A world leader in processing satellite information

MacDonald Dettwiler and Associates (MDA), based in Richmond, British Columbia, was the first Canadian firm to make equipment for receiving and processing satellite data. MDA was formed in 1971, and according to its president, John Pitts, has since become a world leader in a new multi-million-dollar industry.

"Of the 16 or so ground stations in the world today, MacDonald Dettwiler built, or participated in the building of, all but one. Today, most of our remote-sensing work focuses on developing new products to process satellite data and give it meaning," said Mr. Pitts.

Landsat-D, launched in 1982 by the United States, is the only remote-sensing satellite currently sending back non-military images of the earth.

Light images reflected

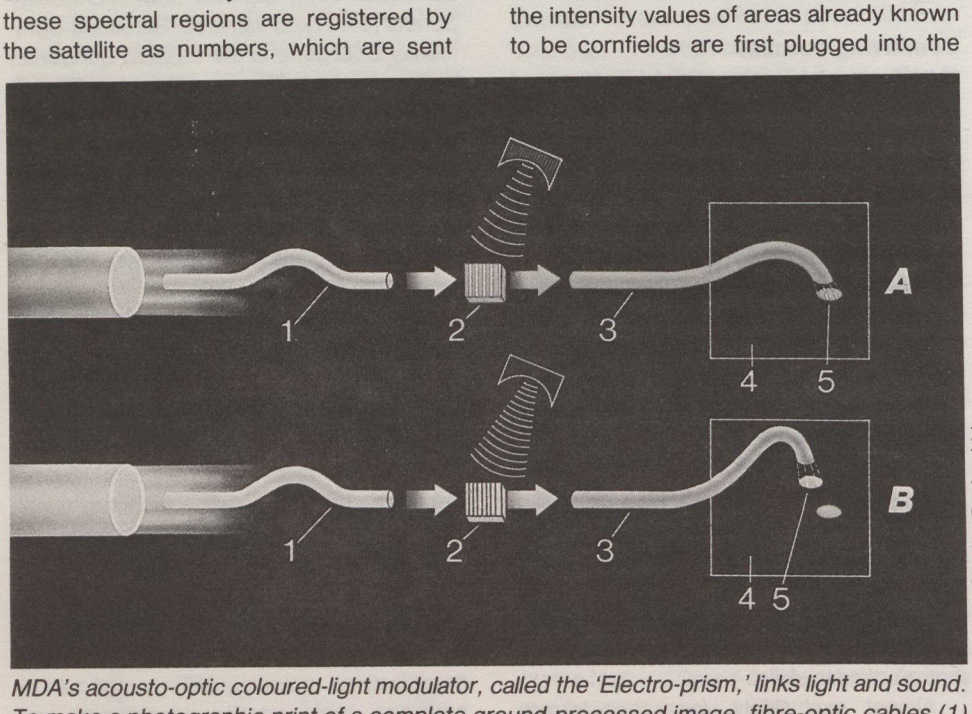
Remote-sensing satellites work similar to cameras in that they form images of objects by focusing and recording reflected visible light. Landsat's eye (called a multi-spectral scanner) can see not only visible light, but also radiation outside the visible spectrum, in an area known as the near infrared. The intensity values observed in these spectral regions are registered by the satellite as numbers, which are sent to earth *via* a radio signal. Here they are picked up at a ground station's receiver dish and stored in a computer.

"The next step," said Mr. Pitts, "is to take those numbers, analyze them, and convert them into a meaningful form — for example, a colour image."

Satellite images are really composed of many small dots which are called 'picture elements' or 'pixels'. Each pixel in Landsat-D represents about an acre of land which is about the smallest area of ground the satellite can resolve.

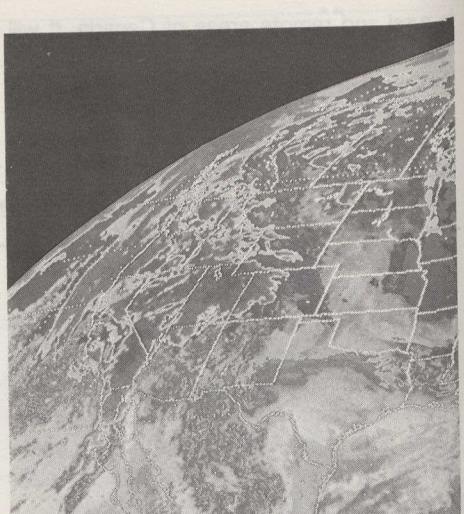
"The satellite's digital information," said Mr. Pitts, "determines the colour intensity of each pixel in its image. Transferring this numerical information to the correct colour in an image, which is done by signal processing on the ground, is a very delicate task. It is also crucial, because each shade of grey can represent something specific like a cornfield, a maple forest, or a housing development."

The information is usually analyzed while still in digital or machine-readable form. Some analysis systems produce only a black-and-white image. These systems recognize adjacent groups of similar pixels and identify what their pixel clusters represent, such as fields of corn, wheat, or barley. To do this, the intensity values of areas already known to be cornfields are first plugged into the computer. These known-cornfield pixels are then compared against all unknown pixels; if any of the unknowns match up, a positive identification is made. This matching process continues until all pixel clusters are identified.



Carisse Graphic Design Ltd.

MDA's acousto-optic coloured-light modulator, called the 'Electro-prism,' links light and sound. To make a photographic print of a complete ground-processed image, fibre-optic cables (1) transmit light from a full-spectrum light source to the Electro-prism (2). This crystal, transparent to light but sensitive to sound vibrations, lies in front of a second fibre-optic cable (3) which delivers the light to the photographic emulsion (4). When the crystal is subjected to a specific sound frequency, it assumes the shape of a diffraction grating. Standing waves inside the crystal increase (A) or decrease (B) the spacing between adjacent lines of this grating, which then transmits only a specific wavelength of light to the second fibre-optic cable. This exposes the emulsion at the other end of the wire to the precise colour intended (5).



NASA/MDA

A Landsat view of western North America superimposed by computer ground processing with continuous dotted lines outlining the continent and provincial and state borders.

Image processed on film

In addition to systems that process satellite information, MacDonald Dettwiler also makes equipment that renders the processed image directly onto film. Called the FIRE 240, this system combines electrical, mechanical, optical, and systems engineering, and produces images in black and white. It uses laser fibre optics, and a spinning mirror, to shoot light directly onto the small area of film that forms each pixel.

Fibre optics involves the use of tiny, transparent glass wires, sometimes smaller than a human hair, that act as light tunnels. These wires are small enough to accurately expose a single pixel at a time.

The colour FIRE 240, produces a colour image instead of one in black and white. Here, different colours which are not necessarily true to the real world, in that forests can be blue or lakes red, are assigned to the Landsat data by ground-based analysts. This colour-coding makes boundaries and other points of interest much easier to see.

MacDonald Dettwiler's equipment is used in the remote-sensing industry by many agencies and firms including the European Space Agency and The National Space Development Agency of Japan. In Canada, the Canada Centre for Remote Sensing, the Department of Energy, Mines and Resources and NRC are supporters of the firm's new technology.

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