Remote sensing:

Seeing from sky to sea

Richard Dubinsky

Very little is known about long term changes over large bodies of water throughout the world. Monitoring oceans and lakes for living and inert suspended material using traditional techniques like direct sampling from ships has been very difficult.

With the mushrooming of technology, new techniques have been developed to observe and monitor our environment. One of these methods is called "remote sensing": photographs or optical measurements are taken from airplanes or satellites. Using this technique, very large areas can be observed and analyzed by examining a definable property such as the reflection of sunlight.

Different bodies of water have different colours. The blue of the Atlantic is different from the green of the North Sea and the hues of large inland lakes and other oceans. This effect has been known for a long time and explains why French submarines are a light grey colour while Japanese are black; American submarines are greenish grey for the Atlantic and black for use in the Carribean.

The light that is least absorbed in water lies in the blue wavelength region of the visible spectrum. From it airplane and satellite observations can provide very useful information about the water below.

Dr. John Miller of York's Physics Department is particularly interested in this phenomenon and his current research is concerned with the remote sensing of water colour. "Actually you're looking at sunlight which strikes the water, enters the water, is scattered and absorbed within the water medium, comes back up and is detected at a sensor."

The biological activity of a lake or sea may be inferred by the amount of a chlorophyl pigment which is common to all green plant life and is found in microscopic particles suspended in most water. This pigment absorbs blue light and causes the water colour to change.

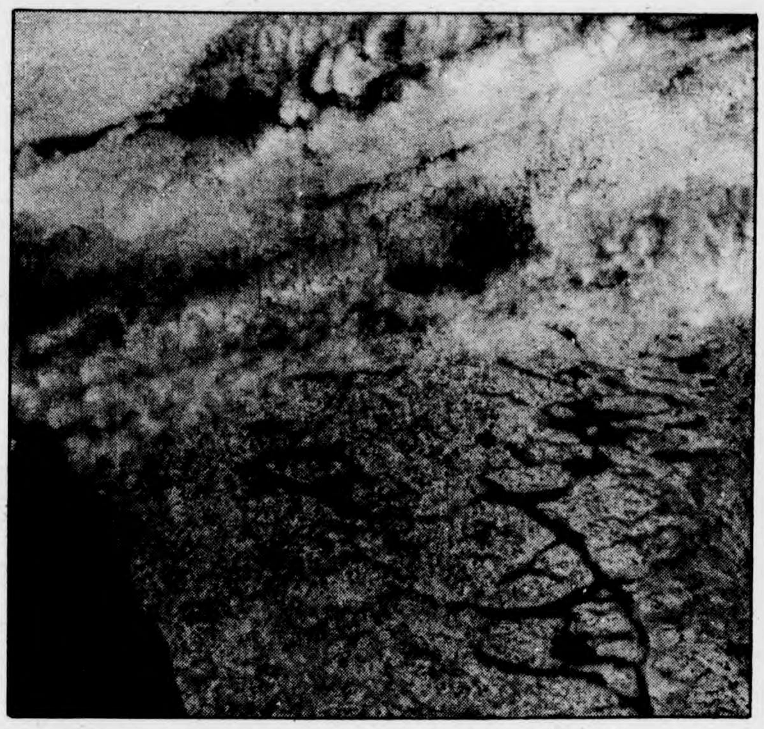
The extent and distribution of plant life in water is only one factor in the colour change of natural water. Dissolved organic molecules from the decomposition of living materials or pollution also have a tendency to absorb in the blue region.

One complication for the remote sensing of water colour are clay materials which give brownish colour to the water since their absorption and scattering extends over the entire spectrum.

Dr. Miller's problem has been to try to sort out the differences and influences of each of these effects in relation to the information that can be obtained from remotely sensed water colours.

Another application of reflection observations is in the measurement of water depth (bathymetry). Depths of up to 30 to 40 meters may be determined from sunlight reflections at the lake bottom. This, however, is very dependent on the turbidity of the water. The information is very important to navigation. Miller explains that "Many maps of Canada's lake bottoms were taken in the late 1800's, using a time consuming and therefore expensive method; we are looking for a rapid and repeatable mapping technique."

A new proejct attempting to model the effect of bottom relfections on the light reflected by the water is being conducted by



Information about oceans can be derived from photos like these

Wilf Wiedmark, a graduate student working with Dr. Miller. This work is also concerned with theoretical calculations related to light transmission in the atmosphere. Norman O'Neill, a Ph.D. candidate, is concerned with the problem of atmospheric influences. The remotely measured light signal is distorted by turbidity due to haze, clouds, and other atmospheric effects.

The major problem is that the desired signal (reflected light from the water) is very weak and most of the light detected (about 80 per cent) represents contamination from the atmosphere. The main effort of Dr. Miller's group is to devise a procedure to extract useful information from the observed reflected light.

Remote sensing of the Earth takes place continually using satellites like the U.S.'s Landstat.

Dr. Miller travelled to Calgary recently to attend a planning group meeting organized by the Canadian Corporation for University Space Science about a feasibility study for the remote sensing of ocean quality. The Institute of Ocean Science has found that there is fluorescence emission from chlorophyl in the red part of the spectrum. This would make the sensing of chlorophyl much simpler since the atmosphere contributes a relatively smaller amount of scattered signals in this wavelength region.

"This is a purely Canadian development," noted Miller.

The first completed stage of the feasibility study has found that this red line is measurable under certain conditions.

Dr. Miller's group is chiefly concerned with evaluating the reliability of the observed data and concentrating on a way to improve the algorithm for remote sensing. The problem is very complex since there are many variables that must be considered.

However, Miller remains very confident. "Our function is to improve the basic physical understanding of the interaction of sunlight with natural waters."

Vole research leads to new fertility discovery

James A. Carlisle

Research on vole population cycles has led a Utah scientist to the discovery of a new fertility drug.

Dr. Patricia Berger announced the discovery of a chemical which stimulates mammalian fertility to the "Regulation of Behaviour Symposium" held by the Biology graduate students at York recently.

Berger was originally interested in the problem of why voles and other mouse-like creatures have such large fluctuations in their populations. She found that under certain conditions, common plants which the animals eat produce a chemical compound which increases their fertility.

"The males mature earlier and their testes become larger and heavier," she said. The effect on the female is to, "increase the number of offspring and the frequency of pregnancy," according to the scientist. "The compound pushes animals to their maximum reproductive performance."

Berger widened her research to include other animals. She has found that chickens, rabbits, cattle and pigs all respond to the chemical by increasing their fertility.

The scientist was not able to explain the chemistry of the plant-produced compound since the Dow Chemical Company has bought the rights to her work. They expect to patent the compound as a fertility drug to assist in livestock breeding.

When questioned about whether the compound affects humans Dr. Berger stated, "I think it probably does."

Although she has not performed experiments on people Dr. Berger pointed out that the chemical is found in common vegetables such as lettuce and spinach.

"In countires such as India and China where malnutrtion is common you would expect a low birth-rate. Their high rate of reproduction may be due, in part, to their consumption of raw vegetables containing the compound," she said.

Berger does not believe that the new drug will be used by humans since, "We don't have to increase the human reproductive rate." It is unlikely to help childless couples since, "most human infertility is due to a defect in the reproductive system. The drug will not correct a defect," stated Berger. "It merely stimulates the system."