Diacell cellulose nitrate were exposed to the argon beam behind Lucite moderators. The entrance angle was 34° to the normal. The sheets of cellulose nitrate which bracketed the predicted argon range were etched for 20 minutes in 6*N* NaOH. According to data and calculations of the track-recording properties of cellulose nitrate (*5*), the etching should make visible the last 5 to 7 mm of an argon track but only the last 1.8 mm of a neon track. To be identified as argon, a track was required to enter each layer at an angle of about 34°, to end at the predicted depth in the stack, and to have a path length of at least 6 mm. A total of 79 such tracks were found inside the beam spot (3.2 cm); none were found outside. During this exposure, 6.7×10^7 neon ions were counted in the primary beam. A partial scan of the sheets near the expected neon range revealed tracks of a length appropriate to stopping neon ions. It is likely that these neon ions were scattered into the argon beam by Coulomb interactions with the air in the beam line (the main neon beam was separated from the argon beam by only 1°). The argon tracks appeared as clear holes through each sheet of cellulose nitrate, whereas the neon tracks generally resulted in conical pits under the same etch conditions. A scan 9 mm upstream of the end of the argon tracks did not yield any pits that etched to full holes or that had well-defined conical structure with proper directions; this finding indicates an absence of background tracks.

A differential range telescope (*6*) with a remotely controlled Lucite absorber was also used to detect the argon ions. A clear signal was observed at the expected argon ion range of 6.06 g/cm², as shown in Fig. 1B. The magnitude of the signal was observed to fluctuate strongly as a function of the vacuum pressure in the synchrotron which averaged about 5×10^{-8} torr. This fluctuation was almost certainly due to the loss of beam by charge-changing collisions with the residual gas.

The electronically measured rates of the argon beam ranged as high as a few particles per second. These rates are sufficient to permit fundamental studies of particle properties, including dosimetry, track effect calibrations, and fragmentation cross sections. A very large increase in argon intensity would result from relatively small improvements in the vacuum. For example, if a vacuum pressure of 10^{-8} torr could be attained, a beam of several hundred particles per second should result. Unfortunately this experiment cannot be carried out since it has not been possible to secure operating funds for the laboratory and the synchrotron is now being put in a standby condition.

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Open Channels in Sea Ice (Leads) as Ion Sources

Abstract. *Open channels in sea ice may be acting as sources of atmospheric ions.*

In 1970 an experiment was conducted at Point Barrow, Alaska, to measure the background aerosol (*1*). The measurements were made at a time when the ice was starting to break up offshore. One of the aerosols that was monitored consisted of sodium-containing particles (*2*); the number of these particles seemed to increase whenever a freshly opened lead appeared upwind of the station.

The conductivities of the positive and negative ions were also measured, and they seemed to increase in magnitude with the appearance of the leads. To check this observation, a Gerdien-type conductivity instrument (*3*) was flown to an area where freshly opened leads were observed. The instrument was positioned there in such a way that it sampled air which had just passed over a freshly opened lead (Fig. 1a, site A). Measurements were carried out at three different heights above the level of the ice (30, 70, and 120 cm) and are presented as a profile of both positive and negative conductivities (Fig. 1b). Baseline measurements were also made near the lee of the lead, 30 cm off the ice (Fig. 1a, site B; see arrows). Errors in the measurements may have been large because a calibration could not be done on the site. However, the measurements of conductivities of both

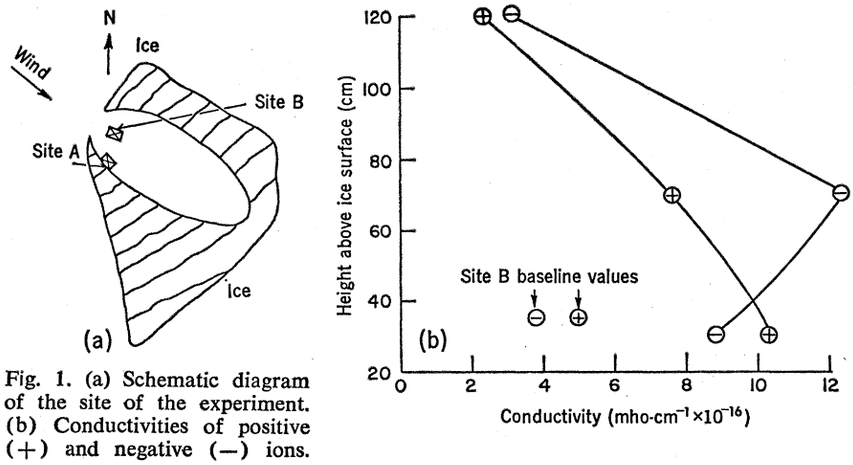

Fig. 1. (a) Schematic diagram of the site of the experiment. (b) Conductivities of positive (+) and negative (−) ions.

the positive and negative ions were made by simply reversing the polarity of the battery and hence reversing the radial electric field in the sampling tube of the instrument, so the data should have a high relative accuracy and the trends in the profiles should be accurately portrayed even though the absolute conductivities may be in error.

The results in the lee of the lead indicated that the conductivities of ions of both polarities were somewhat larger than the baseline values. Also, at 70 cm above the ice, the conductivity of the negative ions was greater than that of the positive ions. The conductivity values decreased rapidly with height and became comparable to the baseline values at about 120 cm.

The fluid in the leads was an ice slush composed of water and pieces of ice with no visible bubble activity. This observation suggests a mechanism of ion formation at the leads which is different from the mechanism of surf electrification (*4*), or is composed of a number of mechanisms, some producing negative ions and some positive ones. Surf electrification originates from the bursting of bubbles at the sea surface and results in the production of a predominantly positive charge, although a similar mechanism in fresh water often results in the production of a negative space charge (*5*). It is possible that some very small bubbles do burst in the ocean-water portion of the open leads and produce excess positive ions. The production of the excess negative ions may possibly be a result of the breakup of microbubbles and the release of gas either during the melting process or during the freezing of new water (*6*). Most significant, however, are the indications that the leads are acting as sources of atmospheric ions.

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Variation in Cardiac Glycoside Content of Monarch Butterflies from Natural Populations in Eastern North America

Abstract. *A new spectrophotometric assay has been used to determine the gross concentration of cardiac glycoside in individual monarch butterflies. Adults sampled during the fall migration in four areas of eastern North America exhibited a wide variation in cardiac glycoside concentration. The correlation between spectrophotometrically measured concentrations and emetic dose determinations supports the existence of a broad palatability spectrum in wild monarch butterflies. The cardiac gylcoside concentration is greater in females than in males and is independent of the dry weight of the butterflies; contrary to prediction, both the concentration mean and variance decrease southward. The defensive advantage of incorporating cardiac glycosides may be balanced by detrimental effects on individual viability.*

Recent studies in ecological chemistry have demonstrated that larvae of monarch butterfiies, *Danaus plexippus* L., sequester cardiac glycosides from milkweed plants (Asclepiadaceae) (*1–3*). This ability confers unpalatability on the insects by making them emetic to avian predators such as the blue jay, *Cyanocitta cristata bromia* Oberholser. Furthermore, the birds react to the vomiting by rejecting numerous subsequent monarchs on sight alone, so that a single emetic experience confers considerable immunity on the prey species (*4*). It has been inferred from these findings together with the well-established emetic properties of digitalis and other cardiac glycosides (*5*) that the cardiac glycosides alone are responsible for the emetic response.

Wild monarch butterflies have been shown to exhibit an emesis dimorphism in which some individuals cause vomiting and others do not. The frequency of emetic butterflies varies in different populations. For instance, 24 percent of a sample of monarchs collected in Massachusetts during the 1969 fall migration proved emetic when force-fed individually to blue jays. Other populations varied in this respect, as few as 10 percent to as many as 90 percent of the butterflies being emetic (*3*, *6*).

It is possible that these populations are dimorphic because some larvae fed on poisonous milkweeds while others fed on nonpoisonous milkweeds such as *Gonolobus rostratus* (Vahl), Roemer and Schultes (*1*). It is also possible that the wild populations have a palatability spectrum (*2*) based on a continuous variation in the amounts of ingested cardiac glycosides, in turn dependent on the variation in kind and amounts of these substances present in the available wild milkweed food plants. According to the latter hypothesis, some of the nonemetic butterflies would contain cardiac glycosides, but in amounts insufficient to cause emesis. Such a finding could explain the results of Duffey (*7*), whose qualitative tests indicated the presence of cardiac glycosides in an unstated number of wild monarchs from Ontario and a single individual from Manitoba.

To explore quantitatively the possible variation in cardenolide content, we have developed a spectrophotometric assay to determine the gross concentration of cardiac glycosides present in individual monarch butterflies. Butterflies were removed from frozen storage (−20°C), dried for 16 hours in a forced draft oven at 60°C, and then ground individually to a fine powder with a mortar and pestle. Portions of the ground powders (0.100 g, about half of one butterfly) were individually weighed into 5-ml volumetric flasks, and about 4.5 ml of 95 percent ethanol was added to each flask. The flasks were then incubated at 70° to 78°C in a water bath shaker for 1 hour to extract the cardiac glycosides. The solutions were cooled to 20°C, brought to volume (5.00 ml), shaken vigorously by hand, and centrifuged at low speed for about 5 minutes in the volumetric flasks in a table centrifuge. The supernatant fluid (extract) was taken for determination of glycoside content.

The cardiac glycosides were determined with a modification of a procedure (*8*) based on the reaction of 2,2′,4,4′-tetranitrodiphenyl (TNDP). Be-