

10/87 - retained by Phillips w/ his comments in red

PROJECT FOR THE HISTORY OF RADIO ASTRONOMY

Transcript of Interview

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Transcribed by Pamela Jernegan 20 April 1979

Interviewee: J. W. Phillips

Interviewer: W. T. Sullivan, III

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Place: ^{Groningen} ~~Glennigan~~ to Gloucestershire, England

Ambience: *long-distance telephone*

Tape 113B

WS Now, just going through your letter first of all, there were a few points that I'd like to ask about. Were you directly involved in the interference which came from the sun which ~~Hayes~~ discovered in 1942?

JP No.

WS No, I gather from the letter that you didn't come back to his group until 1945, is that correct?

I joined in October 1944, and remained until Sept 48
JP ^{In} 1944, I think I joined it. ^{It} was the time of the first V-2. As a matter of fact, I was in London waiting to report when the first V-2 landed, and I think that was October, 1944.

WS I see, and you say you were working in the field in northern Europe until May 1945 - does that mean that you were going out into the field and then back to the lab?

JP Yes. ~~We had as a group, a commitment there, Our commitment - this is the radar group. - And the group was concerned with trying to stop V-2s and I went out to northern Europe, ~~Ostead~~ ^{Belgium and Holland} and ~~Holland~~, Belgium, rather, ~~not Holland~~, to try and get a line on the tracks.~~

WS I see. Now can I ask - what was your training and what was the primary sort of thing you worked on during the war?

JP This is a very interesting question - ~~I wonder if~~, it'll probably horrify you when you hear the answer. My training, I've got a mathematics degree and I was a mathematics teacher before the war. People with any sort of scientific qualifications were put on a register and *not allowed* into the normal Army channels and were called as required. Well, by the time the radar ~~blew up~~ and all the people who really knew anything about either engineering, electrical engineering or radio, were already in signals or *Royal Engineers* or something like that, so they really had to scrape the ~~bottom~~ *barrel* in order to man the radar posts, and at the bottom of the barrel, they found people like me who really knew nothing whatsoever about radio.

*perhaps
boiled up
or
brewed up
would be
better*

WS Well, but you had a scientific mind, so to speak.

JP I had a scientific mind, yes, but for instance, I thought a condenser was something that you stored electricity in.

WS Right.

JP That's the extent of my radio knowledge. Anyway, they gave us a rush course, put us out in the field *of as* civilians, and then in about a year brought us back and gave us some elementary military training, put us into uniforms and then from there, as it happened, I took two more courses in the Army - post graduate courses, and by the end of the war, I was really quite knowledgeable about these things.

WS I see. And so what sort of problems would be typical of what you'd be working on?

JP During the Army?

WS Yes.

JP Oh, ~~I was just servicing~~, initially I was just servicing and maintaining radar equipment in the field. Principally *AA* command.

Perhaps this is misleading. Pure servicing was in the hands of army personnel. Our responsibility was rather an overlooking of the performance of the station as a whole

WS I see. Okay. Well now, ^{after} when you joined ^{Hey's} ~~Hayes~~ group in 194⁴, ~~or I should say, no you had joined it before,~~ ~~but what I want to get at is~~ can you tell me what the makeup of the group was when you first were able to work on scientific matters as opposed to military matters.

JP Well, it was a section of a much larger organization. You know about that?

WS Well, go ahead and tell me.

JP The idea of operation research groups was thought up during the war, and each of the services, I think, had them, the biggest one was the ^{RAF}, the Air Force one. Lovell, I think was in that. There was a smaller one attached to the Army which used to concern itself with various problems other than radar - our particular section was radar and this was led by ~~Heye~~.

WS I see. And how many people would be in this section, in total?

JP Something like 6 officers and probably a dozen supporting staff of one kind or another. It was mixed Army and civilians - so when I say 'officers', it could be civilian or Army officers.

WS And ^{were} ~~did~~ yourself and Stewart and Parsons all officers in this group?

JP Yes, I was a military officer. Parsons was a military officer. Stewart was civilian.

WS Right. Now are there any other people who worked at all on the radio astronomy aspects whose names I should know?

JP No. Radio astronomy, of course, didn't start up until May (seriously), May of 1945. I think it was May. No, I think it would be fair to say that we four led our ^{respective} sections and we were assisted as required.

WS And also, while I think of it, let me get the first names of these people. First of all, Parsons.

WS S. J.

JP I can't remember.

WS And Stewart?

JP I don't think we used Christian names very much in those days. Stewart was Gordon Stewart, I think. And Heye must have been . . .

WS Heye is ~~John~~ ^[James], I believe.

JP Yes. Parsons - I can't remember. [S. John]

WS Okay. Now could you describe what the principal role which each person played in the group was, and how this was decided? ~~more or less?~~

JP Well, when I came back, the thing was already a going concern on the radio astronomy, and I came back in May 1945. One of the reasons for this was that, as you know, the war in Europe had stopped very suddenly. And it was a policy in England not to send all the Army back into the labor market at one go, as they'd done in the previous war and ~~stopped~~ ^{wrecked} everything. So they had an extended release, and this meant there were a lot of people in the Army who had absolutely nothing ^{whatever} to do. And the Army was only too happy for anybody to find anything for them to do. Heye was able, therefore, to get as much assistance as he required although, in fact, we couldn't use very much. And to get equipment, we used existing equipment and converted it to our uses. And he obviously got all that going very quickly, but I wasn't there at the time. I was still in Europe.

WS Now, ~~when~~ you say when you arrived and the work was going on these short echos from the meteors, the short scatter echos . . .

JP Yes, this was well under way. I never had much to do with that. I don't really think I can tell you anything useful. My own work, he'd assembled this ^{4-Yagi array}

I think it was a 2-Yagi array in the first place

JP Continued

~~ray~~ and was plotting a received signal ~~through, plotting~~
~~them~~ against celestial coordinates and he got a large
 globe, something like an 18" school globe - as one used
 in school, and was plotting onto this. And he asked me
 to take this over. Well, there were various contribu-
 tions I was able to make directly because of my mathe-
 matical training, part of which was to make the necessary
 transfers from a spherical globe onto a ^{plane} plain sheet.
 And the other one was to develop what would now be called
 the "relaxation method," and for plotting the results, be-
 cause one had to take into account the ~~signal~~ receiver
 side lobes, which were quite large.

WS Yes, you mention this in your letter. Is this what I
 would think of as a restoration method - trying to re-
 store the true brightness distribution?

JP Yes.

WS I've never heard this term 'relaxation method' - where
 did that come from?

JP Perhaps we use different words on different sides of
 the Atlantic. Relaxation would be the name, I think,
 which would be recognized in numerical methods.

WS I see, Okay. But now going back to this equipment, so
 you say it was put together for this purpose, that it
 wasn't just taken over from the military - as a unit,
 anyway.

JP Not as a unit, although a very large part of it ^{was in}
 existence. For instance, at five meters they were
 very sensitive to the state of the ground echo and so it
 had an artificial ground which is described in the papers.

WS Right, and that would not be usually used for the military?

JP Yes. That was the normal AA command . . .

WS Oh, that was the normal thing, I see.

JP In fact, it was a normal AA ^{com}mand station which was set up in *Richmond* Park for research and training purposes.

WS I see. So this Richmond Park station had been going during the war, also?

JP Oh, yes.

I did some of my early training (1941) on it

WS I see.

JP ~~It had,~~ In fact, when I first did my training, I went ~~out~~ ^{up} to this same place - back in 1941, ~~you know,~~ for some brief field experience and so on. ~~And then it,~~ yes, ~~It was used for~~ the research station's

? ~~the~~ offices ^{were} are just outside ~~the~~ Richmond Park, at *Boe* hampton, and we used ~~it,~~ ^{the station} ~~well~~ that then was ~~the~~ existing - the cabin with its method of rotating, *etc.* was existing, but the aerial array was one that was set up ~~in the shop.~~ *for the job.*

WS I see. Did you know, at that time, as you were doing this work, about Jansky and Reber's work? Did you have those papers in hand?

JP Yes, and I think this awareness and the carrying on from this must have been entirely ^{Hey's} ~~Hayes~~ work. That was all pretty much there.

WS Right. Now, as you were taking these data, what would be your normal operational procedure - can you ~~sort of~~ describe it?

JP Yes. We were in ~~sixth~~ ^{fixed} ~~asimuth,~~ sorry ~~six~~ elevation, somewhere about 12° because of the effect of the ground *contribution,* although the aerials themselves were pointing horizontally, and so during the course of the 24 hours, quite a large part of the sky swept through ^{the horizontal circle traced by} our beam, upwards at one time of the day and then downwards again at the other. *Parts* of course, were never visible — the *circumpolar* regions weren't visible - ever; and

JP (Continued)

nor, of course, were the parts below the horizon. So that gave us a pretty wide band round the sky which we then just took spot readings on - these were readings from a meter, we didn't have any automatic recording.

WS I see, you recorded them by hand from a meter.

JP That's right. And we recorded these at appropriate intervals - something like ~~a~~ half an hour or something, doing a complete rotation in ~~azimuth~~ - every half hour taking logs and then plotting them on to a chart.

WS I see. So would you do this half-hour after half-hour after half-hour - just a long period of . . .

JP That would be the sort of thing, yes. ~~It~~ was all rather primitive, of course.

WS Rather tedious, too.

JP Well, yes. The work was shared between two or three of us - ~~it was~~ only one person ^{was} required. ^{at-a-time} I remember, for instance, that I would do a night watch ~~going up of course,~~ it went on night and day ~~and during night watch,~~ say starting at 9 p.m. in the evening and going through until 8 o'clock the next morning when someone came to relieve me. Setting my alarm to ring at 20 minutes ahead, going asleep, ^{waking} getting up, walking out on a winter's night across the ~~netting~~ on a catwalk, taking my readings, coming back and getting another quarter of an hour's ^{of ?} sleep.

WS I don't quite follow how you could get away with doing it only every twenty minutes or so.

JP Well, of course, the beam itself wasn't that narrow, so you see, we weren't getting very high discrimination.

WS But you were rotating on the sky, though.

JP Yes. Every twenty minutes, of course, was to allow for the rotation ^{of ?} in the sky. We did a complete ^{rotation in} ~~azimuth~~ at

~~at~~ ten degree intervals or something like that, 5 degree probably - I'm not sure. And . . .

WS But I'm still a little bit confused. You were at a fixed ~~azimuth~~ and then waiting for the sky to move through and taking a recording every twenty minutes?

JP Every twenty minutes we did a complete circuit in ~~azimuth~~.

WS Okay, that's what I thought. So then . . .

JP *Drew a line* around the sky.

WS So then it would seem like you could take a reading every minute or half minute and have a different point in the sky.

JP Yes, except that the beam wasn't that narrow, you see.

WS Well, was it that broad? Was it 30° or 40°?

JP No, but the sky doesn't move that fast.

WS But you're moving around in ~~azimuth~~, so you're looking at different parts of the sky.

JP You're taking a complete survey of the sky, every half an hour it ~~should~~ be, and those points were on a line at, I imagine, 5° intervals, although I couldn't be sure of that without looking . . .

WS Okay, so you were recording many different points during the half hour.

JP Yes, in fact, a circuit in ~~azimuth~~ would, I imagine, take something like five or eight minutes, something like that, and then we would take no more until we went around again. Another half hour later.

WS Oh, I see what you're saying. So you would take a quick circuit and then wait a half an hour and then take another quick circuit.

JP Right, that would be the sort of thing.

WS I have in mind Jansky's procedure, which was continuous every twenty minutes, and he had a strip chart recorder

WS (Continued)

so he got continuous recording, that's what was confusing me. So you were just taking it, waiting for the sky to move, taking it again.

JP That's right.

WS I've got you. Then what was the procedure to reduce this data?

JP Well, as I said, there was no automatic recording, certainly not ~~at~~ that time, which in many ways was a good thing, because when we did get on to automatic recording, we then had to face the problem of getting someone to analyze the endless rolls of charts which came off the automatic recorder.

WS Right.

JP That was a bigger problem than the recording. Anyway, so we would have a lot of spot levels; then, ~~this is rare~~, this would become my job with close assistance from a junior member of the team. I already had a large, I should say 5 ^{ft} square, something like that, sheet of ^[Peropex + guided suitably, etc.] ~~printed and so on~~. And I'd work with a china-graph pencil. I had a rotating ~~overlay~~ transparent overlay, which represented the characteristics of the beam, and I just plotted my way around, making the corrections as required — "restoring" it, to use your term, until one got a pattern of the whole sky. But, of course, you'd need a complete twenty-four hours' readings before you could start working on this. ~~problem.~~

WS Right. Now how many of these complete maps of the sky did you make, in practice?

JP I don't really think I can say. The technique improved from time to time, and we would try again, and indeed, one of the major surveys we set up ~~in~~ ^{and started} blew

JP Continued

up because the sun got *active*.

WS Right. Well, we'll come to that shortly. ~~But I'm wondering,~~ Unfortunately I don't ^{now} have a copy of your 1946 letter to Nature. Was that just based on one sampling of the sky, or did you do two or three?

JP I don't think it's likely to have been one sampling of the sky, but I can't remember right now just how much.

WS In any case, you did take several, you made several independent maps of the sky?

JP Yes, indeed. And there would be a fair amount of averaging done, I expect.

WS Right, right. Now what sort of units were you making these plots in, and how did you do your intensity calibration?

JP We were using a, ~~what do you call it,~~ a *base tungsten wire* diode as our standard. I think that's referred to in the *Proc. Roy. Soc* paper.

WS Yes, and so, how did you calibrate it though? Were you trying to do it in terms of a temperature?

JP ~~I think, no,~~ I don't remember. *(on the spur of the moment!)*

WS It's probably in the paper. What about the measurement of the beam characteristics?

JP Well, for this purpose, we flew an oscillator from a captive balloon, and we had an RAF team attached to us for this purpose, who had a delightful life, because they weren't called on very often. But the RAF, like us, had a lot more people than they knew what to do with.

WS Right.

JP So they lived with us, and we flew a balloon when conditions promised to be suitable, flying an oscillator up and down and rotating the cabin and trying to plot ^{The beam.} speed.

WS I see. Okay. Now, talking about things that can go wrong,

WS Continued

you mentioned the thing about the sun blowing up one day, can you tell me about that?

JP Well, normally the quiet sun we couldn't see. The sensitivity and the wave lengths were such that we couldn't see it.

WS Was all of your work at 5 meters?

JP At that time, I think it was all at 5 meters. But I wouldn't be absolutely sure. Certainly, all my work was at 5 meters.

WS In any case, you had no strong urge to look at another wave length to see the spectrum of the radiation?

JP I rather think we tried at 10 centimeters, and didn't get anything. As you probably know, the spectrum . . .

WS Yes, that's a big jump, right.

JP You've got to have fairly good apparatus; I think it really wasn't until they got the really big bowls that they started to get anything ^{at} ~~of~~ the shorter wave lengths.

WS What did you have for an antenna at ten centimeters?

JP It would have been a standard gun control radar.

WS Just a small little dish, probably?

JP A dish of about, at a guess, I would say about four ft. And a beam width, probably, of about 2° - something like that.

WS Okay. Well, back to the other question about the sun interference.

JP Yes, well, we were all set up and we were going to start at sunrise and as it happened, I'd put the members of my team on ^{to} ~~for~~ being there at sunrise, and I turned up at about eight o'clock in the morning just to make sure that it was going all right. ~~And~~ It wasn't going all right at all. ~~Because~~ because the sun was doing a great deal and really blowing everything else off the air. If you were

JP Continued

anywhere near the sun, you couldn't get anything at all.

WS I see. So it was readily recognized as the sun?

JP Immediately, yes.

WS And so, according to your letter, ~~then~~, you began to start monitoring the sun then?

JP Yes.

WS And how long did this go on?

JP Well, it went on for the period of the activity, which I think was something like a week. *In time*, no doubt, the sun spots went around the wrong ^[back] side of the sun. But I would think it was about a week; it might have been slightly less.

WS And you say you contacted other groups - which groups were those?

JP Yes, now here I really can't remember. Appleton, of course, had a set-up ^{at Slough,} ^[associated with] ~~as well~~ which was ~~the successors~~ ~~of his,~~ the people who did the work on ~~the~~ bouncing reflections ~~of~~ the ionosphere. That was still going, and I think this was part of the National Physical Laboratory, but I'm not quite sure. I certainly would have contacted them.

WS Perhaps Ryle at Cambridge?

JP No, I don't think Ryle was going then.

WS Well, let's see, when would this be?

JP Well, I think again I must refer you to the literature on this; ^{it was} written up by Appleton, ^{over Appleton's name with Hey} ~~with Hey~~ as co-author. [^]

WS Oh, yes. I know the paper you mean.

JP And I think that will give the information. I don't think, in fact, there's any acknowledgement to me at all in that. But, in fact, by luck, I was there and got the first observations. And alerted such people as we were in touch with.

WS Well, you'll be interested to see in Hey's book, his paragraph about this relationship with Appleton and he very diplomatically discusses it - for instance, saying "with reluctance, I became aware of the pitfalls of an undefined association... Appleton's incursion into our research findings began to arouse discontent within my own team and the liaison could not survive." and so forth.

JP Yes.

WS So I suppose this is an example of that.

JP Perfect, yes, oh, yes. Hey handled all the outside contacts really, so I don't know very much about it. I was really only working on my own project, and it was just because of the urgency and the novelty of the situation that I took steps to phone such people as I could think of without waiting to ~~see or~~ tell anybody else.

WS Right. Now did you work at all on the scientific aspects of this burst radiation?

JP No, that was really Hey, I think.

WS Okay, you just turned the data over to him? ~~mercerless?~~

JP Yes. He was the one who did the solar wind and this sort of thing.

WS Right. Okay, along this same line, did you worry about the ionospheric effects in your data?

JP No. Apart from realizing there was some distortion near the horizon, but our beam wasn't near enough to the horizon for us to be able to make any estimate. But I think really the ^{blunter answer} ~~heart of it~~ is that I was no scientist.

WS Yes. And the other thing is the man-made interference. Could you tell me about what happened there?

JP That wasn't very troublesome during the early part, and generally speaking, was only temporary, so if we got it

JP Continued

one time, well, the next time we went around it ^{had} probably disappeared, and so it tended to be things like electric trains and so on. With the exception, of course, of the one which I'm sure you're going to discuss in a minute.

WS Well, but now you say in the "early time" you were working with the group for a total of what, two or three years?

JP Well, I actually left the group in ~~September~~, August or September of 1948. But really the work had wound down before that, for reasons which I've indicated in my letter.

WS Right. When would that be?

JP I should think the active time probably didn't go much into 1947, probably.

WS So probably until the end of 1946, beginning of 1947?

JP I should think that was the sort of time when our active work finished.

~~WS Right, so about a year and a half . . .~~

~~JP~~ Our active work on radio astronomy.

WS About a year and a half total.

JP Something like that.

WS Were you implying that by the end of that period that the interference problem had gotten worse?

JP Well, it was getting worse while we were in Richmond Park, and indeed, I think soon after I'd made that major survey which was reported in the ^{Royal} Society paper, I think it really did start getting difficult. We were, of course, well within the outskirts of London, surrounded on all sides by electric trains and so on. Television was coming up - all sorts of things.

WS And so did you move at that point?

JP Well, we did move, but it was a protracted business. They were a long time settling in, I think, to their new place out at ~~Byfleet~~ ^{Byfleet} and we were the last section to move.

WS Bi-Fleet, you say?

Byfleet

JP We never really got going in the new place during my time.

WS I see - at Bi-Fleet, you say?

JP Bi-Fleet, yes, near ~~Woking~~.

Woking (20 miles S.W. of London centre)

WS And I guess, ~~what~~ Malvern was yet later.

JP Malvern wasn't really directly anything to do with us.

WS I see.

JP Malvern was basically the RAF place.

WS So, Hey was associated with Malvern later, but that was a switch for him?

JP Yes, Hey moved out of AORG as I did. We were both offered posts within the civil service ~~the~~ science organization. I chose to go teaching, ~~for the~~, I don't know why. Hey was still at ARG when I left, but he left, I would think, fairly soon after, but I'm not sure.

WS I see. Well, okay, going back to the interference. The story you tell about the Wimbledon television transmitters is very interesting. Could you tell me about it now?

JP Well, this was during one ^{of} these calibrations, ^{when we} and ~~they~~ used to fly an oscillator on a balloon, ~~and we~~ as the crow flies, I suppose we were about two miles from Wimbledon, something like that. And I flew one ^{up} to do a calibration on a nice quiet summer morning, and found I was getting very large interference which was really wrecking my results. And of course, since we had a directional ~~an~~ array, it didn't take very long to get a line on where the interference was coming from.

(a balloon, not a crow)

And ^I got a line straight across Wimbledon. And then

someone remembered that they were supposed to televise ^{be}

^{from} ~~at~~ Wimbledon, ^(the very first-day of the first-transmission from Wimbledon) so I got on the phone and said "What the hell are you doing? You're blowing me off the air."

WS Right.

JP Whereupon they said, (this is all on tape incidentally, [?] *off the cuff?*
 but I think it's accurate.) ~~They said~~ "We're just doing
 the run-up for the broadcast this afternoon, and we're
 getting wrecked - who are you?" We then, fortunately, *Panic!*
 got to talking about it amicably, and it turned out that
 the wave length that they were using had been assigned
 to them, and all Army units had been *instructed* ~~advised~~ to keep
 off it, but since we were rather out on a limb, and
 not within the normal Army orbit, no one had mentioned
 it to us.

WS I see. So they in fact, were very close to your frequency, then?

JP Yes. Yes, ~~I can't~~, I think it was a relay frequency that we were wrecking. I don't think it was their main transmitting frequency.

WS But I don't quite understand ~~about~~, you say that you blew them off the air: This was because of the oscillator on the balloon?

JP Yes.

WS Right. ~~Okay, it wasn't . . .~~

JP Which, incidentally, was visible from Wimbledon, so why the post office engineers couldn't ~~stop~~ *spot the source of interference,* I don't know.

WS Okay. This same unit was used for the meteor radar work, is that right?

~~JP No.~~

WS Or was that another unit?

JP No, it wasn't. *(used for meteor work)* And I think I can say it never was because I think *they* ~~we~~ were using a much more directional array, *)*
 probably, but then I'm rather guessing, probably one *o*
 mounted on a search light chassis. This was another form
 of mounted radar that was used during the war.

WS I see. But was it at that same site? Richmond Park?

JP Yes. *One of them was. Others elsewhere. See Hey's book*

WS And did you "time-share" in terms of when they were radiating, you would not be . . .

JP They would have been using a different frequency, I think. But really, I don't think I can tell you anything useful. I think I can't tell you more than is in the literature.

WS Okay. *[in your letter]* Now, you say, before you got going to the new site, the cold war started. "And the Army directed us to more serious things." Hey also talks about international tensions rising. I was wondering what specifically that was referring to - ~~this~~ ^{is} *this* ^{is} the Berlin ^{Crisis,} or before then?

JP Well, again, I'm only speaking from memory, but I think it was Berlin, yes. Do you happen to know the date of the Berlin *airlift?*

WS It was 1948, I think the first half of 1948, so that would ~~about~~ *[Apr 48 -> Sept. 49]* make sense then, wouldn't it?

JP Yes, well, it might have started up before then, I don't know. But that was certainly ~~the problem at~~ *about* that time.

WS Okay. Now, ~~can you tell me,~~ you mentioned in your letter that Hey exercised general supervision, but can you tell me how the group worked - was everyone working independently and Hey . . .

JP Yes, the organization was very loose. And indeed, ~~after,~~ as I say, Hey started it up, but from then on, certainly as far as my side is concerned, the link was really one of consultation and discussion of results than laying down orders for the day or plans of action ^{or progress reports} or anything like that. And in what was actually done, I think, ~~the decision,~~ it certainly was in my case, the decision of the person doing the work. Although, in full consultation with Hey.

WS Right. So the final paper, I ~~mean~~, would that be a joint effort between you or was it mainly that you would write it and he would approve it?

JP Well, now, that's a ~~little more~~ ^{rather} delicate question, and the answer's got to be delicate.

WS Okay. I will respect that.

JP In fact, I think I can say that I wrote the Royal Society paper, which was the substantive paper. It was certainly done in close discussion with Hey and he would certainly have criticized the manuscripts and commented, and it would have been modified in the light of these criticisms and so on. But basically, it was my paper.

WS Right. So it might have been a fairer thing; he could still be co-author, but for you to be senior author.

JP Say that again?

WS It might have been fairer, Hey could still be co-author but you be senior author.

JP Well, yes. But it is the custom in science, and certainly was then for the senior officer or the professor of the department or whatever, so we weren't in any way doing anything different, and although I did realize that my name ~~got~~ ^{would get} submerged in the et al., I can't say that this was anything other than normal custom of the trade.

WS That still happens today, I think it's not as common, but it still does happen.

JP And ~~indeed, until I realized, and~~ I wasn't even enough of a scientist to realize what was going to happen. I think until I realized what was happening, I had no ~~qualms about it~~ ^{qualms about it} ~~quarrels with~~ at all.

WS Right. So decisions as to whether another scan of the sky would be needed to fix up a certain patch of the sky or things like this, this was all your own . . .

JP This would be my decision, yes.

This is too sweeping. The radio-astronomy was mine, but Hey took a large part of in preparing Section 8 (correlation with other astronomical phenomena), and in discussing the implications of the variables in Cygnus.

1/3 enough exposure of research publications

WS Okay. Now how much were you influenced by the results of other groups? Were you just sort of operating completely by yourself?

JP I think I could say entirely by myself; it happens to be the way that I ^{tend} happen to work. I don't keep closely in touch with other people; you ^{will have} gathered that from how little I know about what ^{else} was going on.

WS Right. And so, in fact, there was really no correspondence with anyone saying "Well, we've got some results, what do you have?" or anything like this?

JP No, no I think I could say not. *Definitely*

WS Okay. When you were writing the paper for the Royal Society and the ones in Nature, who did you feel you were writing to - were you trying to write to astronomers, or to radio engineers, radio physicists? Who did you consider your audience?

JP Well, the Nature one is merely, of course, to register a priority. But the Royal Society paper is obviously aimed at a wide audience, and indeed, it was picked up by them. We did, for instance, have contacts with Greenwich Observatory, who were very interested in this and we visited them and them us. And I think, but I can't be sure of the name, I rather think the ^{man} name that we talked to was the man who later became the head of the observatory, *the* Astronomy *or* Royal.

WS Richard Wooley?

JP No, he was the Australian, wasn't he?

WS Yes.

JP No, one who's either current or recent.

WS As an Astronomer Royal?

JP ~~It might have been, no,~~ He would have been head of the Observatory.

WS Well, at that time they were the same thing. Before Wooley was Spencer Jones, or is there someone else in there?

JP I never had any contact with them.

WS In any case, there was one astronomer that you had contact with - what sort of . . .

JP ----- *joint* paper, which I suppose I could dig out, I think it was a joint paper, and again, Hey handled most of the outside contacts. But I was brought in and it was only my own fault that I didn't get in further.

I cannot find a reprint

WS This joint paper was between whom?

JP It must have been between us and this man at Greenwich.

WS Well, I have a pretty complete radio astronomy bibliography and it does not mention any such paper.

JP I'll see if I can dig out a copy.

WS That would be very interesting if you could find that. What were the issues that you were discussing with this person?

JP The obvious one was trying to identify what we'd got with something visual. But, of course, our ~~identification~~ ^[ability] ~~was so poor, the location model~~ was so poor, that the identification didn't really happen. We knew it was in Cygnus and that was about as far as we could get.

WS Well, now this is for the radio source, which we haven't discussed yet. ~~But also,~~ ^(u) was this only for the radio source, ^{also} or [^] for the general galactic background?

JP I think that until I look up the paper, I'd rather reserve comment on that.

WS Okay, because in your Royal Society paper you did talk quite a bit about the distribution of stars, and obviously you had become educated ^{one way or another} on some of the optical structure of the galaxy.

JP Yes, actually optical astronomy is something I've always had an interest in - I've always watched the sun and the planets and things like this. So that wasn't too *difficult*, and for that reason, actually, I slipped into this very easily.

what is this paper?

WS I see.

JP But I'd never been an observing astronomer; I'd never done any practical work.

WS Okay. So the only solar observations you were ever involved in was that one week of that active period?

JP ^{No,} I wouldn't like to say that.

WS Oh, I see. Can you tell me about the others?

JP On and off, ~~the thing~~, the sun was pretty active for quite a long time, and indeed, one of our problems was that ~~we~~ Parson's ^{really} put a recorder onto ^{the} a machine and we watched the sun for a long time and the result was that we got miles and miles of paper off the recorder and then had the problem of trying to analyze it! We got rid of quite a lot of assistants *who stuck it only for about a* ~~were rather weak~~ and then decided *They'd* find something else to do.... Slight exaggeration, but that's the general idea.

WS Right. ~~In fact~~ . . .

JP We were observing the sun for quite a time on and off, I think.

WS There is this paper by Hey, Parson~~s~~ and Phillips in Monthly Notices in 1948 about solar radio emission mainly at 4 meters wave length from March 1946 to September, 1947, and association with flares, ~~and that~~ *etc.*, ~~sort of thing~~. So this must have been the automatically recorded data?

JP Yes, that's right.

WS That is a long time - that's eighteen months.

JP Yes, well the sun was active for a long time and we would have had to ^{have} ~~made~~ our other observations during the quiet periods of the sun.

WS Right. Now, in this solar work, also, were you in contact at all with other groups, or were you reading the literature about the sun?

JP Well, no, I think we had discussions with Hey as to whether ~~these~~, his, mostly, in fact, entirely his theories about solar winds and so on, could account for the observations. And there was a time lapses between the ultraviolet flares and the interference as received *on earth*, and whether this ^{could be} explained in terms of ^{some} transmission or something or other.

WS So that was mainly Hey's contribution.

JP Hey did that. I ~~was in~~ ^{did} no more than entered into discussion on that.

WS I suppose you had contact with the Greenwich ~~Observatory~~ over the optical flares, also.

JP Yes, and indeed, come to think of it, that probably was our main contact.

~~WS Yes, so . . .~~

JP I may have been wrong in suggesting that it was to do with the Cygnus *[source]*

WS ~~Ah yes, maybe that's it. Let's see,~~ Hey has a description in his book where he says "I grasped the opportunity in this interim period to delve more deeply into the wealth of phenomena we had uncovered in our operational research." This is just after the end of the war. "With an excellent well-balanced team, S.J. Parsons, electrical and mechanical engineer, J.W. Phillips, mathematician, G.S. Stewart, electrical engineer, and myself, physicist, as leader, we embarked on projects utilizing modified radar for radio astronomy research." Would you agree with that description of the team?

JP Yes, yes, that sounds fair enough.

~~WS In terms of . . .~~

~~JP~~ He said it was a well-balanced team, in fact, we were desperately short of physicists - he was the only one. But if you call that well-balanced, yes. *[laughter]*

WS ~~Let's see.~~ Well, ^A as you were carrying out the survey with the galactic radiation, what ^{was} ~~were~~ the primary questions that you wanted to answer? Was it just a cartography job, you just wanted to make a map, or were you interested in the physics of what might be producing this radiation?

JP ~~The only published results of that time.~~ I think, probably I was somewhat confused at that time, because of course, the thing that caused the trouble during the war (and I think this is right, you can verify it from Hey) was radiation from the sun.

WS Oh yes, that's correct.

JP And although the radiation from the ^GGalaxy meant that you couldn't get the sensitivity on a radar receiver that you ought to be able to get, because ^{the noise level was} always higher than it should have been, I really don't think this was bothering us.

WS No, it's not usually a limiting factor.

JP So I think it was rather incidentally that we got onto that. And I would say that Hey really started this, I would say that looking at the published results up until then, which was Jansky and then Reber, Reber's maps were exceedingly sketchy and slight, because of the low intensity and lack of technology ^{at the time he was working.}

WS Well, he couldn't detect radiation far from the galactic plane because he was operating at a good bit higher ^{frequency} wave length - 160 megahertz.

JP Much higher ^{frequency} wave length. So although ~~his~~, I think probably, his angular discrimination was better, his signal was worse. There ^{was an} were obvious gaps to be filled, and we just set out to fill it.

WS So you weren't particularly concerned with what was producing this radiation?

JP Well, no. Of course at that time, there was no reason to think that it was other than ~~rather~~^a diffuse radiation of some quite unidentified source. ~~It~~ⁱ could have been interstellar gas or something like that.

WS Yes. Well, in fact, in your Royal Society paper, you present these two possibilities - either interstellar gas or the summation of many sun spot-like sources of an unknown nature, and your conclusion is that it probably is a mixture of these two things.

JP Yes, and what was certain, I think, was that ^{with} the wide beam we got, we really wouldn't have been able to distinguish between the two.

WS Yes, right.

JP It was only because the Cygnus result was so extraordinary and unique that we saw it at all.

WS So it was clear that you needed . . .

JP *If there had been a lot of "Cygnuses",* ~~lot of~~ we would never have been able to distinguish them.

WS Did you contemplate at all trying to go to a higher frequency or a larger antenna to get better resolution?

JP Well, my first ^{interest?} ~~interest~~ (in fact this never came off because of the disruption of the move) ~~my first interest~~ was to have a look at the sky which we hadn't looked at, and if we had done that, we would have found Cassiopeia.

WS That's right, that's right.

JP *But we never did.*

WS And you were just going to design ^{an array} ~~a ray~~ that could look at the ^{circum} polar regions?

JP That's right.

WS You weren't thinking of going to the southern hemisphere on a Navy ship or something, were you?

JP We weren't that ambitious! *[laughter]*

WS Right.

JP We were all working out time until we left *The service.*

WS I see what you're saying, yes.

JP It was a very lucky break for us; we weren't a very high powered team, as I said in my letter.

WS Well, now tell me about the fluctuating source in the direction of ~~the~~ *Cygnus.....*

Tape 114A

WS Okay, as I was saying, tell me about the discovery of this fluctuating source in Cygnus.

JP Well, we were getting a fair amount of interference by then, and it ~~will~~ ^{would} be no surprise to get difficulty, and for this sort of reason, if no other, we would be making repeated scans twenty-four hours after twenty-four hours, and trying to fill in the spots that were messed up the time before, and so on. And we would, of course, note the interference. Because we had a meter, and the ~~old~~ ^{time} response ~~style~~ of the meter, I don't suppose *was better than* about half a second, the interference would take the form of a fluctuating needle with a period of something like a half second upwards, up to two seconds or something like that. And the fluctuation wouldn't be very large - it might be only ~~in~~ ten percent of the reading, or something like this. Anyway, we had trouble and it was noted, and we did our usual going around again the next day, or ~~the~~ night as the case might be, and so on, and we would record the trouble each time and if you do this long enough, of course the four minute shift begins to show up and as soon as that happened, we realized, ~~I think~~ I can say I realized, that we were really onto something. This was certainly my finding, and I

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JP continued

think it's probably true to say that if I hadn't spotted it, nobody ^{else} would have ^{done} it. Nobody ^{else} spent that much time looking at the results. *It is probably also true that our very primitive form of logging results helped us to spot*

WS And so what did you do when you realized that this was *anomalies* a *sidereal* source?

JP Well, the fact that the periodic fluctuation was something like two seconds, ~~it would be better to~~ ^{of course I} discussed this with Hey, and we realized that if it was originating from a body giving out a variable radiation, then the body couldn't be very large because of the limitation ^{set by} ~~of~~ the speed of light.

WS Right.

JP And I think we discussed that anyway. So we realized that this was something small, like ^{say,} the size of the sun, and it turned out of course, that the argument was quite wrong, ^{but} that the result was right.

WS Right, did you consider at all that it might be something to do with the path between the source and the antenna?

JP I don't think it occurred to me, I doubt if I knew enough about it.

WS Yes.

JP And I think when Lovell brought that up later, it was ~~the Proc. Roy. Soc.~~ ^{paper} no, I couldn't possibly claim to have anticipated that.

WS Okay, so in your minds it was clear that it was to do ^{the angular} with ^a source, and the source had to be small. *But of course dimensions would need to be small, even if the linear dimensions weren't*

JP That's right.

WS Now what were you thinking about for the nature of this ^{(as you} source - it seems like from your paper you were oriented ^{remark in} towards solar activity, so it would be something like a ^{your footnote} sunspot. *I am sure that we would have realized that, But it's all a long time ago, and I don't think our ideas were very clear.*

JP On the meter, it looked very much like the sort of thing we'd been getting from the sun.

WS Right.

JP But I don't think we thought very much, to be honest.

WS Well, this probably ties in also with your Proceedings of the Royal Society paper where you talk about the entire galactic background being the superposition of millions of these types^{of} sources, and I suppose the idea was that if you had enough of these sources, the net effect would be a constant radiation. And only if you had a very strong one - much stronger than the average, would you be able to detect time variations.

And I think it also was to say that we did not realize what a huge discovery we had made

JP Exactly.

WS ~~Did you, well, once again,~~ when you published this short thing in Nature, did you start monitoring the nature of the fluctuations to try to understand the source more?

JP Well, they seemed to be random, and I think we didn't get any further than that. We'd been pretty used to random fluctuations from the sun anyway. But they were pretty spikey, too. And so, no. Certainly, as I say, I was no physicist, I'd never done any physics since I left school, and although I now know quite a lot of physics for one reason or another, I knew very little then.

WS Once the idea of the ionospheric scintillations was brought up, did that seem to be a reasonable possibility?

JP Oh, yes. I was entirely convinced.

WS And you were convinced even before you left the AORG group?

JP I would guess so, and I'm pretty sure that came up well before I left.

WS Okay. In Hey's book, he mentions a visit to AORG by Ratcliffe and by Lovell immediately after the war, do you remember that visit?

JP Well, I remember Lovell coming, ^[also] yes, I do remember Ratcliffe coming but I don't remember anything about it. I remember Lovell coming, and I'm fairly sure that we, in fact, I'm quite sure, we lent Lovell some equipment.

WS That's right. He mentions that, he talks about how he and Parsons went up to Jodrell Bank and helped them install it actually. But were you part of that at all?

JP I just met Lovell more or less socially during the course of ~~that~~. *the visit to Richmond, not Manchester*

WS Okay. You were not involved with any of the meteor showers?

JP No.

WS Right

JP Only, again, peripheral discussion of what could be the explanation, and this ^{part of} ~~whole~~ thing.

WS Okay, I have a question here about why the radio astronomy effort ended at AORG and I guess the answer simply is that the military had to get back to military things.

JP Yes. The pressure had really been on for some while.

This is, again, (well you've got it on tape, but ~~they~~ ^{we must be} ~~were pretty discrete~~ ^{discreet} ~~about it~~) ^{and} I think in a way ^{that} the military had been a bit uneasy about having these maverick civilians around anyway.

WS Yes, yes.

JP This was happening right early in the war, because a lot of the civilians were very clear (being what they were, scientists and so on) that they didn't fit into military discipline, and if they were going to, they'd have to be forced there, you know. So ^{there was} that sort of tension. ^A And indeed, the Army set up or tried to set up a ^{parallel} ~~permanent~~ organization to AORG. ^{This} was at about that time.

WS I see.

JP With its own staff officers and so on. But I don't know what finally happened to it; it certainly wasn't working when I knew about it, mainly because they couldn't get a hold of the caliber of men - not from Army ranks.

*suggest
"right-kind
of men for
research"*

WS Right. Well, the final question I had was why you left radio astronomy. You say you apparently had the chance to continue, in research anyway, although would that have been radio astronomy or would that have been something else?

JP Well, almost certainly, yes. Although the engagement wouldn't have been in those terms. I would have been engaged to join the civil service scientific service, ~~as a~~, and I had an offer at a suitable post level, and undoubtedly since the interview was heavily slanted towards radio astronomy, I'm quite sure that I would have at least gone over to radar. I don't know whether the civil service itself was doing radio astronomy, or for that matter, I don't know whether Hey continued radio astronomy for some while.

WS No, he says that he went off into administrative type matters for a period of four or five years.

JP Yes, that's what I would have expected.

WS But this job that you had, you might have been able to continue with it, you're saying?

JP Unless there ^{Thought of} ~~were~~ more urgent things for me to do.

WS Yes, it's all hypothetical. But how did you view the field; of course, by that time you knew there was a group in Australia and two other groups in England, what was your view of the field in 1948?

JP Well, it was a revelation - I had no idea there was that much there, and I was very much impressed with the fact that people of the caliber that were then working, Ryle,

JP (Continued)

and the people in Australia, and the people doing theoretical work in Holland, were out of my league anyway. I thought it was very doubtful I could have kept up with them. And in any case, I don't ^{really} think it's ~~my type of thing~~, I'm a researcher-really, that's the answer.

WS Well, I think you're being a little bit too modest in that; the record proves otherwise - for when you gave it a go, anyway.

JP More than my share of luck, shall we say?

WS Right. Okay, well, I'll shut off the tape.

~~~~~

[off the record] Phillips told me that another reason that Hey had to stay associated with Appleton or keep in his good graces was that Appleton was the means by which he could get material published in the Proceedings of the Royal Society, since he was a member of the Royal Society. ¶ And so that ends the interview with J.W. Phillips over the phone from Groningen to his home in Gloucestershire on 31 August 1978.

*I think I am correct in saying that papers for Proc. Roy. Soc. have to be sponsored by a member*