continued to beat for some time. Hemoconcentration and local fluid loss into the area of the burn were minimal at the time of death. Necropsy in these cats showed pulmonary congestion, subendocardial hemorrhages in the left ventricle and in one instance punctate hemorrhages in the liver and submucous hemorrhages in the duodenum.

Since the sudden death in these experiments could not be explained on the basis of loss of fluid and since the nervous factor had been eliminated experimentally,[2] the phenomenon was attributed to a toxin. The investigation was carried forward to study the possibility that changes produced by heat in the circulating blood could account for rapid death from burns.

Measurements of subcutaneous temperature in experimental scalds[3] show that temperatures of 55 to 65 degrees C. are reached and maintained for several minutes. Citrated cat's blood was heated to 65° C. (149° F.) for one minute; it remained fluid but became dark in color and showed evident hemolysis. Heating of plasma to 56°–65° C. resulted in the formation of a voluminous fine precipitate, presumably fibrinogen. On the other hand, when serum was treated in the same way, no visible change was evident. Fresh coagulable blood heated quickly to 65° C. remained fluid and became incoagulable.

After heating a small amount of citrated cat blood for one minute to 65° C., reinjection intravenously into the same animal resulted in rapid death. This reaction was similar to the rapid deaths observed following burns. Blood pressure fell markedly and respiration ceased within one to two minutes, but the heart continued to beat for 5 to 10 minutes and artificial respiration was of no avail. As little as 3 to 4 cc of heated blood injected rapidly produced this characteristic fatal outcome. The same phenomenon has been observed repeatedly in cats under nembutal following rapid intravenous injection of 1 to 2 cc of autogenous plasma previously heated to 65° C. for one minute. Intravenous injection of heated serum in much larger amounts had no significant effect. The supernatant of centrifuged heated plasma was also ineffective, indicating that it is the fine precipitate of fibrinogen in heated plasma which possesses the toxic properties.

By very slow intravenous injection of heated plasma, much larger amounts could be introduced without producing rapid death. In one experiment, after injection of 13 cc of heated plasma, blood pressure was low for an hour and respiration became rapid and shallow. The cat survived for four days, during which time it was very weak and unresponsive and made no spontaneous movements. Necropsy showed marked congestion of the lungs, slight renal congestion, a discolored dark gray and softened liver and a gastric ulcer one cm in diameter which had perforated.

The experiments were then extended to study the effect of intravenous injection of heated human plasma and serum into unanesthetized rabbits. Human plasma heated to 56° to 65° C. showed a precipitate similar to that observed in heated cat plasma, while heated human serum was apparently unchanged. Rapid injection through a 22 gauge needle of 2 to 5 cc of heated human plasma into the ear vein of rabbits resulted in rapid arrest of respiration followed by anoxic convulsions with occasional gasping. The heart continued to beat for some time, but artificial respiration was ineffective. All the rabbits injected with heated plasma died within 5 to 10 minutes. The centrifuged precipitate of heated human plasma gave the same reaction, while intravenous injection of as much as 40 cc of the supernatant or of unheated human plasma had no effect. Intraperitoneal injection of heated human plasma was also ineffective. Rapid intravenous injection of heated human serum in amounts up to 40 cc was likewise innocuous to the rabbits.

Necropsy of rabbits which died from injection of heated human plasma or precipitate showed no gross pathology in the internal organs or in the brain other than occasional slight pulmonary congestion. Microscopic examination of the lungs revealed wide-spread and numerous capillary protein emboli.

[1] Aided by a grant from the Graduate School of the University of Minnesota.

[2] H. Kabat and R. F. Hedin, *Surgery*, 11: 766–776, 1942.

[3] H. Pfeiffer, *Virchow's Arch. f. path. Anat.*, 180: 367, 1905.