ents, which are elongated along the line joining their peaks in PA 102° and are also slightly resolved in the transverse direction. The line joining the peaks passes through the 15m.7 D galaxy from which the radio components were probably ejected. The 160 MHz parameters are summarized in Table II.

**TABLE II**

Measurements of Pictor-A at 160 MHz

<table>
<thead>
<tr>
<th>Integrated flux density</th>
<th>314±16 Jy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak flux density ratio E/W components</td>
<td>1.12</td>
</tr>
<tr>
<td>Separation of peaks</td>
<td>5’.4±0’.2 arc in PA 102°±1°</td>
</tr>
<tr>
<td>Positions (1950.0)</td>
<td></td>
</tr>
<tr>
<td>E. component</td>
<td>R.A. 05h18m36s.4, Dec. -45°50’06”</td>
</tr>
<tr>
<td>W. component</td>
<td>R.A. 05h18m05s.4, Dec. -45°48’56”</td>
</tr>
</tbody>
</table>

The 1410 MHz map of Schwarz et al. (1974) prepared with a synthesized beam of 1’.0 x 1’.3 arc resolves the source into four components aligned in PA ~ 102°—two strong outer components separated by 6’.8 arc and two weaker inner peaks with a separation of 3’.8 arc; this also agrees with Ekers (1969) interpretation of his interferometer fringe amplitudes. The 1’.9 x 1’.9 arc beam used in preparing the 160 MHz map of Figure 2 has obviously smoothed out this detail to give two elongated peaks with separation of 5’.4 arc. Conversion of the 1410 MHz synthesized map with our beam reproduces our 160 MHz brightness distribution rather well, except that, as Lockhart and Morimoto (1968) have already noted, at metre wavelengths, in contrast to centimetre wavelengths, the eastern component is more intense than the western component.

The ratio of east peak to west peak ranges from ~ 1.2 at 80 MHz to ~ 0.9 at 5000 MHz with similar degrees of resolution at the two frequencies, indicating that the integrated radiation from the eastern components of the source has a significantly steeper spectrum than that from the western components. We shall not be able to measure the individual spectra of the four components until the metre-wavelength resolution is increased by at least a factor of two.

Schwarz et al. have shown that the strong outer western component is rather strongly and uniformly polarized at 17% with the implied field direction orthogonal to the line joining the components and the parent galaxy; the other components are only weakly polarized. However, following the results of Price and Stuhl (1973) from high-resolution polarimetry of the central sources of Centaurus-A it seems likely that more highly polarized fine structure is present.

Any conclusions regarding the relative directions of the magnetic field and plasma outflow from the parent galaxy should be deferred for the present.


**Hardware and Software for the Llanherne Low Frequency Sky Surveys**

P. S. Whitham *Department of Physics, University of Tasmania*

Since 1971, the Llanherne low frequency radio telescope (Ellis 1972) has been used to conduct surveys of the sky at several decametric wavelengths. Prior to 1974, only pen recordings on paper chart for one declination at each of the wavelengths were obtained each night and all the work to produce the final sky maps was to have been done by hand. However in 1974, a general purpose digital minicomputer (a Digital Equipment Corporation PDP 8/E) has considerably increased the research capabilities of the telescope. In the continuum sky survey's profiles at several different declinations are now obtained each night. In addition all the information gathered in an observing session is written onto magnetic tape which is later analysed on the...
University of Tasmania’s computer (an Elliot-503) thus providing the possibility of removing much of the tedious manual work in preparing the final sky maps. This paper describes the system developed by the author which is used by Cane (1975) to obtain the profiles from which the sky maps are being compiled.

The computer as purchased from Digital Equipment Corporation (DEC) had 4K of memory and was accompanied by a teletype, two DECTape drives, extended arithmetic hardware and power fail and recovery hardware. The following hardware was locally designed and built: a telescope beam controller interface, solar and sidereal clocks and their interfaces, a real time clock, a C.R.O. display and interface, and interface to a X-Y plotter, a 16-channel multiplexer and analogue to a digital converter, two digital to analogue converters, four external interrupts, a 12-channel buffered digital input/output and an external 12-bit switch register.

The Disk Monitor software operating system, purchased from DEC, was used to create the software (all written at the machine code level) which now controls the Llanherne telescope. The software that has been developed includes a general purpose teletype handler, a file handling package, averaging routines (Rayner and Whitham 1973) and a beam control package.

The teletype handler provides the facility to send and receive messages, numbers, file names, the date and sidereal and solar times to or from the computer via the teletype. The teletype handler also provides general interrupt servicing for all the computer peripherals including the power fail hardware which restarts the computer automatically.

The file handling package enables the user to write raw or semi-processed data to DECTape (a small reel of magnetic tape formatted so that it appears as a disk to the computer) in a form that can later be processed on the Elliott 503 computer. Routines to open, write to and close files are provided.

The beam control package allows the telescope beam to be steered under computer or manual control. Routines are also provided to handle beam control error interrupts caused by loss of beam control when hardware other than the computer, such as the ionosonde, is in charge of the beam.

The sky observing program consists largely of calls to subroutines in the packages described above and interrupt service routines for the peripherals used for the sky survey.

The program is initiated by a teletype dialogue, an example of which is shown in Figure 1. A new file is opened and the sidereal day is divided into any number of regions, for which a first (southern most) and last (northern most) declination, starting time, declination step and time spent at each declination is provided by the user.

The computer program then takes over — it deduces which region it should be observing at that time and starts sweeping over that region. Each time the computer steers the beam to a new position there is a ten second delay, corresponding to the settle time of the minimum reading circuits (Ellis 1960) used in the receivers, before “stable averaging” (Deardorff and Trimble 1968) is used to integrate the receiver output for the remainder of the dwell time.

Every hour noise generator and zero level calibrations are supplied via the computer’s output word and then the last hour’s data is dumped to DECTape. The program continues in this fashion until it is time to start on a new region of sky or it is interrupted by loss of a telescope beam control or a power failure. The file is closed when the observer indicates, via the teletype, that he wishes to commence a new observing schedule.

```
.R SKY

SKY OBSERVING PROGRAM

FILE NAME : MAY12
NO. OF RECEIVERS : 4
FIRST MX CHANNEL : 0
NO. OF REGIONS : 2
DETAILS OF FIRST REGION :
STARTING TIME : 0700
FIRST DECLINATION : 0
LAST DECLINATION : -65
DEC STEP : 1
SECONDS BETWEEN STEPS : 30

NEXT REGION :
STARTING TIME : 1700
FIRST DECLINATION : -20
LAST DECLINATION : -5
DEC STEP : 1
SECONDS BETWEEN STEPS : 30
```

Figure 1. Sample teletype dialogue for the observing program. Commands or answers to questions are underlined.
An analogue record (chart recordings) of the receivers' output is taken to determine which sections of the data on DECTape are free from interference and thus worth analysing. Programs written for the Elliot 503 computer enable the data on DECTape to be unscrambled and plotted out as profiles.

The interface was designed and built by Mr G. A. Gowland. The author wishes to acknowledge the invaluable assistance provided by Mr Gowland throughout this project. The project was financed by grants from the Australian Research Grants Committee and the Radio Research Board.


### Jupiter

#### Long Term Variations in Jupiter's 11 cm Radio Emission

P. M. McCulloch  
*Department of Physics, University of Tasmania*

During the past twelve years five series of observations have been made of the polarization of Jupiter's radio emission at a wavelength of 11 cm. This data shows characteristics which have been stable over a period of years as well as some unexplained variations. The observations were made during one complete orbital period of Jupiter and hence were obtained over the full range of values of $D_E$, the angle between Jupiter's rotational axis and the plane of the sky. These are summarized in Table 1. The 1967 observations have been reported previously (Komesaroff and McCulloch 1967) and the 1963 data is from Roberts and Komesaroff (1965).

Each series of observations consisted of measurements of the total flux, fractional polarization and the position angle of the linearly polarized component as a function of Jovian longitude. The data from each type of measurement was analysed by fitting a 7 parameter Fourier series of the form

$$ D = D_0 + \sum_{n=1}^{3} D_n \sin n (\lambda_{III} - \phi_n) $$

where $\lambda_{III}$ is the System III (1957.0) central meridian longitude. The phases of the dominant terms in each Fourier series show a long term drift due to the discrepancy in the System III (1957.0) rotation period. We have measured this drift and determine the best least squares estimate of the rotation period as 9h55m29.72 ± 0.05s where the error is 90 percentile. This is in good agreement with the rotation period determined from decametric observations by Duncan (1975). The phase of the Fourier components has subsequently been corrected to this revised rotation period and referred to the epoch of the Pioneer 10 encounter with Jupiter.

The origin of the radiation is generally accepted as synchrotron emission from relativistic electrons trapped in Jupiter's magnetic field. Previous observations, e.g. Roberts and Komesaroff (1965) have suggested and the Pioneer observations, Smith et al. (1974) and Acuna and Ness, (1975), have confirmed that Jupiter's magnetic field deviates significantly from a centred dipole. Recently Komesaroff and McCulloch (1975a, b) have shown that position angle measurements and Pioneer 10 measurements are consistent with a magnetic field possessing planar symmetry. In the absence of shadowing this magnetic field configuration would give rise to a plot of position angle

<table>
<thead>
<tr>
<th>Date</th>
<th>$D_E$</th>
</tr>
</thead>
<tbody>
<tr>
<td>November 1963</td>
<td>+2°.8</td>
</tr>
<tr>
<td>January 1967</td>
<td>+0°.8</td>
</tr>
<tr>
<td>February 1968</td>
<td>-1°.0</td>
</tr>
<tr>
<td>June 1970</td>
<td>-2°.86</td>
</tr>
<tr>
<td>September 1974</td>
<td>+1°.58</td>
</tr>
</tbody>
</table>

| Epochs of observations and corresponding values of $D_E$ |

Figure 1. Polar diagram showing the relative amplitudes and phases of the Fourier components in the position angle profile. The symbols referring to the different epochs are ● 1963, ▲ 1967, ● 1968, + 1970 and ▲ 1974. The circles indicate the standard error in each component. Note the change of scale for the third harmonic. The units for the amplitude scale are degrees.