Accumulation of SAICAR and AICAR by nonproliferating suspensions of strains B-94 and B-96/1, respectively, was examined by methods previously described (*5*). Glucose and ammonium chloride served as the sources of carbon and nitrogen. The accumulated compounds were measured as diazotizable amines with special modifications (*3*) to distinguish between SAICA and AICA. In Table 1, the amounts of the purines required for a 50-percent inhibition of SAICAR formation in strain B-94 are compared with the amounts required for similar inhibition of AICAR formation in strain B-96/1. In the latter case, where interconversions are not impaired, there is no more than a twofold difference between any of the purines, but in strain B-94, where interconversions are restricted, only adenine, the specific growth factor for this strain, shows a comparable degree of inhibition. As can be seen in Fig. 1, hypoxanthine has only 0.1 the activity of adenine; guanine and xanthine are comparatively inactive. The inhibition obtained with higher concentrations of hypoxanthine could be due to a weak feedback action, or, more probably, to an indirect effect whereby available substrates are diverted from their *de novo* purpose. For example, in the conversion of hypoxanthine to adenylosuccinic acid, a process known to operate in strain B-94, two substrates must be used which are also required for the *de novo* formation of SAICAR; these are 5-phosphoribosyl-1-pyrophosphate (PRPP) and aspartic acid. Xanthine and guanine would effect only a diversion of PRPP, and hence even higher concentrations would be required for inhibition. Thus, two mechanisms may be operating—one, an indirect effect inherent in the artificiality of the system whereby exogenously proffered compounds may compete for substrates; the other, a direct feedback action, operative in vivo and specifically triggered by very small concentrations of adenine or one of its ribosylated congeners (*6*).

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4. "SAICAR" is used as an abbreviation for the ribotide of 5-amino-4-imidazole-N-succinylocarboxamide; "AICAR," for the ribotide of 5-amino-4-imidazolecarboxamide.
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Dispersal of Fresh-Water Algae by Migratory Water Birds

Abstract. Many migratory water birds killed in Texas and Oklahoma contained viable fresh-water algae in the lower digestive tracts. Such birds are thought to play a significant role in the long-range dispersal of certain algae, particularly those species easily killed by desiccation.

Many fresh-water algae are distributed widely over entire continents, if not the world. How such forms are transported from one body of water to another is not well known, but the usual explanation has been that they are carried either by wind or on the feet, feathers, and bills of birds (*1*). As previously noted (*2*), neither method would be very effective in dispersing algae easily killed by desiccation, for example, the desmids. Such algae might be transported considerable distances without being subjected to desiccation if they could survive a passage through the alimentary canal of migratory birds (*3*). The observations reported here indicate that many fresh-water forms are able to do so.

Over a period of approximately one year, 25 different migratory waterfowl (126 birds) were shot from playas and fish-hatchery ponds in western Texas and south-central Oklahoma. Thirteen were discarded because of empty or shot-perforated large intestines. The birds were placed on ice as soon as they were killed, and later examined, usually within 1 to 3 hours. At that time one inch of gut from between the junction of the caecum and the cloaca was ligated and removed. Also an occasional sample was taken from the distal portion of one of the caeca. After the section of the intestine had been dipped in 70-percent ethyl alcohol to remove possible contaminants, one end was removed with sterile scissors, and the fecal contents were allowed to drop into a sterile flask of distilled water. A few minutes later 5 ml of this suspension was pipetted to a second flask containing autoclaved soil-water medium. This procedure was followed for each bird, yielding two sets of flasks. Both sets of flasks were then placed in a culture cabinet at 23°C under continuous artificial light for a period of 3 to 10 days. At the end of that time the contents were examined microscopically for living algae.

Viable algal cells were present in the lower digestive tract or caecum of one or more of the birds from each of the 25 genera examined. Viable algae were present in birds killed over both land and water. From such piscivorous genera as grebes, herons, kingfishers, and egrets only a few simple unicellular green algae of the "Chlorella type" and an occasional blue-green alga were obtained. A much greater variety of algae was found in ducks and bottom-feeding

Table 1. A comparison of the number and kinds of viable fresh-water algae recovered from the lower digestive tracts of some migratory water birds.

Bird	No. of birds examined	No. of algal genera present	Representative genera of algae*
Pied-bill grebe (*Podilymbus podiceps*)	9	2	
Green-winged teal (*Anas carolinensis*)	14	17	4, 5, 6, 7, 10, 11, 13, 14
Blue-winged teal (*Anas discors*)	5	14	3, 4, 5, 6, 10, 13
Shoveler (*Spatula clypeata*)	6	20	1, 2, 4, 5, 6, 8, 10, 13, 15
American coot (*Fulica americana*)	7	28	2, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15
Killdeer (*Charadrius vociferus*)	20	20	4, 5, 6, 7, 9, 10, 11, 13, 14, 15
Dowitcher (*Limnodromus griseus*)	9	20	1, 2, 3, 4, 5, 6, 7, 10, 13, 14, 15
American avocet (*Recurvirostra americana*)	4	15	1, 5, 6, 10, 12, 13, 15
Wilson's phalarope (*Steganopus tricolor*)	2	11	5, 6, 8, 9, 10, 13
Belted kingfisher (*Megaceryle alcyon*)	2	1	

* Key: 1, *Gonium*; 2, *Pandorina*; 3, *Eudorina*; 4, *Oedogonium*; 5, *Pediastrum*; 6, *Scenedesmus*; 7, *Spirogyra*; 8, *Closterium*; 9, *Penium*; 10, *Cosmarium*; 11, *Staurastrum*; 12, *Phacus*; 13, Naviculoid diatoms; 14, *Merismopedia*; 15, *Arthrospira*.

shore birds. In this latter group there were a number of fresh-water forms characteristic of the ponds of the region, in addition to the ubiquitous unicellular green algae. Some of the more interesting algae found in a representative group of birds are listed in Table 1.

As a rule, more algae were present in birds shot during the spring than at any other time of the year. This probably reflected the greater diversity of algae normally present in the playas at that season. A scarcity of seeds and insects also may have caused the birds to ingest increased amounts of algae.

A microscopic examination of fecal material shortly after it was removed from the birds disclosed that *Gonium, Pandorina,* and at least four genera of desmids had passed through the alimentary canal as vegetative cells. Since many blue-green algae as well as a number of smaller unicellular green algae have no specialized resting stages they also must have passed through as vegetative cells. Viable filamentous green algae were never observed in any part of the digestive tract beyond the gizzard, although partially digested cells were often present. Filaments of *Spirogyra* and *Oedogonium,* present in the flasks after approximately one week, probably developed from zygotes.

Attempts to germinate intact *Chara* zygotes found throughout the guts of a coot and a blue-winged teal were unsuccessful. Neither motile yellow-green algae nor dinoflagellates were ever observed in cultures from any of the birds. The afore-mentioned three groups are known to have relatively complex cultural requirements, and the possibility cannot be ruled out that failure was due to unsuitable media or environmental conditions.

From a consideration of the rate of movement through the alimentary tract (*4*) and flying speed (*5*) of common migratory water birds, it seems reasonable to conclude that many fresh-water algae can be carried easily between lakes 100 to 150 miles apart. Cells or colonies in the caecum may be carried several times this distance.

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Effect of Light on Motility, Life-Span, and Respiration of Bovine Spermatozoa

Abstract. Exposure to light of bovine spermatozoa suspended in various media results in a progressive decline in metabolic activity followed by the premature death of the cells. The inhibitory and spermicidal effects of visible light resemble a photodynamic action; the photosensitizer is an intrinsic component of the cell.

The deleterious effects of short-wavelength radiation on spermatozoa have been examined in some detail by a number of workers (*1*). Wells and Giese (*2*), studying photoreactivation of ultraviolet-irradiated sperm of the purple sea urchin *Strongylocentrotus purpuratus,* observed that visible light was also very harmful to these cells, immotilizing them and rendering them incapable of fertilizing normal eggs. A later investigation (*3*) showed that glycine exerted a protective effect during exposure to visible light.

With the development of an artificial medium in which bovine spermatozoa can be maintained at room temperatures in a physiologically active state in vitro for several days (*4*), it has become possible to study experimentally the response of these cells to visible light.

The collection and processing of bovine semen was carried out essentially as described by Norman *et al.* (*4*). The sperm were suspended in a modified coconut-milk extender which contained, in final concentration, 15 percent coconut milk, 2.16 percent sodium citrate dihydrate, 0.068 percent dihydrostreptomycin sulfate, 0.031 percent sodium penicillin, 0.3 percent sulfanilamide, and 2.5 units of mycostatin per milliliter. The final concentration of the cells, determined with a hemocytometer, was between 10×10^6 and 15×10^6 cells per milliliter. Plastic vials containing the cell suspension were illuminated for varying periods on a glass plate 7 mm thick, placed 33 cm from a bank of two 40-watt white fluorescent bulbs. These lamps have a spectral range from 0.4 to 0.7 μ (*5*). The light intensity at the level of the sample vials was 300 ft-ca, as measured with a model 756 Weston illumination meter, and the ambient temperature was maintained at 26° ± 2°C during the experiment. The parameters used to determine the light sensitivity of the cells were the percentage of dead cells, as measured by the differential staining method of Campbell, Dott, and Glover (*6*); motility; and oxygen consumption, expressed as Z_{O_2}. Appropriate controls were kept in the dark.

Table 1 is a summary of the results of three replicate experiments on continuous illumination of the spermatozoa. These data indicate that exposure to light results in concomitant loss of mo-

Table 2. Effect of light on spermatozoa suspended in various media. Light intensity, 1400 ft-ca.

Exposure (hr)	Dead cells %		Motility	
	Light	Dark	Light	Dark
Krebs-Ringer phosphate				
10	56	30	2.0	3.5
60	63	39	0.5	2.5
*Krebs-Ringer phosphate plus antibiotics**				
10	74	38	0	3.5
60	100	52	0	3.0
0.85% NaCl				
10	89	32	0	4.0
60	100	68	0	2.5
0.85% NaCl plus antibiotics				
10	88	32	0	3.5
60	100	100	0	0
15% Coconut milk in Krebs-Ringer plus antibiotics				
10	51	22	0	4.5
60	100	34	0	3.0
Skim milk†				
24			0	3.0
60	95	36	0	2.5

* Same as in coconut-milk extender.
† Temperature, 5°C.

Table 1. Effect of light on spermatozoa suspended in various media. Light intensity, 300 ft-ca. Values are averages for three replicate experiments. Temperature during exposure, 26° ± 2°C.

Exposure time (hr)	Dead cells (%)		Motility*		Z_{O_2}	
	Light	Dark	Light	Dark	Light	Dark
Coconut-milk extender (10×10^6 to 15×10^6 cells/ml)						
24	50	32	0	3.0	0.4	5.34
72	100	36	0	3.0		
Coconut-milk extender and catalase (10 mg%) (10×10^6 to 15×10^6 cells/ml)						
24	36		2.0			
Coconut-milk extender (2×10^8 cells/ml)						
24	32	36	2.5	3.5		
72	73	31	1.0	3.0	0.0	3.5

* Motility ratings: 5.0, excellent; 4.0, good; 3.0, fair; 2.0, poor; 1.0, vibratory; 0.0, nonmotile.