Professor John N. Couch kindly examined the infected eggs and identified the fungi as *Lagenidium callinectes* Couch, the primary parasite, and *Rhizophidium*, sp., which may be either parasitic or saprophytic (Couch, 1942).[1]

Experimental data indicate that infected eggs are usually below the normal size. Whereas uninfected eggs under optimum conditions in the laboratory gave a 70 to 90 per cent. hatch of normal first-stage zoeae, fungus-infected eggs under similar environmental conditions either failed to develop to the hatching stage or hatched into prezoeae, considered to be abnormal. The prezoeae rarely survived longer than forty-eight hours.

In 1942 infected and uninfected egg masses were suspended in the York River to determine the effect of the fungi on egg development under natural conditions. The infected eggs failed to hatch, and the fungus grew considerably. The uninfected egg masses showed an abundance of empty egg cases, indicating a fairly normal hatch.

The fungus appears to be quite uniformly distributed throughout the egg masses and is present in eggs in all stages of development.

Random samples of eggs have been examined from widely separated parts of Tidewater Virginia, namely, Rappahannock River, York River, Hampton Roads and Lynnhaven. The results to date indicate marked regional variations in the per cent. of infection.

The parasitic fungi represent an important biological factor that occupies a place with certain physical factors, such as low salinity, that are known to greatly reduce the per cent. of hatch (Sandoz and Rogers).[2] In light of the hatching results obtained, the value of protecting heavily infected egg-bearing crabs against commercial use appears questionable. Therefore, in selecting and evaluating a crab sanctuary for the protection of brood stock, attention should be given to determining the extent of parasitic fungus infection present as well as the suitability of the physical and chemical conditions that characterize the area.

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VITAMIN C IN THE NEEDLES OF SOME CONIFERS

SINCE the report of Shishkin published recently in SCIENCE[1] "that needles of ordinary pine trees contain large quantities of vitamin C," some authors (Dunham,[2] B. Schick,[3] Ch. Macnamara[3] and M. Donnelly[4] have called attention to the fact that the decoction of the needles of the evergreen tree was used with success against scurvy in the early expedition of Jacques Cartier in 1535 and further in the war between Sweden and Russia (1708–09).

This fact has suggested to us the investigation of the vitamin C content of the decoction of some conifers (needles), principally those growing largely in Southern Brazil (Araucaria, Podocarpus).

The determinations were performed on a 5 per cent. extract prepared by boiling the ground leaves with water, as is generally done in the preparation of tea. In other cases the leaves were ground and extracted with 2 per cent. metaphosphoric acid. The determinations were carried out before and after the treatment with H_2S and CO_2.

Tillmans' 2,6-dichlorophenolindophenol titration method was employed. We are indebted to Dr. F. R. Milanez, of the Biological Department of the Rio de Janeiro Botanical Garden, for the samples used in these analyses.

A brief summary of our results is shown in Table 1.

TABLE 1

No. of samples	Species	mg per 100 ml of the extract	
		ascorbic acid	dehydro-ascorbic acid
5	*Araucaria augustifolia* (*brasiliensis*)	2.7	1.0
5	*Podocarpus Sellowii*	3.3	1.3
1	*Podocarpus Lambertii*	2.8	1.9
2	*Araucaria excelsa*	0.5	0.8
1	*Pinus excelsa*	2.3	1.0

Although ascorbic acid is not present in the decoction in large amounts, the use of the pine-tea would be helpful in some countries where the vitamin C is not readily available.

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THE TWILIGHT CEREMONIES OF HORSE-FLIES AND BIRDS

IN a recent number of SCIENCE[1] Leonard Haseman published an article on "The Courting Flights of Tabanids," describing a humming, hovering flight of horseflies which is performed by the males alone and only at the twilight hour. I wish to point out that

[1] John N. Couch, *J. Elisha Mitchell Scien. Soc.*, Vol. 58, No. 2, December, 1942.
[2] Mildred D. Sandoz and Rosalie Rogers, *Ecology* (in press).

[1] SCIENCE, April 16, 1943, pp. 354–355.
[2] *Ibid.*, August 6, 1943, p. 132.
[3] *Ibid.*, September 10, 1943, pp. 241–242.
[4] *Ibid.*, October 8, 1943, p. 325.

[1] L. Haseman, SCIENCE, 97: 285, 1943.

this performance of the horseflies is, in its duration and time of occurrence, fundamentally similar to the twilight song of birds. Haseman tells us that in *Tabanus sulcifrons* the performance begins very early in the morning, at a low intensity of light, "a fraction of one foot-candle," and continues for a definite period, "20 to 25 minutes," until the light has reached an intensity of three to five foot-candles; the flight then ceases more or less abruptly. As the season advances, bringing a change in the hours of twilight and sunrise, the hour of the flight changes accordingly. All these details of the horsefly's performance are found, essentially the same, in the twilight song of birds.

Haseman speaks of the twilight flights of the horseflies as "courting" flights; but while the males were performing the twilight flight he could find no females among them and no pairs coupling. Mosier and Snyder[2] express doubt as to whether the early morning flight of *T. americanus* is a courting flight. Hine,[3] in Ohio, found that the mating of *T. sulcifrons* occurred in a very restricted period, about 8 to 8:30 A.M., Standard Time, which would be some three hours or more after the early morning flight. Accordingly, instead of calling the twilight performance of the horseflies a "courting" flight, would it not be well to name it "the twilight hovering flight"?

There is much evidence to indicate that the twilight song of birds has little or no connection with mating. Even if it has a slight connection with mating, that fact can not account for the exact relation of the song to the hours of twilight. Why birds sing a twilight song is not completely understood, but the song has some relation to the bird's daily cycle, his seasonal cycle and his photoperiodism.

We shall speak especially of the daily cycle of the wood pewee, a species of bird whose song is most suitable for statistical study (see the monograph on "The Song of the Wood Pewee").[4] In this species the daily cycle is symmetrical; the male sings a twilight song both morning and evening, and in certain important details the order of events in the morning song is reversed in the evening song, so that the latter is a "mirror image" of the former.

This symmetrical daily cycle anticipates the solar day, being about 17 minutes ahead of it. In other words, the birds keep "daylight-saving time"; but the bird's chronometer is only 17 minutes ahead of the sun, instead of 60 minutes like ours. In the morning the wood pewee anticipates the dawn by beginning to sing when the light intensity is extremely low (about 0.01 foot-candle). In the evening he anticipates nightfall by ending his song while there is still considerable daylight (about two foot-candles).

In saying that the bird "anticipates" the dawn we are not raising the question whether he has any conscious expectation of it. We state only that he acts ahead of time. Every one knows that organisms anticipate the seasons. In the springtime trees often put forth their flowers and leaves before the weather is suitable. In the autumn many birds begin their migration in August; in doing so they are anticipating winter unconsciously, for they certainly do not know that winter is coming. Anticipation, in the sense of acting beforehand, is one of the fundamental properties of life.

We stated that the wood pewee's chronometer is 17 minutes fast, as compared with sun time. We shall explain briefly how the number 17 is derived from our data. In the morning the wood pewee begins to sing at S.d.9°36′. (S.d. = Sun's depression, the vertical angular distance of the sun below the horizon.) In the evening he ends his song at S.d.4°40′. The average of these two is practically S.d.7°, and we regard this as the main dividing point between day and night, for the wood pewee. In the morning he begins to sing 17 minutes before S.d.7°, and in the evening he ends his song 17 minutes before S.d.7°. That gives two measuring points at which the wood pewee anticipates the sun by 17 minutes; and in the monograph cited[4] I have described also four other measuring points which support the conclusion that his daily cycle is 17 minutes earlier than the solar day.

A great many species of songbirds, perhaps all species, anticipate the solar day. Apparently the same is true of the horseflies. Unfortunately, we have no data for both morning and evening from the same species of horsefly. The authors quoted have observed the twilight hovering flight of *T. sulcifrons* and *T. americanus* only in the morning, and *T. giganteus* only in the evening. In regard to this evening performer, Haseman says, "This species seemed to require more light, as they began . . . with a light intensity of about 30 foot-candles and continued for some thirty minutes, ceasing when the light had dropped to an average of about 3 foot-candles." I suggest that this difference in regard to intensity of light is not an inter-specific difference, or not purely such; it is a difference between the morning and the evening performance. If this interpretation is correct, the horseflies do anticipate the solar day. It is to be hoped that field entomologists will find out if *T. sulcifrons* or *T. americanus* ever performs in the evening, or *T. giganteus* in the morning; if so, this will give opportunity to answer definitely the question of their anticipation of the solar day.

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[2] Mosier and Snyder, *Proc. Ent. Soc. Wash.*, 20: 115, 1918.

[3] J. S. Hine, U. S. Dept. Agr. Bur. Ent. Tech. Ser., No. 12, Part II, p. 24, 1906. (Haseman's citation of Hine is not quite correct.)

[4] W. Craig, *N. Y. State Mus. Bull.*, No. 334, 1943.