ple, would be somewhat higher in value expressed as atmospheres. Plant cells when turgescent have a cell sap represented by 5 to 10 atmospheres. Beet sugar sap has a value of 15 to 21 atmospheres, or that of a 25 to 30 per cent. solution of sucrose. Fungi as Penicillia and Aspergilli have been grown in concentrated solutions having a value of 157 to 160 atmospheres, or an equivalent of 45 per cent. KNO_3.[2] Owen[3] in Louisiana was able to grow yeasts in molasses having a density of 70 per cent. total solids or when figured as sucrose the equivalent of 225 to 260 atmospheres. As molasses contains lower sugars and gums the figure is actually higher. We have grown yeasts in culture tubes where the medium was 62 per cent. total solids, which may be represented by 140 to 180 atmospheres figured as sucrose. The actual figure is higher for the reason stated above. Also we have grown yeasts in hanging drops of mixed syrup having a density of 70 per cent. or again expressed in atmospheres 225 to 260. Yeasts did not grow in the purest cane syrup (c.p.) of 68 per cent. total solids. Cream centers of chocolate coated candies inoculated with sugar tolerant yeasts burst after a period of storage normal for ripening such confections. The syrup density of the expressed syrup phase of the cream of fondant was 76 to 77 per cent., or greater than 225 to 260 atmospheres.

Summarizing, we may state that yeasts apparently do not grow in solutions of mixed sugars having a density of 79 per cent. This concentration appears to indicate the cessation of activity for sugar tolerant yeasts. Investigators at the Michigan Agricultural Station have apparently reached the same conclusion.[4] We need to bear in mind, however, that between cessation of reproductive development and cessation of all activity there is a period where enzymatic activity of living cells and finally autolysis of dead cells progresses.

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MORE DATA ON THE LUNG FLUKE, PARAGONIMUS, IN NORTH AMERICA

WALLACE,[1] of the University of Minnesota, has recently found that the mink is the normal definitive host of *Paragonimus* in North America. He examined minks from fur farms. He included a small amount of life history data in his report and in a second article[2] gave a more detailed account of this phase of the work. The work here reported was begun in March, 1930, independently of and without knowledge of Wallace's work. My records show that metacercariae were discovered June 22, 1930, and mature worms secured on September 4, 1930, from an experimentally fed cat. The mink was determined to be the normal definitive host in North America without knowledge of Wallace's contribution which was published after my survey of the fur-bearing animals was completed.

In the fall of 1929, in connection with another problem, a cat was used that had come from Platt, a small village on the outskirts of Ann Arbor. Examination of its feces at the time revealed the characteristic eggs of *Paragonimus* and this diagnosis was verified several months later at the death of the cat when eight adult worms and a large number of eggs were removed from the lungs. On the basis of this discovery, a search for the metacercaria was begun the following spring when various species of crayfishes from local ponds, lakes and streams were examined and on June 22, 1930, a metacercaria closely resembling that of the Asiatic lung fluke was discovered in the pericardial region of 60 per cent. of the *Cambarus propinquus*[3] collected in Fleming Creek, a stream several miles east of Ann Arbor. Cysts were fed at intervals to a cat which developed the characteristic *Paragonimus* cough. On September 4, 1930, ten weeks after the first experimental feeding, the cat was killed and forty-three worms of various ages as well as thousands of eggs were recovered from the lungs. Subsequent examination of crayfishes from the same stream revealed that *C. robustus* also harbored the metacercariae but very few individuals were infected. The cysts are usually found in the wall of the heart or adhering to it, though occasionally some are found either attached to the tissues surrounding the pericardial cavity or free in the lumen of any of the large blood vessels leaving the heart. In heavy infections, the majority of the cysts occur in clusters arranged in a belt across the broad base of the heart. Even in the heaviest infections, the cysts are absent from the gills or muscles. In the fall, collections of stream crayfishes taken from all parts of the lower peninsula to determine the distribution of the worm in this part of the state, added another host species, *C. virilis*. Wallace found metacercariae in a single species, *C. immunis spinirostris*. Apparently any species of crayfish occurring in the appropriate environment will serve as an intermediate host though

[2] *Ibid.*, p. 140.

[3] Wm. L. Owen, "Swells in Canned Cane Syrup and Molasses," "Facts about Sugar," 21, pp. 946–9, Oct. 2, 1926.

[4] F. W. Fabian and R. I. Quinet, "A Study of the Cause of Honey Fermentation," Mich. Agr. Sta., *Tech. Bull.* 92, pp. 1–41, 20 figs, Feb., 1928.

[1] F. G. Wallace, "Lung Flukes of the Genus Paragonimus in American Mink," *Jour. Am. Vet. Med. Asso.*, 31: 225–234, 1931.

[2] F. G. Wallace, "The North American Lung Fluke," SCIENCE, n. s., 73: 481–482, 1931.

[3] The writer is indebted to Mr. E. P. Creaser, of the University Museums, for identification of crayfishes.

some species prove to be more capable hosts than others.

To determine the distribution of the lung fluke and its normal host in Michigan, there were secured from trappers all over the state, during the 1930 trapping season, 1,011 carcasses of fur-bearing animals consisting of 563 minks, 308 raccoons, 109 opossums, 22 weasels, 8 muskrats and one badger. The flukes were found only in minks of which 17 per cent. carried the infection. Though raccoons are voracious eaters of crayfishes they are apparently immune to lung fluke infection. A raccoon which had been fed hundreds of cysts, during the summer of 1930, was found to be negative upon examination in the fall. An attempt is now being made to infect young raccoons. An unsuccessful attempt was made to infect an opossum following the examination of the carcasses. No sign of infection was found in 241 carcasses of wild muskrats examined in connection with a former problem though a feeding experiment demonstrated that muskrats are capable of infection. The 8 muskrats reported above were examined because they had been caught in Honey Creek, a stream in which all the *C. propinquus* examined, as well as a high percentage of the *C. robustus,* were infected. *C. propinquus* from this stream not uncommonly yield 40 metacercariae while one yielded 75.

Paragonimus occurs rarely in cats or dogs. Though thousands of cats and hundreds of dogs are examined annually in laboratories, this obvious pulmonary infection is seldom reported. The rarity of the infection in these animals is explainable on the basis of their food habits. It is generally believed that the various mammalian hosts of *Paragonimus* obtain their infection through the eating of fresh-water crabs or crayfishes but to my knowledge it has never been proven that cats or dogs eat these crustaceans. On two occasions both living and dead crayfishes were placed before the naturally infected cat from Platt following several days of starvation but she did not display the slightest interest in them. This same cat at various times eagerly ate the flesh of wild mammals and birds, even hawks and owls, though cooked food was in the cage. Another cat manifesting the same attitude toward wild food could not be induced to eat crayfishes after two days of starvation.[4] This experiment has not yet been tried upon dogs. If cats and dogs do not eat crayfishes, the only other possibility of their securing *Paragonimus* is by eating the final hosts containing recently ingested metacercariae or slightly developed worms, thus acquiring their infection secondarily. That this method of transmission is possible, at least with worms not exceeding twenty-four hours' sojourn in the final host, was demonstrated when two rats fed one hundred metacercariae twenty-four hours previously were forcibly fed to a dog. On examination two months later, four young adult worms were found in two cysts in the dog's lungs.

Though it is the consensus of opinion that nothing will eat a mink, data have been collected to prove that both cats and dogs do occasionally eat them. Accounts of personal experiences on this matter were solicited from trappers of minks. Out of thirty-three replies, three trappers stated that they had seen dogs eat minks. One trapper reported that he had seen cats eat minks while still another replied that cats do eat minks but he did not indicate that he had witnessed the act. Two other trappers volunteered the information that they had seen foxes eat minks.

When the collection of carcasses of fur-bearing animals mentioned above was being made, the fresh carcasses of minks were given to each of four cats. Two of the cats would not touch the carcasses while one ate the liver, lungs and muscles when they were removed from the carcass and given to it separately. The fourth cat, an exceptionally large animal, at the regular feeding time ate the entire thorax of a mink and might have eaten more had not the remainder been removed.

Further studies on the various aspects of the *Paragonimus* problem are under way and will be reported upon from time to time.

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[4] Since this manuscript was submitted two of my cats, when starved, have eaten crayfishes.

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