Data Loggers and Programming

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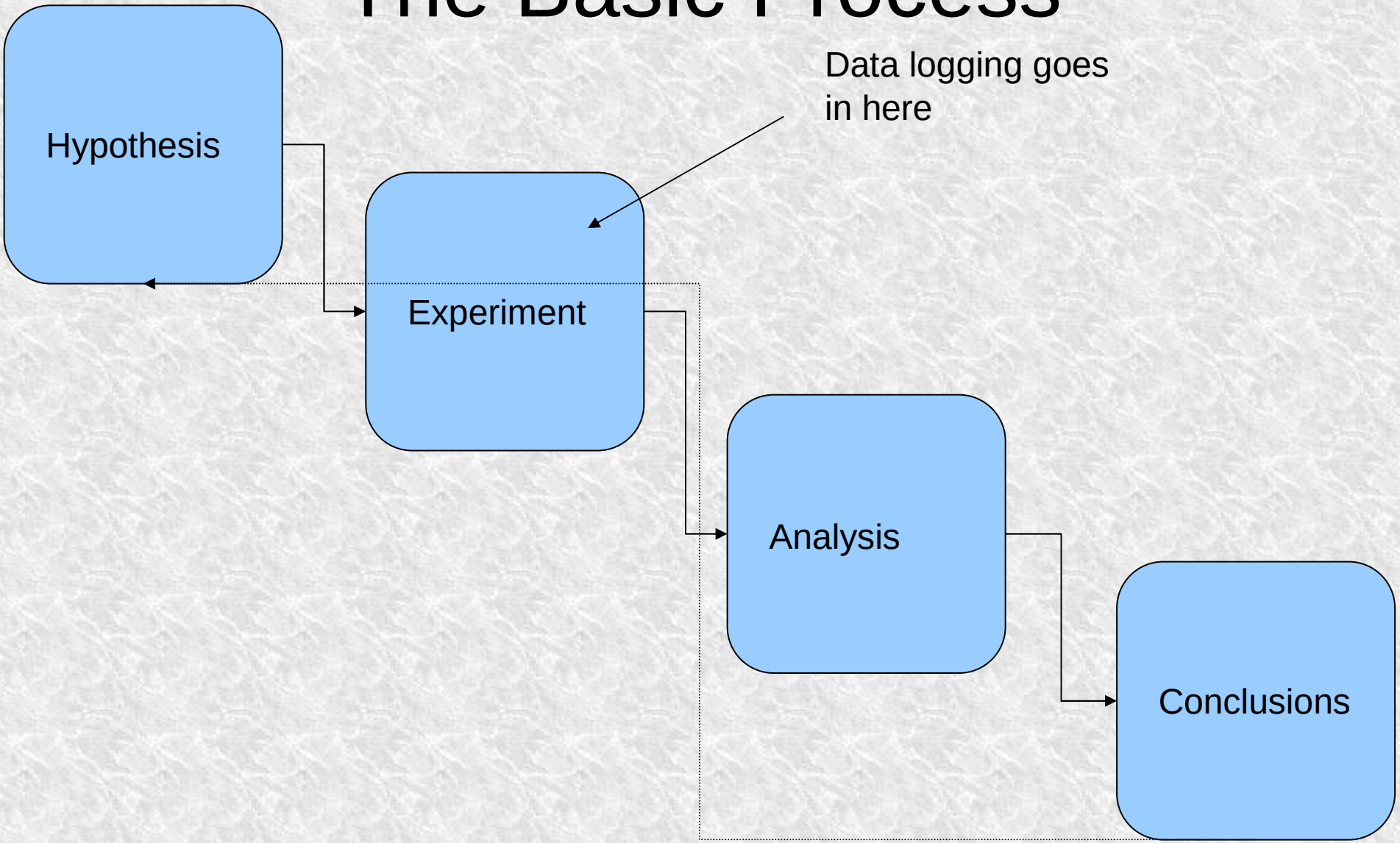
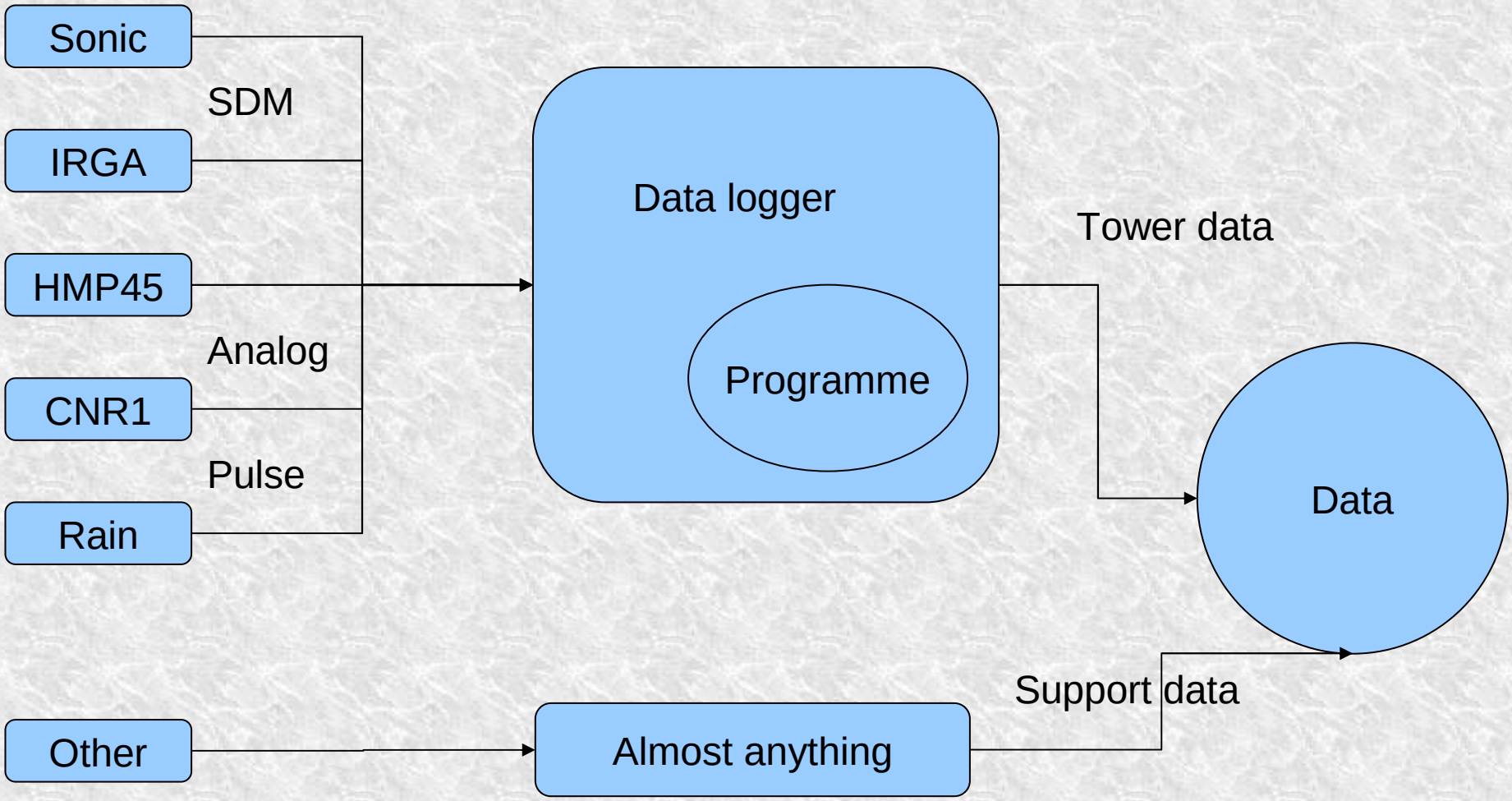
Outline

- Where does logging fit and why is it important?
- Good Old Days
- Data logger options
- TERN/OzFlux data loggers
- Monash standard logger programme

The Basic Process



The Experimental Apparatus

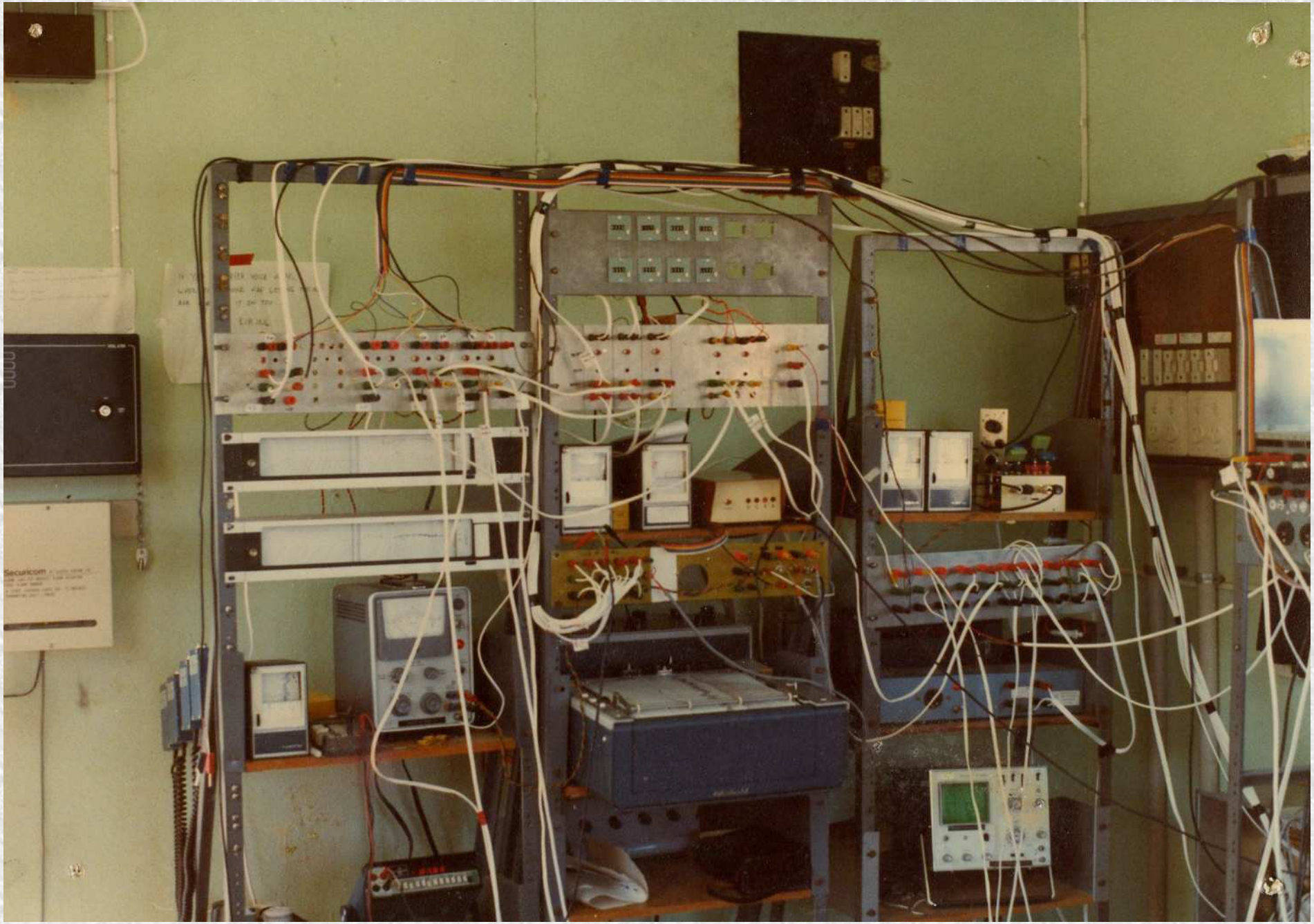


Thanks to Doug Fox (circa 1980)

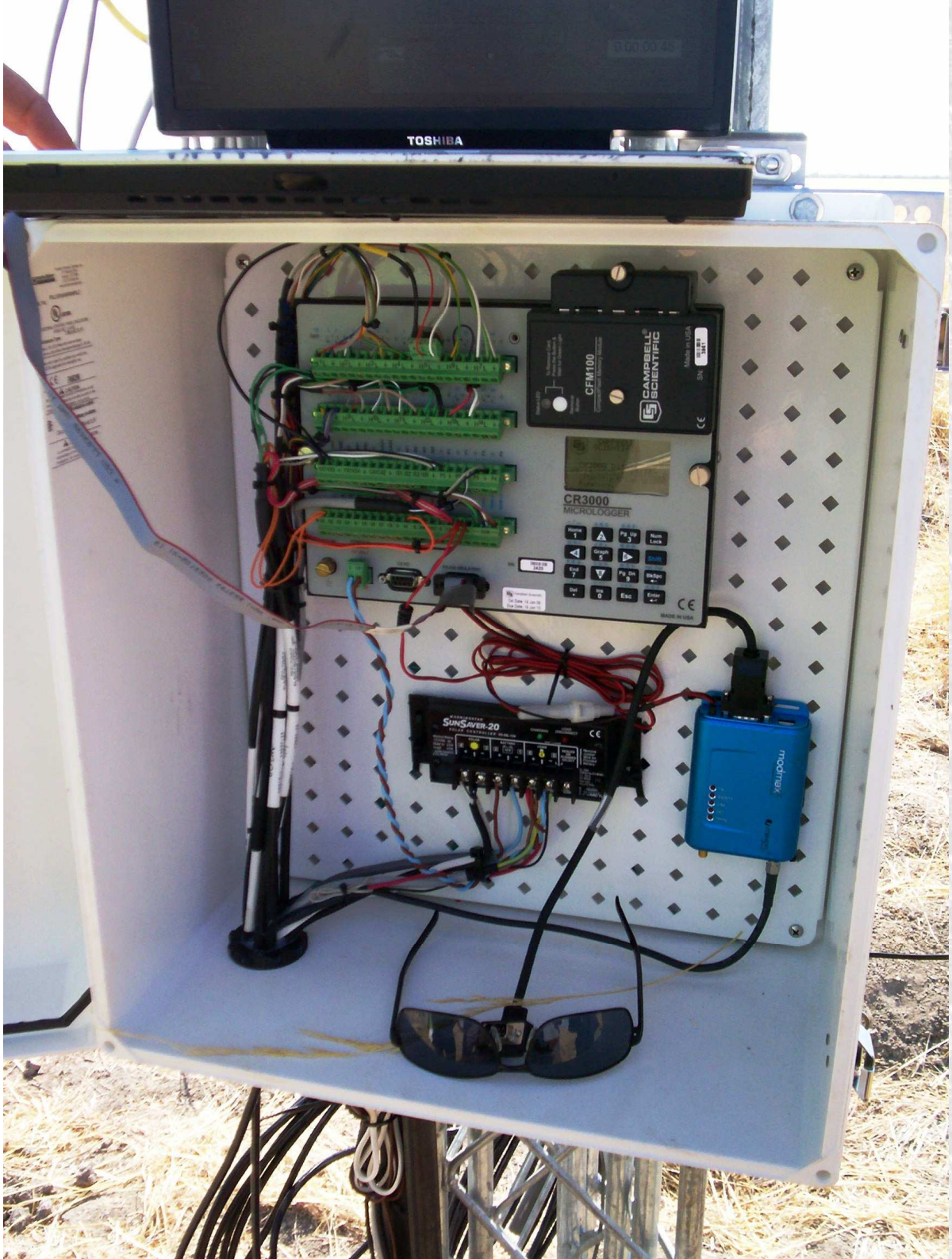
Requirements of Data Logger

- Bullet-proof sampling, storage and supply of data
- Accept inputs from all instruments (analogue, pulse, frequency, serial) without extra circuitry
- Enough intelligence to communicate robustly and to do simple on-line processing
- Ability to sample and store turbulence (10 Hz) data

Aramoana, SI, NZ (1979)



Commodore CDM (1980)



Sturt Plains (2008)

- Campbell Scientific CR3000 data logger
- Maxon Modmax 3G modem
- Solar panel regulator
- Really neat wiring
- 24/7 turbulent fluxes

Data Logger Options

- Application specific system
  - Usually PC based, assembled in-house
  - Software usually written or tuned in-house
  - Tumbarumba
- Commercially available system
  - Usually small purpose built package
  - Software written by manufacturer
  - TERN/OzFlux Campbell Scientific CR3000

CR3000

- Data logger used for TERN/OzFlux towers
- 14 differential, 28 single-ended analogue
- 4 pulse, 4 Vx & 4 Ix
- 8 control ports, 2 switched 12V, SDM & RS232
- 4 Mb SRAM (> 1 year 30 minute tower data)
- 2 Gb CF card (110 days 10 Hz sonic/irga data)

CR Family of Data Loggers

- User programme written in CRBasic
  - CSI proprietary version of ... BASIC (CBM)
- Rich suite of measurement instructions
- Rich programming language
- Good communications language (serial, TCP/IP)
- User defined outputs and intervals

Modern loggers are orders of magnitude more powerful than the PDP11-03 I used for data processing in 1980

Support Software: LoggerNet

- Combines:
  - Programme editor
  - Logger network manager
  - Logger status
  - Communications
  - Scheduled data upload
  - Near real-time display of data
- Well integrated, robust package

Someone smarter than us has done the hard work

Data Logger Programme Requirements Monash/CDU Perspective (~9 towers)

- Standardise on quantities output and variable names
- Standardise on wiring interface to logger
  - Fast instrument swap (detachable terminal strips)
- Easily expanded to include site specific instruments
  - Lessen CPU load, add spare channels
- Modular, code comments, documentation

Standard Programme

- Developed from original written by Ed Swiatek
- Standard wiring interface
- Standard variable names and outputs
- Separate fast (10 Hz) and slow (0.1 Hz) scan blocks
- Modularised (code segments into subroutines)
- Able to add multiplexer to add analogue channels

Standard Outputs

- u,v,w,T_v,q,c at 10 Hz (fast_std)
  - 110 days on 2 Gb CF card
- Subset of full meteorological data stored to logger memory only (slow_core)
  - Radiation, fluxes (raw and WPL), temperature, humidity, wind speed, soil temperature, soil moisture at 30 minutes
- Full meteorological data stored to logger memory and CF card (slow_rad, slow_flux, slow_rad)
  - As above plus all covariance terms, housekeeping

Things It Doesn't Do

- Noise rejection on 10 Hz data
  - No spike removal
- No coordinate rotation
  - Save all means, variances and covariances and do rotation in post-processing
- No quality control for online fluxes
  - Failed sensor means bad fluxes

Roll Out

- Wombat State Forest
- NT towers
  - Howard Springs, Daly Uncleared, Daly Regrowth, Daly Pasture, Dry River, Sturt Plains
- Victorian towers
  - Kinglake, Goulburn-Broken
- TERN/OxFlux?
- THE WORLD?