Bolton-Stanley Cosmic Noise Expedition to New Zealand - 1948

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Socorro, New Mexico USA

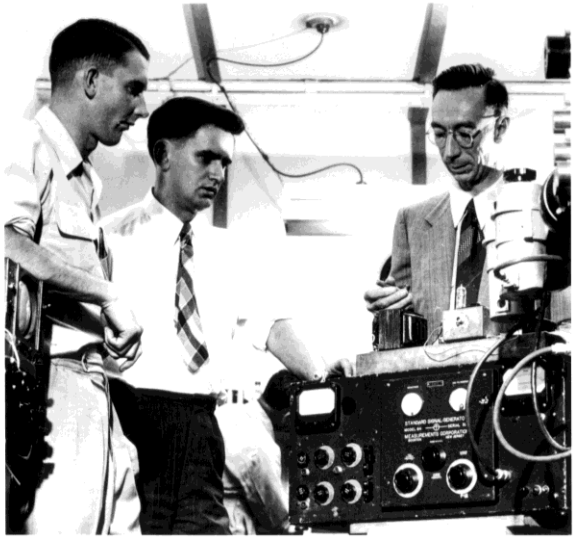
Orewa, 30 Jan. 2013

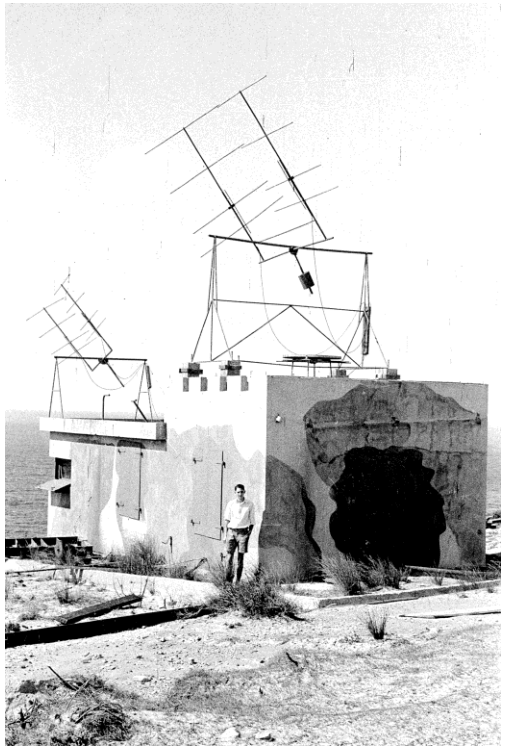
http://www.nrao.edu/

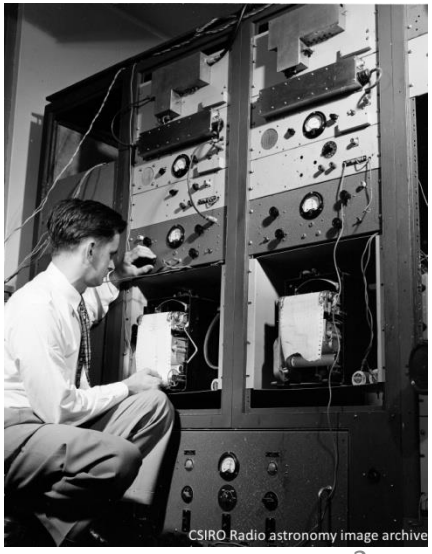
A short overview- concentrate on the Pakiri Hill portion of 1948

- How the Greenwood family found us in Sept 2008
- Why the expedition and what happened before the expedition
- Time line of the expedition
- The interaction with the Greenwood family
- Newspaper coverage of the visit – 8 articles in NZ and 3 in Australia in 1948 and then again in 2009 two written by Delwyn Dickey. **Rodney Times**
- The results of the expedition and the Nature paper of 1949

John, Gordon and the head of the group- J. L. Pawsey – early 1954







The Cosmic Noise Expedition to NZ in 1948 by John Bolton and Gordon Stanley

- Woody Sullivan writes : “The short paper by Bolton, Stanley and Slee (1949 in **Nature)** was one of the most important in early radio astronomy, presenting a first plausible link between ‘galactic noise’ and traditional astronomy.”

The story of the miracle of 2008 – talk at the Stardome on 29 Sept 2008 Auckland Astronomical Society

- I met Grant Christie, my host
- Libby and I went with Grant to Piha on 1 October and with help from Sandra Coney we met Simon Stoddard, a park ranger and later in the day Jordan Alexander and Kate Stone . We see Piha
- Next day- 2 Oct- we went to Leigh and Pakiri Hill with Sergei Gulyaev and Peter Thomasson

continued

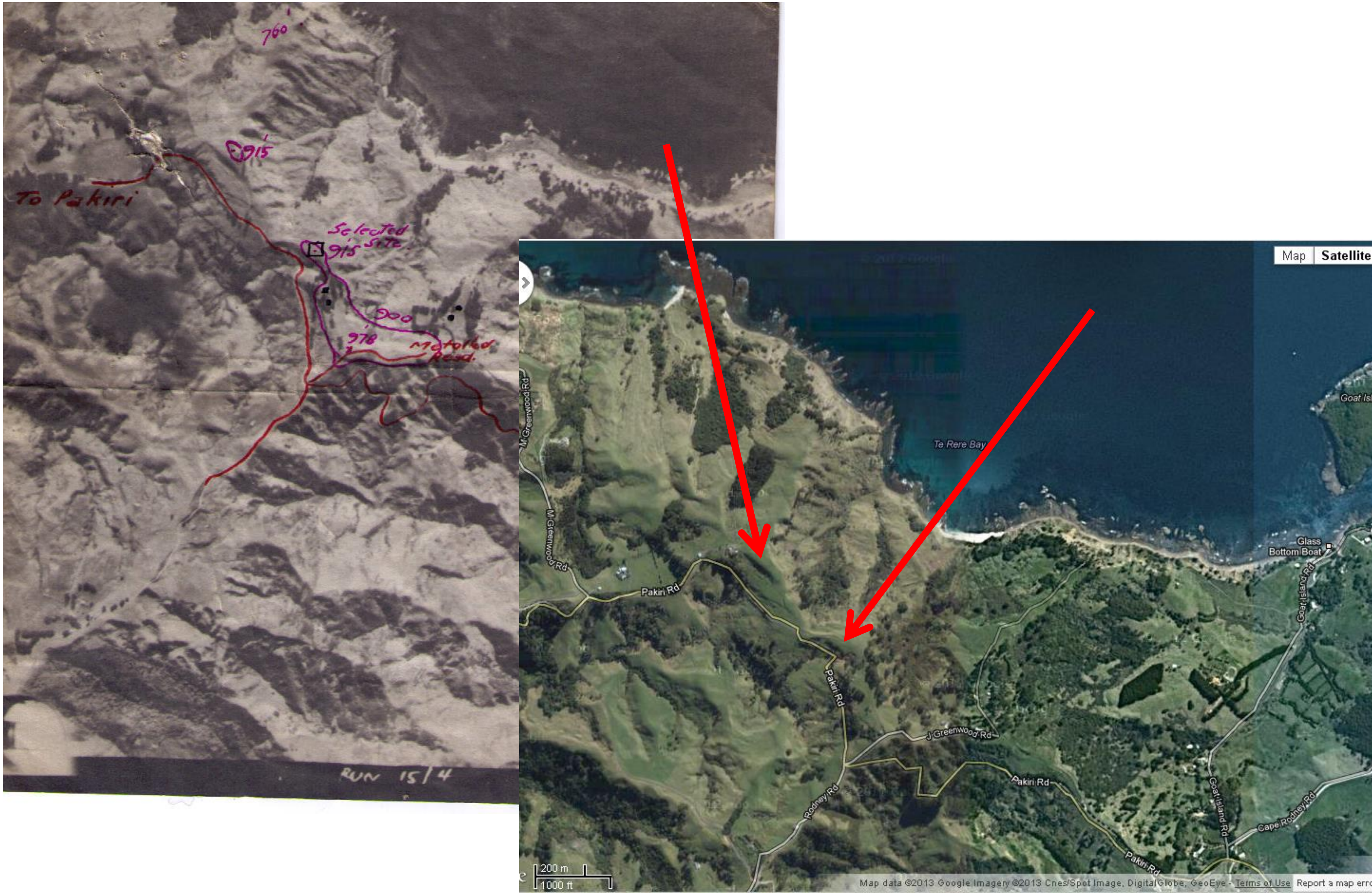
- We had the longitude and latitude of the Pakiri site and maps (typical errors a few 100 m)
- We ended up initially at the property just to the north – Martin and Jane Munro's farm. We trespassed and later on we meet Bill Munro and his friend Pete Bettridge. Sergei and I discussed the location- we had second thoughts. I thought this was not the place and we moved on

continued

- We went to the next farm on J Greenwood Road to the south- we could see this from the Munro farm at a distance of about 400 m
- We asked the tenant for permission to walk on his property. We thought we were at the right place (Bolton's longitude and latitude have errors of 100-200 m only). We were convinced we were at the right place.
- We drove around Leigh and kidnapped Dorothy Cooper – the beginning of a long friendship

Our trip Sept. 2008 – started at Martin Munro's farm – used our GPS. Met Bill Munro, he contacted John Matheson who called Peter Greenwood after we left for the US the next day; later that day a black car with a Russian and a Brit and two Americans kidnapped Dorothy Cooper in Leigh

The Greeenwood farm Springbank – but we did not know it ! Few weeks later Peter, Doreen and Gordon at the site


760'
915'
To Pakiri
Selected site
915
900
978
Metalled Road
RUN 15/4
Map
Satellite
Goat Islan
Te Rere Bay
Glass Bottom Boat
M Greenwood Rd
Pakiri Rd
J Greenwood Rd
Rodney Rd
Goat Island Rd
Cape Rodney Rd
200 m
1000 ft
Map data ©2013 Google Imagery ©2013 Cnes/Spot Image, DigitalGlobe, GeoEye - Terms of Use
Report a map error

Libby and Miller Goss return to US on 3 Oct 2008

- Immediate emails from Peter and Sally Greenwood
- We talked on the phone – Peter told me : “You are the first astronomer I have talked to in 60 years.”
- I heard about the fabulous archive that Beverley Chessum (née Greenwood) had preserved
- On 10 Oct Beverley and I were in email contact- as she described the original sea-cliff interferometer recording , I was amazed and thrilled! We had many phone conversations
- Then a year later we returned

Peter showed us the site of the radio telescope from 61 years earlier- 2009

Radio Astronomy history was made here. We returned with Peter 16 Nov 2009

Few days later. Delwyn Dickey and I returned for more photos- I learned about No 8 wire- Ron Ekers at the site- the photo in the Greenwood family archive

The time line

- 6-8 June 1948 – arrive at Leigh . Greenwood farm, John and Gordon have bad colds
- 10 June ---- start testing with Cygnus A 23 36 NZST for 7 hours
- 14 June – routine Cygnus A data
- 23 June – visit of DSIR , Burbidge and Alan Maxwell from Auckland University College
- 24 June – the visit of Ronald McIntosh of **Auckland Star** and an editor of **the NZ Herald**. Later in the day two correspondents from **NZ Herald**
- 24 June – stop Cyg A observations and access quality
- 25 June – **Auckland Star** article “Important Cosmic Research at Leigh”- John is very upset
- 26 June-NZ Herald article “Cosmic Noise from Regions of the Milky Way. Investigations by Night at Leigh in New Scientific Field.”
- 8 July – start again with Cyg A observations

Time line continued

- 11 to 18 July – Taurus A data. The recording from 18 July is left with the Greenwood family
- 29 July – leave Leigh for Piha . Birthday card for Beverley from John Bolton. Cygnus A observed 23 times at Leigh and Taurus 5 times
- 31 July – start observations at Piha. After a few nights at the cold , flea invested tourist hotel. Move in with the caretakers Don and Lorraine Taylor at the RNZAF mothballed station
- 31 July to 7 August Cyg A observed, Taurus 31 July to 4 August, Cen A 2 to 8 August and Virgo A (with new name – moved from Coma Berenices to Virgo after first days observations) from 31 July to 8 August. Sun observed 6, 7, 8 August to test refraction calibration. Joint simultaneous observation with Bruce Slee back at Dover Heights, Sydney
- 6 August – Gordon wrote a thank you letter to Mrs. Greenwood
- 7 August **– NZ Herald** " Radiation from Space. Scientists move to Piha."

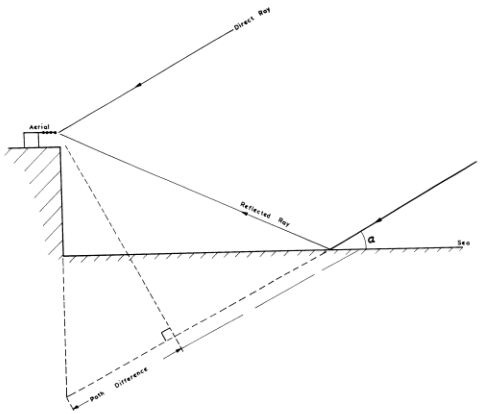
Time line continued

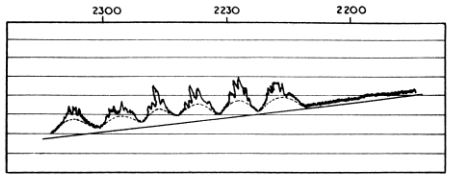
- 9 August – John gives a talk at Auckland University College described in the **NZ Herald** on 12 August " Cosmic Noise. New Zealand Lost Opportunity . Study of Radiations."
- 10 August – leave Piha for Auckland . 13 Aug John leaves for Sydney and a week later Gordon
- 17 September 1948. John wrote Mr. and Mrs. Greenwood with thank you and also announced the Tau A identification with the Crab Nebula. At Piha we obtained "perfect patterns on four of our sources."
- 22 January 2009- **Rodney Times**, "Legend Starts at Pakiri," by Delwyn Dickey

The state of "**cosmic noise**" in 1947-48

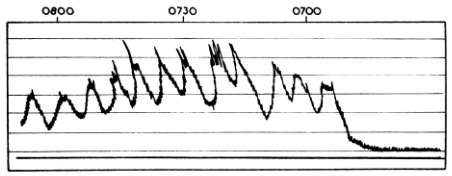
- One solid identification of a radio source with a well known optical object : The Sun and the Moon
- The northern source Cygnus A was detected in Sydney but the errors in the position were some degrees- large discrepancy between Cambridge and Sydney
- The new sources discovered in late 1947 at Dover Heights,Sydney:Tau A ,Virgo A, Cen A
- Published in **Nature** – mid 1948. No id's

The Sea Cliff Interferometer- first use of radio astronomical interferometry 26 Jan. 1946- Australia Day- by Ruby Payne-Scott , Pawsey and McCready





SOURCE RISING
FIG. 1



SUN RISING
FIG. 2

21h

24

time

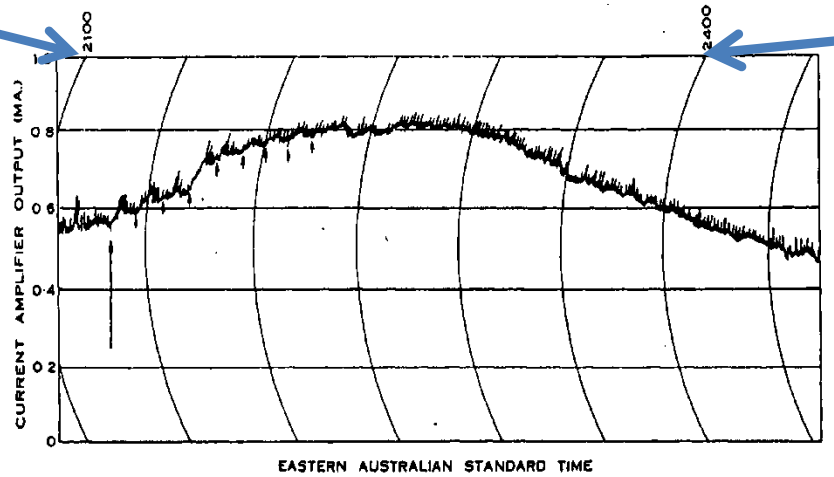


Fig. 1A.—Source Taurus–A as seen from Dover Heights, Sydney, November 6, 1947. Frequency 100 Mc/s. Times, Eastern Australian Standard. Rising point and probable minima are indicated by arrows. Vertical lines on record are due to pick-up from timing mechanism.

15h

16

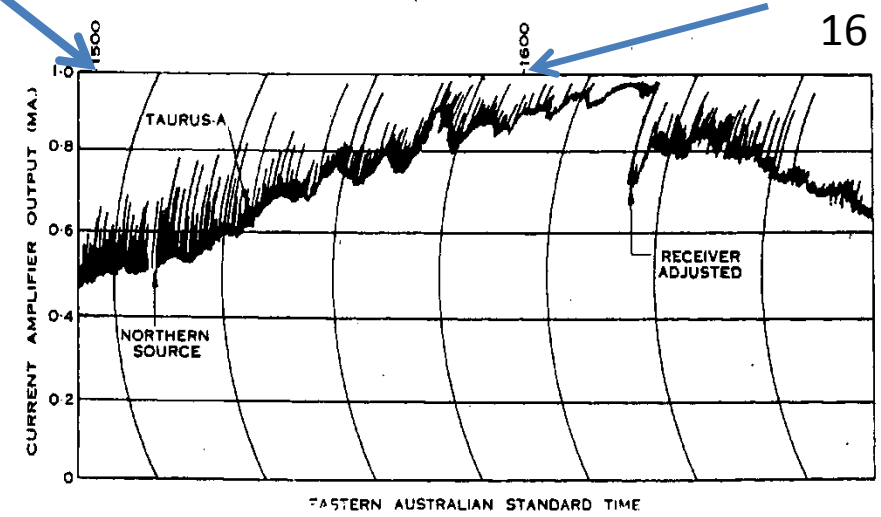


Fig. 1B.—Sources Taurus–A and (8·48) as seen from Dover Heights, Sydney, February 5, 1948. Frequency 100 Mc/s. Times, Eastern Australian Standard. Vertical lines in trace are due to distant atmospherics.

Then needed a WEST facing cliff. To observe the sources setting. Also they needed a HIGHER cliff- to improve the resolution and the "fringe rate." More importantly by combing rising and setting observations (East and West facing) the positional errors had a quantum jump improved in accuracy

- Looked at Western Australia
- Norfolk and Lord Howe Islands
- Many locations on the North Island- where the distance between E and W coasts was small

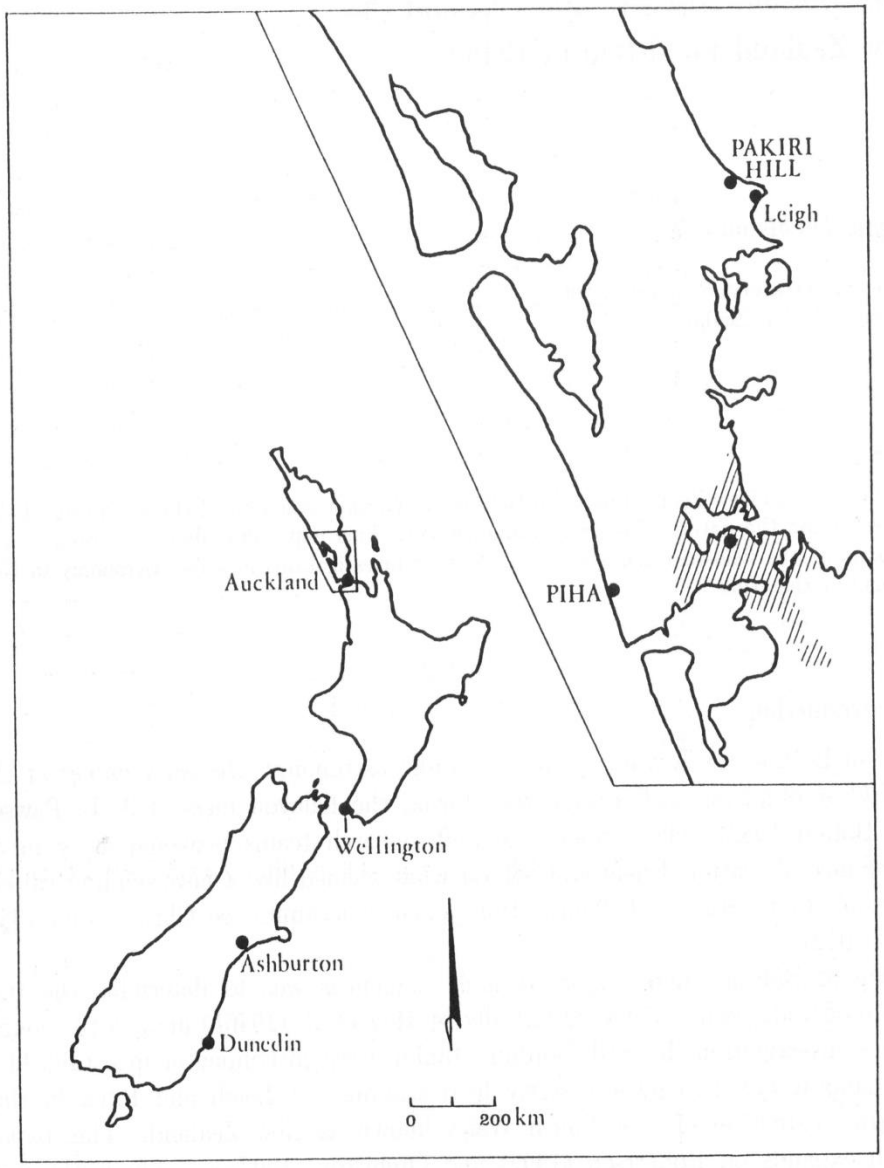


Fig. 1. New Zealand localities mentioned in the text.

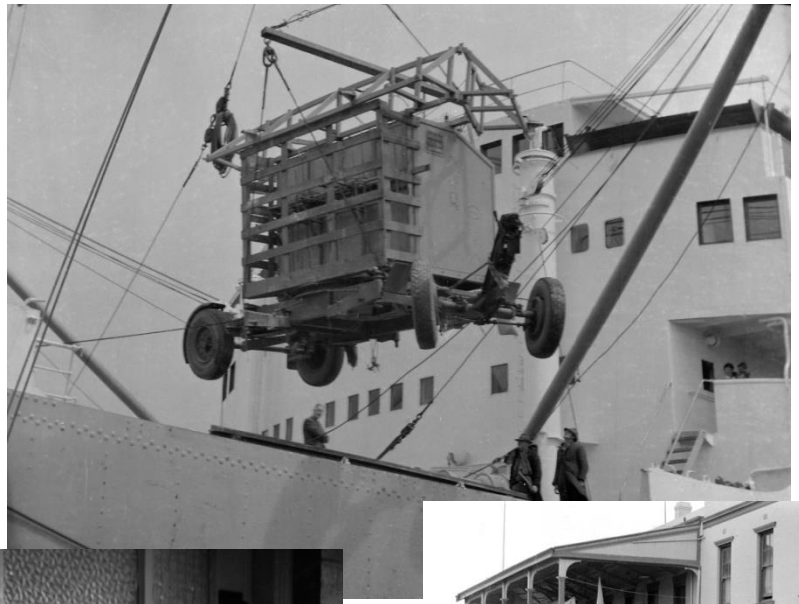
The motif of the NZ Expedition was Cygnus A- the strongest radio source known – outside Sun

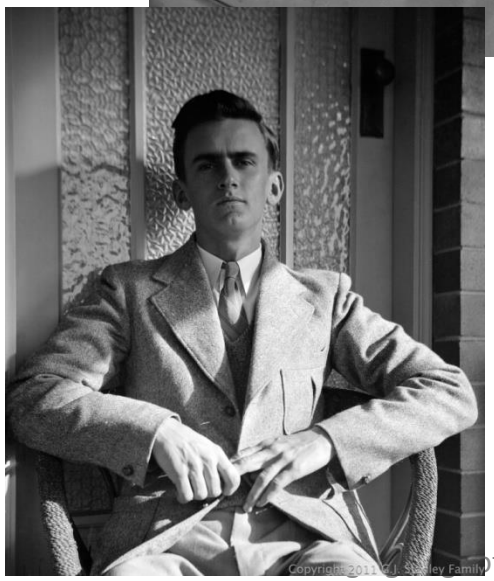
- The parameters of the exhibition (location, time of year, horizon etc) determined by Cygnus A – only reached 15 deg above the horizon in the north – above the horizon for only 7 hours per day. The other radio objects were almost an after thought
- The fact that it is far north from Australia and NZ played a major role in the evolution of early radio astronomy
- Refraction was a major problem
- And it was in the galactic plane where the star density is high- early thinking was that this was a nearby star associated with strong radio emission. This meant the radio position had to be determined with high accuracy to find the associated “star.” In the end it is associated with a massive galaxy at a huge distance from the Sun – about 700 million light years !

Preparations for the NZ Expedition

- Correspondence with many different entities in NZ.
- The Surveyor General- suggested Cape Reinga, Cape Brett- Little Barrier Island, Pakiri , Cape Colville, North Cape (no suitable site). Choice was Cape Reinga or Leigh
- DSIR- wanted a large truck and 200 gallons of petrol- Brooke at Auckland Industrial Development Lab of DSIR was the contact person.
- PMG- radio interference . Auckland police transmitter 97MHz
- Prime Minister's Depart. in Wellington- told them to go through Depart of External Affairs. In the end not needed
- Waitemata Electric-power board
- CSIR Head Office in Melbourne
- Weather Bureau in NZ
- List of tools to take- including 2 blankets
- Shipping details- "Salamaua" 28 May 1948 from Sydney

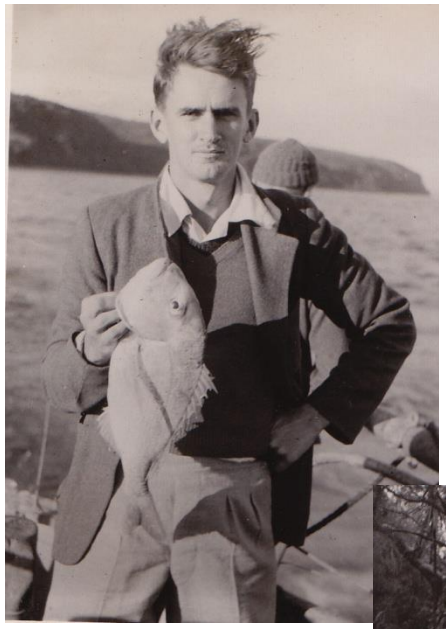
Auckland-Leigh June 1948---- images from Gordon Stanley as processed by Stephen Stanley





Pakiri Hill – Springbank Farm

Other activities



John and Gordon knew the Greenwood children well

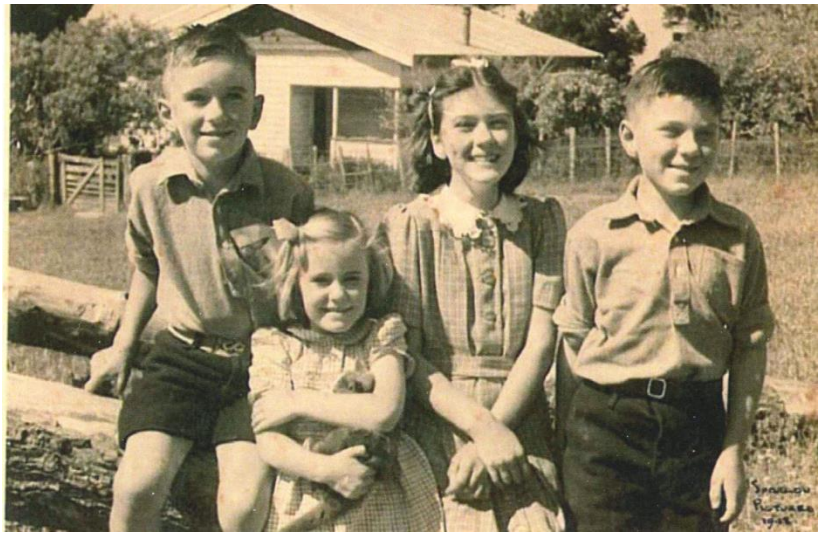
Irwin and Elva Greenwood

Beverley Chessum b 1937,

Gordon Greenwood b 1939,

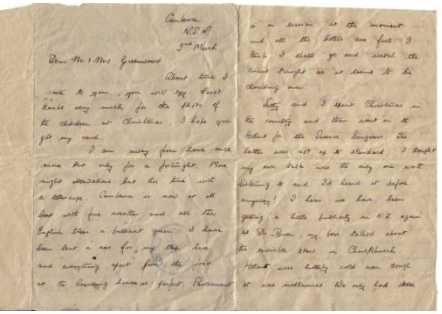
Peter Greenwood b 1940,

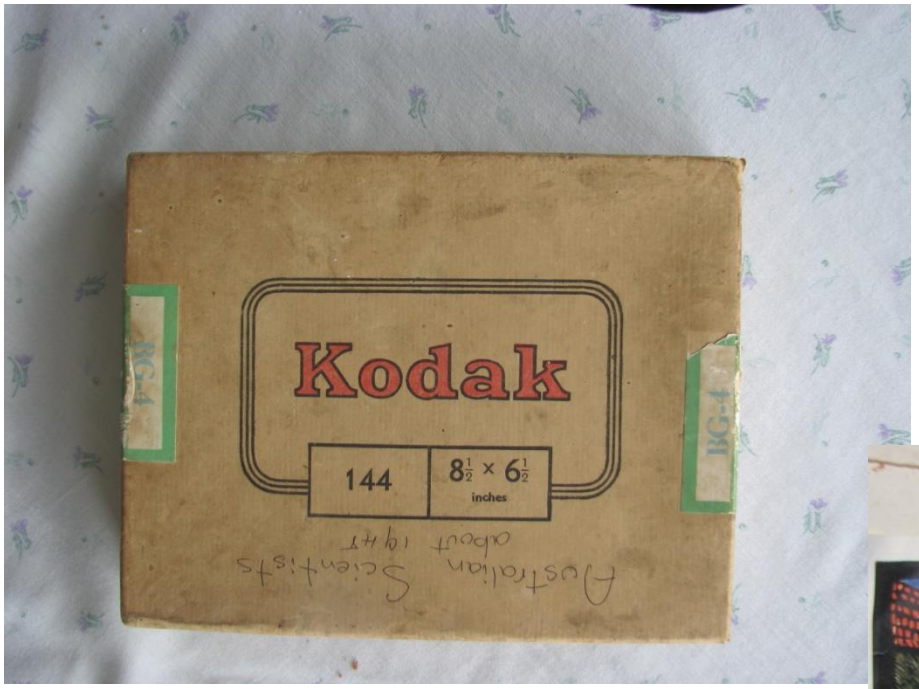
Doreen Richards b 1943

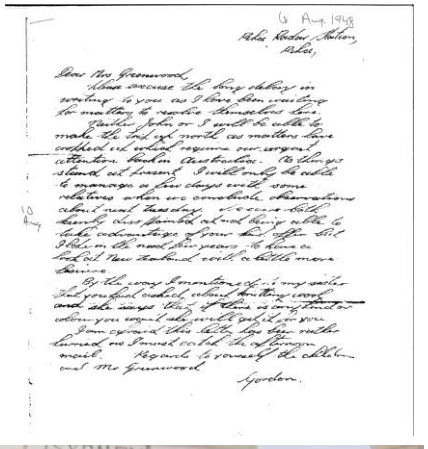


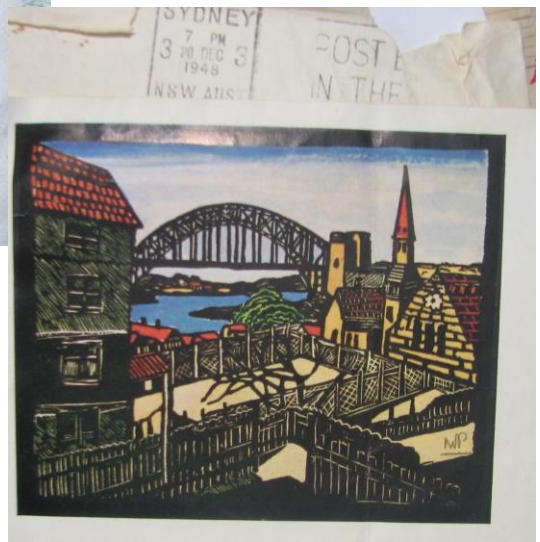
The Greenwood family archive was preserved; Beverley Chessum; Libby and I have a fine visit in 2009

Letters from John and Gordon – Christmas cards, photos, newspaper clippings etc

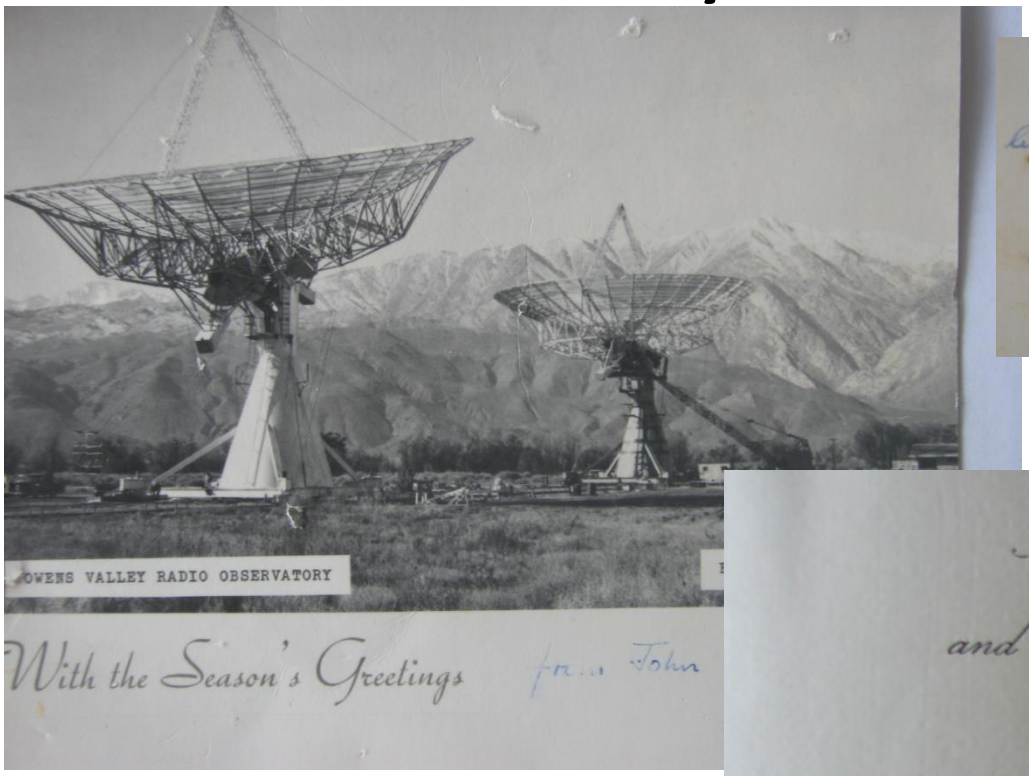








My favourites

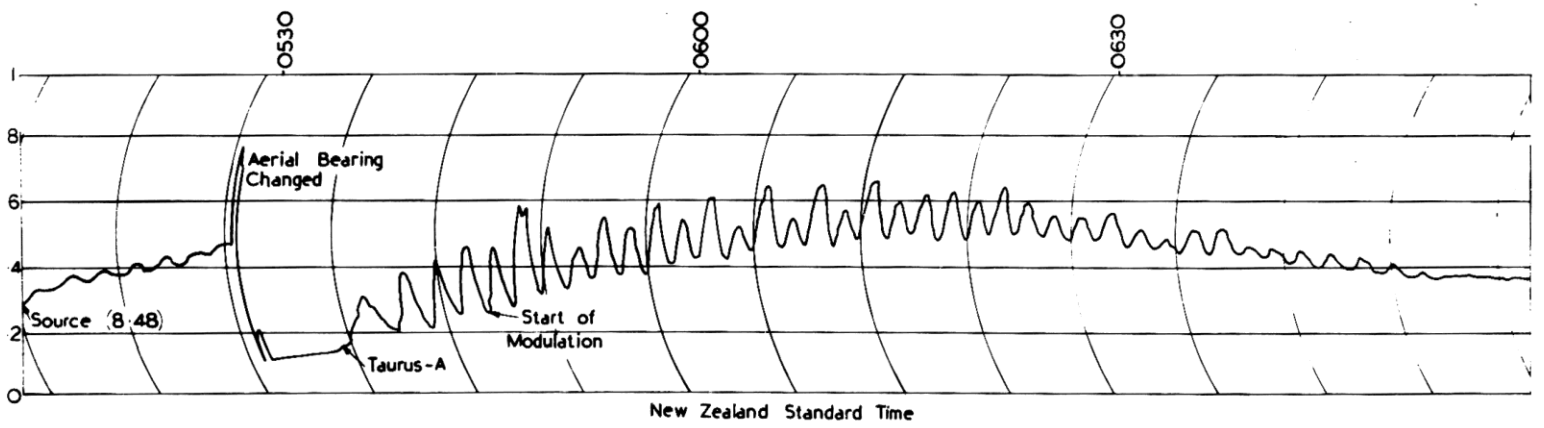


Still building aerials – there are a little bigger than the ones at Pakakohi. Nearly 90 feet in diameter and weigh 200 tons each.

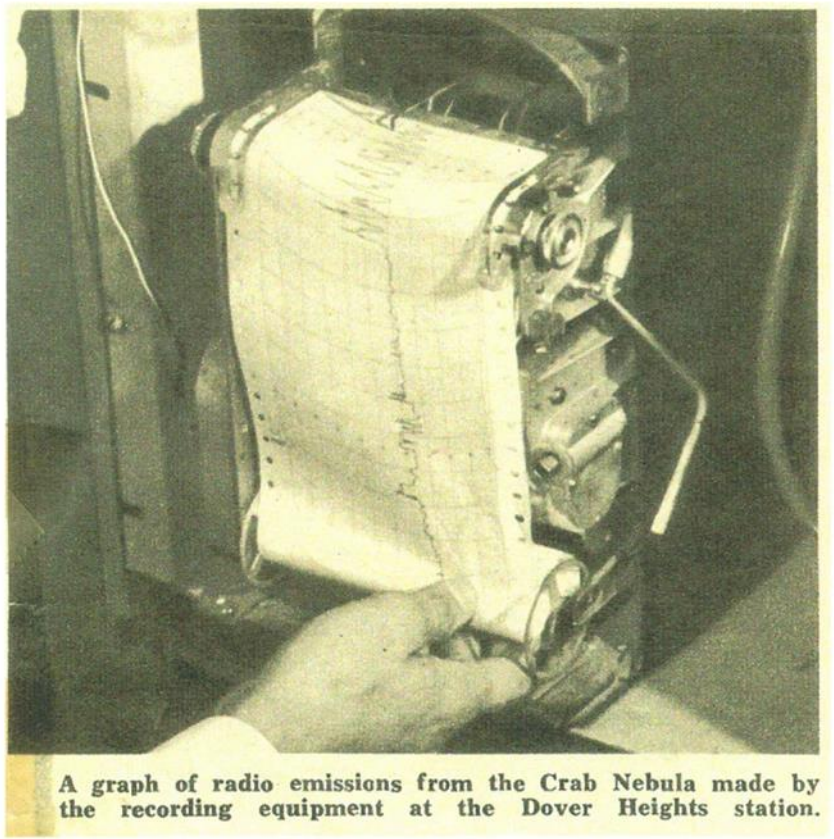
The Season's Greetings
and Every Good Wish for a
Happy New Year
from John.

We have another expedition planned for next year – this time to North Queensland. Probably without Gordon as he now has a small son. We often talk of the happy time we spent with you on the hill top.

Taurus A, and 3C123- 13 July 1948



The chart recorder at Dover Heights



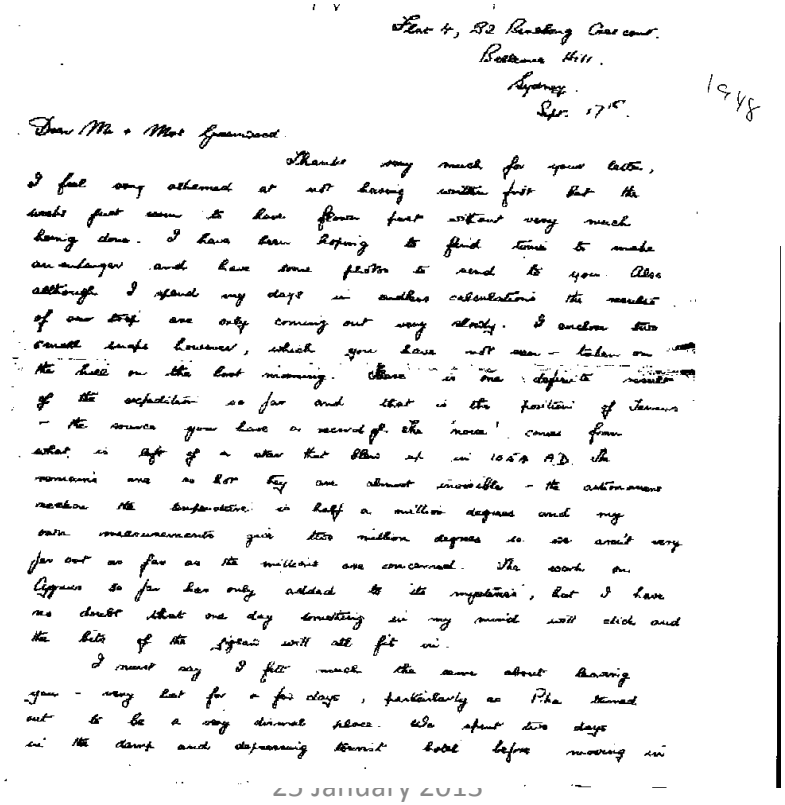
A graph of radio emissions from the Crab Nebula made by the recording equipment at the Dover Heights station.

The original recording will be given to the National Library of New Zeeland- Alexander Turnbull Library

In Sydney the interpretation of the data by John

- Now after the work in Sydney the position of Tau A was precise at the level of 10 arc min instead of degree
- Virgo A had been placed in the wrong constellation based on the earlier Dover Heights; at Piha the first observation missed detecting "Coma Berenices A"
- Cygnus A work continued and never lead to a successful result- and I suspect that at least ¾ of the effort in NZ was expended on Cygnus A

"There is one definite result of the expedition so far and that is the position of Taurus – the source you have a record of the 'noise' comes from a star that blew up in AD 1054 AD. The remains are so hot that they are almost a million degrees and my own measurements give two million degrees so aren't very far out as …. The work on Cygnus so far has only added to its mysteries, but I have no doubt that one day something in my mind will click and the bits of the jigsaw will all fit in… I must say that I felt the same about leaving you- very lost for a few days, particularly as Piha turned out to be a dismal place. [Then looked after by the Taylors… the caretakers of the RNZAF station..]



Flat 4, 82 Rawson Crescent
Bellevue Hill.
Sydney.
Sept. 17th.

1948

Dear Mr + Mrs Greenwood

Thanks very much for your letter, I feel very ashamed at not having written first but the weeks just seem to have flown past without very much having done. I have been hoping to find time to make an enlarger and have some prints to send to you. Also although I spend my days in endless calculations the results of our trip are only coming out very slowly. I enclose two small snaps however, which you have not seen – taken on the hill on the last morning. There is one definite result of the expedition so far and that is the position of Taurus – the source you have a record of the 'noise' comes from what is left of a star that blew up in 1054 A.D. The remains are so hot they are almost incredible – the astronomers reckon the temperature is half a million degrees and my own measurements give two million degrees so we aren't very far out as the millions are concerned. The work on Cygnus so far has only added to its mysteries, but I have no doubt that one day something in my mind will click and the bits of the jigsaw will all fit in.

I must say I felt much the same about leaving you – very lost for a few days, particularly as Piha turned out to be a very dismal place. We spent two days in the damp and depressing tourist hotel before moving in

Positions of Three Discrete Sources of Galactic Radio-Frequency Radiation

In a recent communication[1] an account was given of the discovery of a number of discrete sources of galactic radio-frequency radiation. Accurate measurements of the position of three of these sources have since been made from sites on the east and west coasts of New Zealand and on the east coast of Australia. The technique employed was to observe the sources at rising or setting, with an aerial on a high cliff overlooking the sea. These observations, when corrected for atmospheric refraction, allow the path of a source above the horizon to be plotted, and the time of its rising and setting—and hence its celestial co-ordinates—to be determined.

It is found that all three sources correspond within limits of experimental error to positions of certain nebulous objects. The positions of the sources determined and details of these objects are given in the accompanying table.

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Source	Position (Epoch 1948)		Possible associated visible object		
	Right ascension	Declination	Object	Spectrum	Remarks
Taurus A	$5^h\ 31^m\ 00^s \pm 30^s$	$+22°\ 01' \pm 7'$	N.G.C. 1952 (Messier 1)	Continuous. Weak emission lines of H, He, forbidden lines of N, O and Si	The Crab nebula, expand shell of an old super-n
Virgo A	$12^h\ 28^m\ 06^s \pm 37^s$	$+12°\ 41' \pm 10'$	N.G.C. 4486 (Messier 87)	Continuous	Spherical nebula—unresolved
Centaurus A	$13^h\ 22^m\ 20^s \pm 60^s$	$-42°\ 37' \pm 8'$	N.G.C. 5128	Continuous. Weak emission lines, $H\beta$, $H\gamma$, $H\delta$, and λ 4686	Unresolved nebula cro by a marked obscu band

The position of the source Taurus A agrees, within the limits of experimental error, with that of the Crab nebula. This is believed to be the expanding shell of the supernova of A.D. 1054. The present dimensions of the nebula are $4' \times 6'$, and photographs taken with different wave-length ranges show considerable fine structure, including $H\alpha$ filaments. The emission from the nebulosity is some 600 times that of the central star identified by Baade[2]. Minkowski[3] considers that most of the radiation from the central star is in the far ultra-violet and estimates the surface temperature as 500,000° K. He suggests a temperature of 50,000° K. for the nebulosity and explains a low ratio of $H\alpha$ to [N II] emission as being due to a deficiency of hydrogen. It should be pointed out, however, that a much higher temperature would have a similar effect on this ratio and at the same time increase the electron density. Intensity measurements we have made at 100 Mc./s., assuming a source size of 5′, give an apparent temperature of 2,000,000° K. for Taurus A. The present estimates of density and temperature in the Crab nebula would fall well short of explaining this result by strictly thermal processes. Non-thermal components resulting from the expansion of the nebula do not, however, seem unlikely.

Both N.G.C. 5128 and N.G.C. 4486 are generally classed as extra-galactic nebulæ, though Paraskevoulos[4] considers that the position of the obscuring band splitting the disk of N.G.C. 5128 into halves is unusual. Such obscuring bands are normally seen in nebulæ viewed on edge. Neither of these objects has been resolved into stars, so there is little definite evidence to decide whether they are true extra-galactic nebulæ or diffuse nebulosities within our own galaxy. If the identification of these objects with the discrete sources of radio-frequency energy can be accepted, it would tend to favour the latter alternative, for the possibility of an unusual object in our own galaxy seems greater than a large accumulation of such objects at a great distance.

Full details of the technique and observations involved in the determination of the positions of these three discrete sources will be published elsewhere[5].

This work is part of the research programme of the Division of Radiophysics, Commonwealth Scientific and Industrial Research Organisation, Australia.

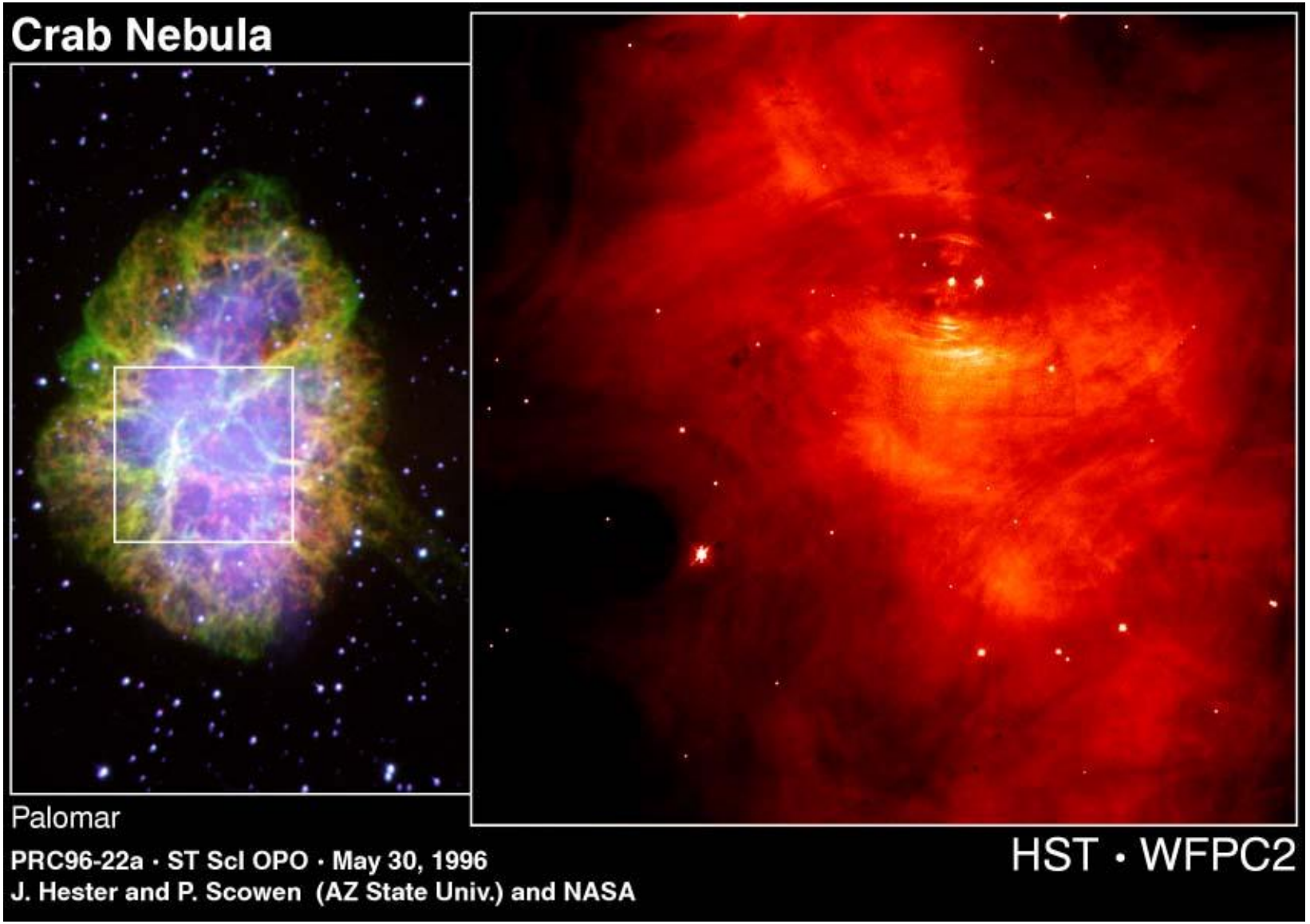
J. G. Bolton
G. J. Stanley
O. B. Slee

Radiophysics Laboratory,
Commonwealth Scientific and Industrial
Research Organisation,
Australia. May 2.

[1] Bolton, J. G., *Nature*, **162**, 141 (1948).
[2] Baade, W., *Astrophys. J.*, **96**, 188 (1942).
[3] Minkowski, R., *Astrophys. J.*, **96**, 199 (1942).
[4] Paraskevoulos, J. S., *Harvard Bull.* 890, 1 (1935).
[5] Bolton, J. G., and Stanley, G. J., *Aust. J. Sci. Res.*, A (in the press).

The astronomical news of 1949

- Bolton wrote : " but the limits of position enclose the most remarkable object in this region- NGC 1952 or the Crab nebula." But as Sullivan says : ' This in fact was a gross underestimate, for the Crab nebula was one of the most remarkable objects ***in the entire sky***."
- Bolton impressed the astronomy establishment with these identifications of Virgo A, Cen A and Taurus A. Oort at Leiden, R. Minkowski and W. Baade at Mt. Wilson in Pasadena CA. A number of letters were exchanged with them. Oort was especially interested in Tau A- did not believe the Virgo A id. He said : "Lots of galaxies in the Virgo cluster…"
- Minkowski was to play an important role in the subsequent career of Bolton, helping bring him to Caltech in 1955 (to 1960) and visiting Sydney in the early 1960's
- The publication was July 1949 in Nature. Radio astronomy had come of age


Crab Nebula
Palomar
PRC96-22a · ST ScI OPO · May 30, 1996
J. Hester and P. Scowen (AZ State Univ.) and NASA
HST · WFPC2

A few anecdotes and a question

- The golf ball gift and the end of petrol rationing in Australia mid 1949
- Irwin Greenwood's important contribution to the expedition late one night – from a story of Gordon Greenwood
- I am puzzled – there was never a visit in subsequent years . I am certain Gordon and likely John were in NZ now and again. The letters and Christmas cards stopped in the 1950's. Certainly the Bolton family knew many of the details of the 1948 expedition

Piha