PATENTS ACT 1977

IN THE MATTER OF references under sections 8 and 12 by the Secretary of State for Defence in respect of the pattern recognition correlator shown in the specification of GB patent application 2317487, and opposition thereto by the patent applicants, Rupert Charles David Young and Chris Reginald Chatwin

DECISION

Introduction

1 These references relate to a pattern recognition correlator which, for all practical purposes, can be taken to be the one described in the specification of GB patent application 2317487. The claimant asserts that the rights to a patent for this correlator, or at least certain aspects of it, belong to him because it (or those aspects) were devised by researchers who were employed by the claimant. The patent applicants deny this.

2 The dispute centres around the activities of one of the two patent applicants, Dr Young. In a nutshell, he was working on pattern recognition correlators with the other patent applicant, Professor Chatwin, at Glasgow University. He then took up employment with the claimant at the Defence Evaluation and Research Agency ("DERA") and continued working on such correlators, but left after little over a year and rejoined Professor Chatwin at Glasgow and then, later, Sussex University. The key question is, how much was invented before Dr Young went to DERA and how much was invented by Dr Young whilst at DERA and/or by other DERA staff?

Outline history

3 To set the scene, I will start by describing the history of events in a little more detail. In 1991 Professor Chatwin and Dr Young made a first application for a grant for work on pattern recognition correlators under a scheme known as Brite-Euram. The parties have called this the Brite-Euram A proposal, but its details need not concern us as the correlator that was the subject of this proposal was of a different type to the one in dispute. In April 1992 they submitted a second such grant application, the Brite-Euram B proposal. This correlator was of the same type as the one in dispute, but the proposal did not receive funding and thus was not published at the time. For completeness, I should say that in 1993 they submitted a third application, the Brite-Euram C proposal, but the correlator here was again not of the same type as the one in dispute.

4 In September 1993 Dr Young left Glasgow University and joined a research team at DERA, led by a Professor Lewis, where he continued working in the same general field.

During his time at DERA he made a drawing in his log book of a pattern recognition correlator which is broadly similar to the drawing in the patent specification. He left DERA in November 1994. Both sides argue that everything described in the patent specification had been invented before Dr Young left DERA - the claimant argues it was invented whilst Dr Young was at DERA whilst the defendants argue that they invented it all before Dr Young even went to DERA. The patent application itself, though, was not filed until September 1996, by which time both Dr Young and Professor Chatwin were at Sussex University.

5 Two years later, in September 1998, DERA filed a patent application of their own which I am told (though I have not inspected it) is for the same subject matter. Shortly after that, they filed the present claim, and that in due course led to a hearing before me on 4 October 2000. At the hearing the parties were represented by their patent agents, the claimant by Mr John Lawrence of Barker Bretell and the defendants by Mr Derek Jackson of Derek Jackson Associates.

6 The patent application with which this claim is concerned, GB 2317487, was filed by Professor Chatwin and Dr Young as co-applicants and co-inventors. I have been given little information on Professor Chatwin's involvement because nearly all the evidence relates to what Dr Young did or did not do, but there is no suggestion that he was in any way involved with the work that went on at DERA. However, it seems to be accepted by both sides that he was involved in all developments relevant to this invention that took place while Dr Young was at Glasgow, so I shall assume that he co-entitled with Dr Young to anything that was invented there.

The invention

7 Very often in entitlement disputes, the details of the invention are hardly relevant. This case, though, is an exception, and in order to deal with the issues it is necessary to understand the features of the correlator in question in some detail. The evidence includes some very helpful explanations from Dr Young of the principles and mathematics underlying the various elements of the correlator, but for the purposes of this decision I will try to keep it as simple as possible.

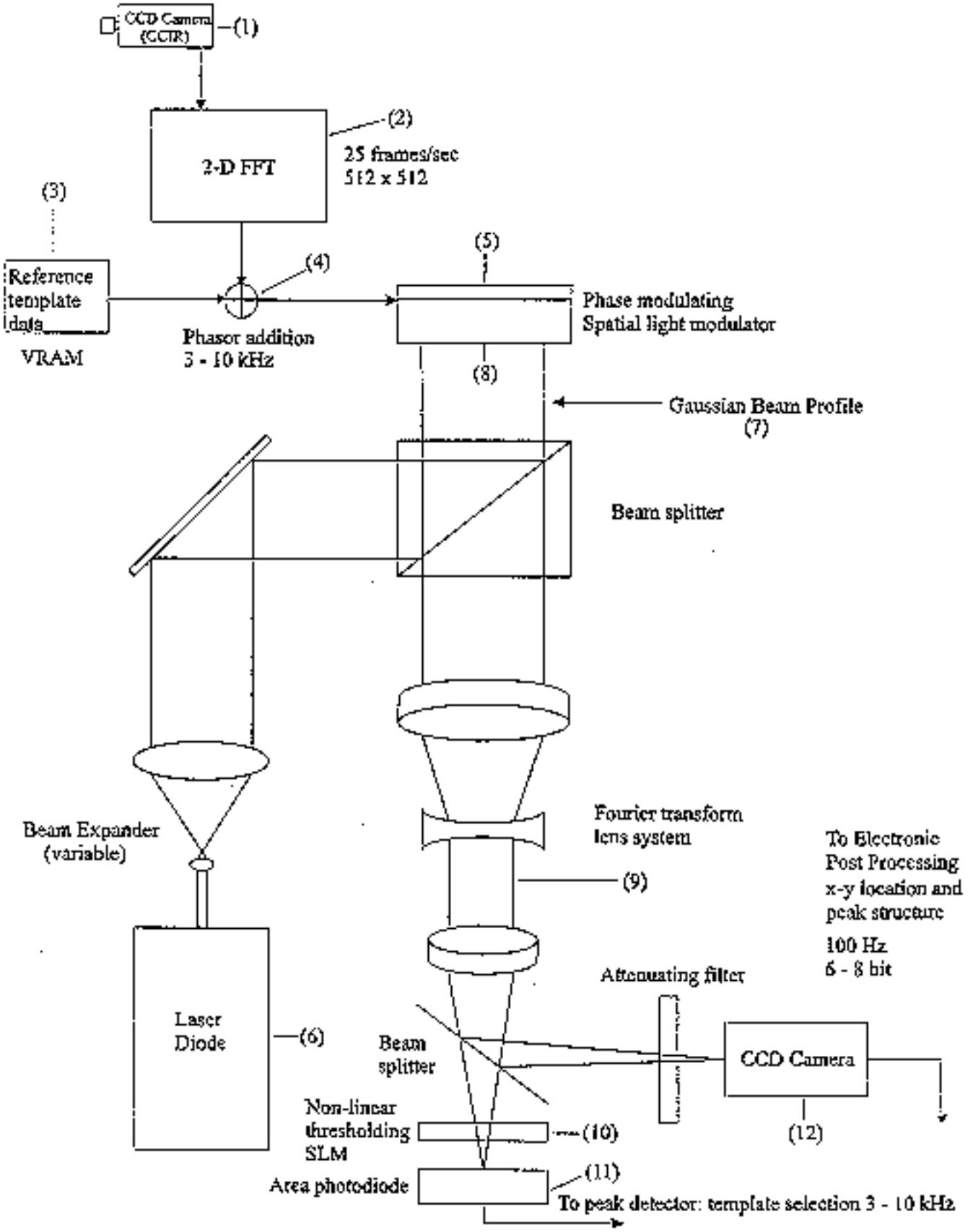
8 The correlator is concerned with the problem of recognising in an image of a scene the presence of a particular, known object. The problem is a relatively straightforward one if it is known that the object will be at a particular position and of a known size and orientation. One simply evaluates a mathematical function known as the "cross correlation" of the scene image and a reference image that includes the object, and if the object is present, a peak will appear in the function. The problem gets rather more complicated if the object can be at any position or of any size or orientation, or indeed if it could be one of a large range of objects. Essentially, one has to evaluate the cross correlation function for a large number of possible reference images. If, as would be usual, the scene is being continuously monitored, these evaluations for all possible reference images have to be repeated every time the scene image is refreshed, which will typically be 25 times a second. That gives just 40 ms to perform all these very-complex evaluations. If there are, say, 100 reference images, that means there is only 400 microseconds for each evaluation.

9 Normally an image will be "pixellated", ie represented by an array of pixels each of which will have a value. Evaluating the cross correlation function of two pixellated images in principle involves a computationally-complex multiplication of the various pixel values. However, there are all sorts of wheezes to make that computation easier - indeed, to make it feasible at all given the speed with which it needs to be performed. One common approach is to take the two-dimensional Fourier transforms of the scene and reference images, multiply the resulting two-dimensional complex spectra and then inverse Fourier transform the result. This computation process is faster and yet, mathematically, gives the same end result. Building on this, one can then make further gains in computational speed by performing the Fourier transformation and two-dimensional multiplication optically, displaying the scene image on a spacial light modulator (SLM) and introducing the references images either holographically or on another SLM. As I understand it, the Brite-Euram A and C proposals related to correlators of this type. Alternatively, one can stay with digital computation but reduce the operation of multiplying the complex numbers that represent the transforms into the much-simpler process of adding moduli and phases -or even just adding the phases if the moduli information can be discarded. There are, not surprisingly, pros and cons for each approach.

10 The correlator that forms the subject of the present patent application is neither digital nor optical, but a hybrid of the two. The first part of the computation is performed digitally and the second part optically. Referring to the drawing (reproduced below), data representing the conjugate Fourier transforms of a plurality of reference images is stored in rapid access memory (3). The pixellated and digitised scene image from a CCD camera (1) is transformed in a two-dimensional Fourier transformer (2) and then combined with the data for each reference image in turn by phase addition at (4). At this stage the system switches from digital to optical, because the resulting two-dimensional array of values is displayed on a first, reflecting, SLM illuminated from a diode (6), and the inverse Fourier transform then takes place in a lens (9).

11 The final part of the operation is to detect whether there is a peak in the resulting two-dimensional correlation function and if so, when and where it occurred. When it occurred identifies which of the reference images caused the peak and thus which of the objects represented by the set of reference images is present in the scene. Where it occurred identifies where the object is in the two-dimensional image. The whether and when are detected by the second SLM and area photodiode (10), (11) at the bottom of the drawing. The SLM may be either transmissive, as shown, or reflective, but either way is a rather special one because each pixel responds in a non-linear manner to the light incident upon it. It may, for example, include a photosensor and non-linear threshold circuit at every pixel whose output modulates the incident light by addressing a liquid crystal layer or a micro-mirror array. Alternatively it may comprise the combination of a non-pixellated photosensitive layer and a ferro-electric crystal layer with an inherently non-linear reflection characteristic. The patent specification also suggests that a saturable absorber could be used. Whatever arrangement is used, if there is a correlation peak above a certain threshold it will get through to the area photodiode (11) and be detected. Where the peak occurred can then be determined with the aid of CCD camera (12).

Figure (1) Hybrid Digital/ Optical Correlator System



12 The success of this system depends on having SLMs with very fast response times. As far as the first SLM is concerned, that depends on how crudely one quantises the phasor addition. The specification suggests this can be between 1 and 5 bit addition, thus giving between 2 and 32 levels of quantisation. An SLM that has to respond to multi-level modulating signals is going to be slower than one that only has to respond to two levels. The specification discusses this problem and the performance of SLMs that have been developed, and explains that effective correlation can in fact be achieved even with just two-level modulation. It calls two level modulation, which requires just one-bit phase addition, "binary", and I shall adopt this term myself. The specification does not, though, restrict itself to binary modulation.

13 I will say very little about the claims of the patent application. They were drafted by the inventors themselves, without professional assistance, and as is clear from the outstanding examination report they would need some work on them to put them into a satisfactory state for grant. Neither party, though, paid much attention to the claims, save to observe that claim 4, which is concerned with the use of the second SLM to detect correlation peaks, is not limited to hybrid correlators but covers all-optical ones too. Apart from this, the parties concentrated on what was described, and I shall do the same.

The law

14 I do not need to say much about the applicable law because its interpretation was not in dispute, nor indeed was the basis on which it should be applied to the present case. For completeness, I shall run through it briefly, though without quoting it in full.

15 Section 7 of the Act tells us who is entitled to the grant of a patent. It goes primarily to the inventor or joint inventors subject to certain exceptions. One of those exceptions is when, by virtue of any enactment or rule of law, someone else was entitled to the whole property in it at the time of the making of the invention. This leads to section 39, which says that an invention made by an employed inventor belongs to the employer if it was made in the course of the employee's duties in circumstances such that an invention might reasonably be expected to result from carrying out those duties. It is not in dispute that those circumstances apply to Dr Young whilst he was employed by DERA, ie that any invention in respect of this correlator made by him during his period at DERA belongs to the claimant.

16 This claim has been brought under sections 8 and 12 of the Act, which give the comptroller the power to hear disputes about entitlement. Section 8 relates to any invention, though usually, as here, the invention will have been the subject of a GB patent application. Section 12 relates specifically to the entitlement to patents abroad or under an international convention. Both sections give the comptroller the power to make such order as she thinks fit to give effect to her determination of the questions referred to her.

17 Neither side drew my attention to any specific case law at the hearing itself, though in his skeleton argument Mr Lawrence did refer to three principles that had been developed by case law. The first, which derives from *Viziball Ltd's application [1988] RPC 213*, is that in an entitlement action, at least when it takes place prior to grant of a patent, one cannot be concerned with whether the alleged invention is, in fact, a patentable one. One has to

look at what the inventor conceives to be his invention. It follows from this that one has to look at everything that is described, not just at what is claimed.

18 The second principle, which derives from *Henry Bros v Magherafelt [1999] RPC 442* and *[1997] RPC 693*, is that where an invention is a particular combination of features, it is not enough to look at where each feature in isolation came from; one has to look at where the idea of putting them together originated. The third, which comes from *3M v Evode BL O/237/00*, is that for certain inventions it is not sufficient to dream up an idealised objective - it is necessary to have a degree of confidence that they are workable and the means to realise them.

19 I accept that all these principles are applicable in the present case, and will keep them in mind as I look at the issues.

20 I must say a word about onus too. The claimant accepts that the onus rests on him, but argues that having (as he contends) shown the whole invention was known to DERA whilst Dr Young was there, the evidential burden shifts to the other side. I do not think the burden shifts so easily. If we accept for the moment that DERA did know about the whole invention at the time, that could mean Dr Young developed the system whilst at DERA, but it is just as consistent with the possibility that he brought the idea with him to DERA. I accept that the fact that the drawing in Dr Young's log book was made more than a year after he had joined DERA gives a little more weight to the claimant's argument, but I doubt whether that in itself is enough to shift the burden. In the event, however, since the defendants have submitted masses of evidence on the pre-DERA period and the claimant has done the same for the DERA period, nothing turns on the question of onus.

The pleadings and evidence

21 The way this case has been prosecuted up to the hearing leaves quite a lot to be desired. One fundamental problem has been the defendant's deep-rooted mistrust of the claimant, and the resulting lack of cooperation between the parties has made it very difficult to narrow down the real issues that need to be resolved. Indeed, at the end of the evidence rounds I was so concerned at the number of facts that still appeared to be in dispute that I told the parties I expected each of them to review their case to consider whether, in the light of all the evidence, there were any matters they could concede with a view to narrowing the issues that needed to be considered at the hearing. That request met with no response, and it was not until the day before the hearing that the two sides managed to agree on any facts.

22 A related problem has been the muddling of evidence and argument. We have arguments not just in the statements of case but throughout much of the evidence, with the result that it is very difficult to be sure one has actually picked up all the arguments that are being made. I must apologise for the fact that at one stage the Office exacerbated the problem by demanding that some lengthy arguments submitted with one of the evidence rounds be refiled as evidence. However, as the arguments grew, sprouting up all over the place, it became ever more difficult to see the wood for the trees.

23 Another fundamental problem has been the inability of either side to focus clearly and concisely on the issues. This is shown most starkly by the defendant's evidence, which is long winded and unbelievably repetitive. It includes no fewer than eleven affidavits from Dr Young, all bearing the same date and together amounting to over 100 closely-typed pages plus numerous exhibits, quite apart from hundreds of pages filed with their statement in reply. However, the claimant is not free of blame either. Whilst his evidence may be less voluminous, his representative presented me with a skeleton argument that was as repetitious as Dr Young's evidence and a colossal 62 pages long. Of course, there will be cases which are so complex that this amount of evidence and argument would be justified, but this is not such a case.

24 In an attempt to cut through this mess, at the beginning of the hearing I told each of the representatives that I expected them to take me through all the arguments they were still maintaining and to draw my attention to the evidence that supported what they were saying. If there are arguments that were put during the course of these proceedings that I have not dealt with, that is because they were not put to me during the hearing.

25 I feel compelled to mention one other factor too. Both sides have at some stage during these proceedings behaved in a way which seems, *prima facie*, reprehensible. In particular, the claimant in support of his statement of case submitted a copy of a document which was apparently falsified insofar as matter potentially damaging to his case was omitted from the copy, an act that may well have been a major factor in destroying any scintilla of trust between the two sides. The defendants do not appear to have entirely clean hands either, having submitted in evidence transcript extracts from a secret tape recording of what were probably without-prejudice discussions, and also made representations to the claimant about the patentability of the subject matter and their motives in filing the patent application which are manifestly unbelievable. Both sides were making an issue of these points until a relatively late stage. However, when it came to the hearing they dropped these matters, so I will say no more about them.

26 There is conflict of evidence on a number of points. Normally the best way to resolve that would be for the relevant witnesses to be cross examined, but there was no cross examination in this case. Perhaps I should be relieved at that, given the obvious difficulty some of the witnesses evidently have in being focussed and concise, but it still leaves me unsure how much weight I can attach to the assertions made in the various affidavits. I certainly have doubts about some of Dr Young's evidence, since it was he who made some of the unbelievable assertions about the filing of the patent specification and as discussed later, he also had to retract assertions about what he learned while at DERA. However, that does not mean I am entirely happy about the evidence of the other witnesses either, because I get the impression there is a fair amount of rationalising after the event. Because of this, I have decided that I can attach relatively little weight to assertions made in the affidavits. Instead I have relied primarily, for evidence of what happened, on the contemporary documents that have been exhibited to the affidavits.

The issues

27 As I have said, the two sides agree that if any developments took place while Dr Young was at DERA, the rights in those developments belong to the claimant by virtue of section

39. Neither side is arguing there were any developments relevant to the matters I have to decide after Dr Young left DERA, so this means that the central question is whether the whole correlator described in the patent application was invented by Dr Young and Professor Chatwin before Dr Young went to DERA. If yes, everything belongs to them. If no, the contribution that was made at DERA belongs to the claimant.

28 The claimant also conceded that the basic concept of a hybrid digital/optical pattern recognition correlator was disclosed in the Brite-Euram B proposal and was thus definitely "pre-DERA". However, there are two features of the hybrid system as described in the patent specification which, he maintains, were not in the Brite-Euram B proposal and were a DERA contribution. These features are:

(a) The use of binary rather than multi-level phase addition for combining the reference and scene data, and correspondingly, the use of a binary first SLM. The parties referred to this as "binary plus binary", and I shall do the same.

(b) The use for the second SLM of one which is pixellated, with detectors and circuitry at each pixel, the circuitry controlling the transmissivity (or reflectivity, as the case may be) of the pixel depending on whether the light incident on the pixel is above or below a threshold. The parties referred to this as a "smart SLM", and again, I shall adopt their terminology.

29 At the hearing, the defendants accepted in relation to feature (a) that Dr Young did not invent the particular high-speed binary SLM being used by DERA, but as the full details of this SLM are not described in the patent specification, this concession will have little bearing on my decision. On feature (b), they conceded that DERA knew about smart SLMs before Dr Young joined them. They also conceded that the drawing he made in his log book whilst at DERA differs from that described in the Brite-Euram B proposal.

30 In the rest of this decision I shall look carefully at these two features in turn. However, before doing that I need to clear up a few other issues that had been live until right up to the hearing. Firstly, the defendants have now assured DERA there are no equivalent overseas or international applications, so I am not being asked to make any order under section 12 in respect of any specific such application. Secondly, the claimant had at very least sought the right to a licence under any GB patent on the grounds that Dr Young had worked with them to develop these correlators for over a year without ever giving any hint that he claimed proprietary rights in them. The defendants have now given an undertaking that they will not be pursuing the GB application, so I am no longer being asked to make any order in respect of a licence. Thirdly, the claimants had sought a declaration that the patent specification does not disclose the use of an exclusive OR gate, but that issue too has gone away.

The use of "binary plus binary"

31 I now turn to the first substantive issue, whether or not the "binary plus binary" feature was pre or post DERA. The use of binary plus binary is actually mentioned in the Brite-Euram B proposal, but in a somewhat dismissive way. The claimants say this is because

the defendants had not at that stage realised quantisation as crude as this would work. The defendants say they were well aware it would work, but preferred to use multi-level phase addition and modulation because it would give higher quality results.

32 Both sides took me through various key passages in the proposal, but they put different glosses on them. I will look at them in turn, starting with a passage on page 6 of the proposal discussing the then state of the art, which says:

> "Alternatively, the reference function Fourier transforms may be input to the optical system using a phase modulating spatial light modulator. This approach has been limited in the past by the binary phase modulating capability of the available SLMs."

There is another passage expanding on this a little on page 16:

> "Only binary phase modulation is possible since as the smectic C phase is employed the liquid crystal orientation can only switchable *(sic)* between two states. Such a device has been demonstrated in an optical correlator with satisfactory results. However, the coarse phase quantisation leads to an inevitable degradation of performance and only relatively simple pattern recognition tasks have been demonstrated with binary input imagery."

33 Whilst these passages show the defendants were aware of binary SLMs and the fact that they could be used in pattern recognition correlators, this is in the context of an optical system. I do not think they can be read as implying they had realised such SLMs would also be satisfactory in the hybrid system which their proposal was contemplating. This comes down to the *Henry Bros v Magherafelt* principle - it is not enough to show the individual elements of the invention were known; one has to look at who thought of incorporating them in the system in question. The way in which optical, digital and hybrid correlators work, and the constraints on the performance of the system elements, are so different that one cannot automatically assume features that are satisfactory in one will also be satisfactory in another, so I am satisfied this passage cannot be taken as evidence that they had realised binary plus binary was worth contemplating for a hybrid system.

34 This conclusion is reinforced by a passage on page 7 that follows the one just quoted on page 6. Having referred to the slow response of existing multi-level nematic crystal devices, it goes on to talk about recent SLM developments and says:

> "Of particular importance has been the fabrication of high resolution silicon active backplanes addressing a rapid response (100μsec) chiral smectic C ferroelectric liquid crystal layer permitting a binary phase modulation. However, the electroclinic effect in the chiral smectic A mesophase allows the multi-level phase modulation of a coherent beam at a multi-kHz frame rate and so will be used . . . in the proposed project. . . . Much of the published research has concentrated on filter realisations implementable with the very limited levels of phase quantisation possible with widely available SLMs. The much higher levels of phase quantisation possible with smectic A based devices will allow the implementation of more deeply multiplexed filters and so exploitation of the theoretical development work that has been done in this area over the last ten years."

There is no implication in this passage that the defendants considered binary modulation would work in their system. On the contrary, the clear implication is that they felt they needed a fast, multi-level SLM.

35 This is itself reinforced by a number of other passages in the Brite-Euram B proposal. On page 10 they say that until a fast multi-level SLM is available they will work with a slow multi-level one - not, it will be noted, with a fast binary one even though these were already available. On page 18 they discuss the processor board that will be needed to perform the "complex to complex 16 bit" fast Fourier transformation of the image signal - no suggestion here that they may only need a binary output. Finally, there is a reference on page 15 to research needed in order to determine "the phase quantisation required to obtain high quality correlation responses", implying they were looking for multi-level but hadn't finally decided how many levels. Mr Lawrence also invited me to interpret references to complex signals on pages 7 and 14 as also implying multi-level signals, but I have to say I am not convinced these particular references could not also be construed as embracing binary signals.

36 It is also noteworthy that the defendants were aware of the need to develop a system that was fast. This is brought out on page 3 (in a reference to a possible application in the automotive industry) and page 8 (in a discussion of how to enhance speed). Despite this, they did not suggest going for binary plus binary, which would have enhanced speed very significantly. They asserted that this was because the main constraint on speed was the second SLM, but this assertion does not sit well with their own evidence. All the emphasis in the Brite-Euram B proposal is on the speed of the first SLM, and in a letter at the time from Dr Young to a Dr Collins at the University of Neuchâtel (exhibit 2 to his affidavit RY1), Dr Young says that:

> "Essentially the only component preventing practical realisation of the high speed correlator is the speed of response of the presently available linear nematic based SLMs".

There is a comment in one of Dr Young's many affidavits (RY1, page 2) that suggests he may later have realised the output camera (not, though, the second SLM) could have become a constraint on speed, but there is nothing to suggest he realised that when he was drawing up the proposal. Certainly I do not accept Mr Jackson's submission that the presence in the proposal of the sentence "Read-out is accomplished with a rapid frame-rate (500 frames/sec) CCD array" shows they had recognised the speed of the correlation peak detector was the main constraint.

37 The defendants say the Brite-Euram B proposal shows they were well aware binary plus binary would work in their proposed hybrid system but that they preferred to go for multi-level modulation because it would be better. Having reviewed the proposal carefully, I disagree. If I only had this proposal to go on, for the reasons I have discussed above I would conclude that they had not appreciated binary plus binary was a real possibility.

38 However, the Brite-Euram B proposal is not the only document I have. In particular, there are three other documents that were created during the preparation of that proposal which paint a somewhat different picture. The first is an undated letter from Dr Young to a Dr Bagshaw at the GEC-Marconi Research Centre (exhibit 1 to his affidavit RY2). He says

he is trying to gather together a consortium for a follow-on Brite-Euram programme to develop a hybrid digital/optical correlator - which can only be a reference to Brite-Euram B - and asks whether GEC would be interested in developing a suitable phase modulating SLM. In the attached specification he says:

> "Phase modulation: 4 bits maximum. However, 1 bit would still allow operation although with reduced S/N ratio."

39 The second document is the letter to Dr Collins to which I have already referred, which again was clearly written in the context of the preparation of the Brite-Euram B proposal for a hybrid correlator. In it Dr Young says:

> "I think the best option for the Brite programme would be to build the correlator with either a linear nematic SLM and emphasise to the EC to *(sic)* potential for considerable speed increase using the smectic A or if GEC Chelmsford are interested to use a binary phase modulating smectic C device."

40 These two documents seem to me to be a clear indication that, whatever he may have felt when he actually wrote the Brite-Euram B proposal, at this stage Dr Young recognised binary plus binary would work in his hybrid correlator and was prepared to contemplate using it if nothing better was available. They are reinforced by the third document (exhibit 4 to the same affidavit), which is a letter dated 26 March 1992 from a Professor Johnson at the University of Colorado to Professor Chatwin, following up a telephone conversation, quoting him a price for a binary switching SLM. Again I am satisfied from the evidence that this quote was made in the context of the proposed hybrid system, albeit just after the Brite-Euram B proposal had been formally submitted. If Professor Chatwin had not told her previously that a binary SLM would do, I am sure she would not have offered it.

41 Mr Lawrence tried to dismiss all three documents as irrelevant and/or merely confirming the line taken in the Brite-Euram B proposal itself, viz that multi-level is best and binary is no good. I disagree with him, because they clearly go further than this. He also alluded in a rather unclear manner to the possibility that some of these documents may have been implicitly confidential. That seems unlikely, but even if it were true I cannot see how that affects what they tell us about the options that were in the defendants' minds at the time.

42 Mr Lawrence also tried to suggest that statements made by the defendants in a paper published (along with other co-authors) in 1999 (attachment A to affidavit BSL2) implied the defendants had not thought of using binary plus binary before Dr Young went to DERA. I do not think the statements imply that at all. I can find nothing in them that is inconsistent with what I have concluded above.

43 In short, then, whilst the evidence strongly suggests that by the time the defendants submitted the Brite-Euram B proposal they had discarded the possibility of using binary plus binary, I am quite satisfied that prior to this they had recognised it was a real option in the context of a hybrid system and that they had been prepared to use it if "better" (ie multi-bit) hardware could not be obtained. I must emphasise that this is not just a question of the defendants recognising with hindsight that binary plus binary was an alternative, nor of them dismissing it as soon as it had crossed their minds because they did not think it

would work. It was at least for a while, a real option in their minds. Thus the first limb of the claimant's case falls.

44 It may well be that, having discarded binary plus binary in the Brite-Euram B proposal, it needed Dr Young's move to DERA to revive the possibility in his mind. In my view, though, that does not entitle the claimant to rights in the idea, because it had already been conceived by the defendants at an earlier stage.

The use of a "smart" SLM

45 I will now move on to the second substantive issue. As the defendants accept, the use of a smart SLM is not disclosed in the Brite-Euram B proposal. Indeed, all the emphasis in this proposal is on the earlier parts of the system and it says very little about the detection of correlation peaks. The diagram in the proposal simply shows a "rapid CCD" to detect the correlation peaks, and the text has hardly anything more - just one sentence saying:

> "A rapid frame rate CCD array is then used to download the correlation plane signal for peak height and location measurement."

This clearly suggests that the defendants were not considering using a smart SLM - or, for that matter, <u>any</u> SLM - to detect correlation peaks.

46 The defendants assert that nevertheless they were well aware of smart SLMs before Dr Young went to DERA and that they already had the idea of using them in the hybrid pattern recognition correlator. The claimant say this is not true. He claims DERA were developing a smart SLM before Dr Young came to them and that it was while he was working at DERA that the idea of using it in the hybrid correlator arose.

47 I will start by looking at the evidence of what went on at DERA. The defendants accept that DERA were developing a smart SLM before Dr Young arrived, and indeed there is clear evidence of this in an "invention note" written by Professor Lewis in May 1992 (exhibit H to Dr Wilson's affidavit RAW3). However, at that stage the only application envisaged was as a dazzle protection device. In other words, instead of passing light peaks above a threshold, it did the inverse and blocked them so as to prevent damage to whatever followed the SLM from bright spots. It is also clear from an additional note dated March 1993 that they were still developing the device a year later, though still only envisaging its use for dazzle protection.

48 In June 1993 - and this is before Dr Young joined DERA - a second additional note discusses the idea of using the smart SLM as a peak detector in a pattern recognition correlator. As the note explained, this of course required the SLM to pass light peaks rather than block them. The body of the note discusses all this in the context of a specific optical correlator being developed by Professor Lewis, but a manuscript comment on the drawing in the note specifically says that the optical signal supplied to the SLM could come from "more-or-less any other optical matched filter/correlator structure producing correlation peaks in the plane of the smart SLM".

49 There is a third additional note dated January 1994. Its contents need not concern us, but

its existence and date shows that the smart SLM was still being actively developed by Professor Lewis and his team after Dr Young had joined DERA.

50 I am satisfied from these notes that DERA were not only developing a smart SLM before Dr Young joined them but had recognised it could be used in any pattern recognition correlator whose output stage required detection of peaks in a two-dimensional optical beam. When Dr Young joined DERA he was working in the very team (ie Professor Lewis's team) that was developing the smart SLM, even if Dr Young himself was not involved in that development. This strongly suggests that the idea of incorporating a smart SLM in the hybrid correlator that Dr Young worked on whilst at DERA either came to him while he was working at DERA or was given to him by his research colleagues at DERA, particularly since this was not mentioned in the Brite-Euram B proposal. Either way, that means the idea must have originated from a DERA employee or employees who, since they were being employed to do research, was or were employed in a capacity to which section 39(1)(a) must clearly apply.

51 I should perhaps say that at one stage Dr Young denied that he was given any knowledge of the DERA smart SLM whilst he was there. In the light of a bid for funding development of the smart SLM for use in pattern recognition correlators which was found on his own files at DERA and which specifically names him as one of the four staff who was to undertake the development (exhibit 2 to Dr Wilson's affidavit RAW1), Dr Young conceded that he did know about it. I find this apparent lapse of memory on such an important point surprising, and it does not enhance Dr Young's credibility as a witness.

52 Notwithstanding the above evidence, and as I have said above, the defendants assert that the idea of using a smart SLM in the hybrid correlator had already occurred to them before Dr Young went to DERA. That possibility could be compatible with the above, so I must now look at the evidence which, the defendants say, supports it.

53 The first is a paper written by the defendants and a Professor Scott, also from Glasgow, and published in the journal Optical Engineering in October 1993, before Dr Young joined DERA (exhibit 3 to Dr Young's affidavit RY1). This discusses what it calls a hybrid optical/digital pattern recognition correlator, although I note that it is not the type of hybrid that we are now concerned with as the combining of the reference and scene data takes place optically, not digitally. In the section on detecting the correlation peaks it suggests that what is really needed is a non-linear thresholding photodetector but then says:

> "However, the authors herein are not aware that any such device yet exists that responds in this way."

54 As the authors freely acknowledge in this paper, the recognition that this is what is ideally needed came from an earlier Applied Optics paper (exhibit 1 to the same affidavit). However, neither of these papers contemplates using an SLM as distinct from a mere detector array, so even if one ignores the fact that they were concerned with a different type of correlator system, they do not show the defendants had thought of the idea of using an SLM, let alone a smart one. Indeed, they suggest the defendants were unable to contemplate using any sort of pixel-level thresholding arrangement because, so far as they knew, none had been developed.

55 The defendants also rely on two other papers published in 1993 (exhibits 4 and 6) in Optical Pattern Recognition and Applied Optics, but these are both in the context of optical correlators and again rely on threshold detectors, not SLMs. Two further papers with common authorship (exhibits 7 and 8), one from 1992 in Optics Letters and the other from 1993 in Applied Optics, do indeed discuss a form of "smart" SLM. However, these are not the same as the smart SLMs with which we are concerned because they are what is called "winner takes all" - ie they let through just the highest peak, not every peak above a threshold. Moreover, the later paper is not concerned with correlators at all, whilst the earlier one only mentions optical correlators.

56 There is one last paper from Optics Letters in 1991 (exhibit 9). This does indeed disclose a smart SLM which has thresholding at every pixel, although the only application considered is optoelectronic computing. However, it differs from DERA's smart SLM in that the varying light levels to be detected were created by casting a shadow on the SLM from a separate light source, and that does not seem a very practical approach for detecting correlation peaks. Of course, I recognise that what was being described was merely an experimental set up and that may be why the shadow technique was used, but there is nothing in the paper to suggest what alternative techniques might be used in practice.

57 In my view none of these papers provide any evidence that the defendants thought of using a smart SLM in their hybrid pattern recognition correlator. For a start, apart from the 1991 Optics Letters paper, none of them even disclose a smart SLM, and even with the one in the 1991 paper, it is not very apparent how it could be used in a correlator. Further - although I will, as Mr Jackson urged me to, concede this carries slightly less weight because the problem of correlation peak detection is essentially the same in both an optical and a hybrid correlator - none of them disclose application to the type of hybrid correlator with which we are concerned.

58 As Mr Lawrence pointed out, though, there is an even more important point. The patent specification in issue is written rather like a technical paper and concludes with a list of no fewer than 36 references to papers in learned journals. Not one of the above papers is included in that list. If these are the papers that gave the defendants the idea of using a smart SLM in their hybrid correlator, I do not find it credible that all of them came to be omitted from the list when so many other papers are quoted. It seems much more likely that these papers have been dredged up after these proceedings were launched, to bolster the defendants' case. Indeed, as Mr Lawrence pointed out, in the relevant affidavit Dr Young does not even state expressly he read exhibits 7 and 8 at the time. All he says is that he came back from a conference in April 1993 and read a number of papers in Applied Optics, carefully avoiding, so it seems to me, saying that he actually read these specific papers at that time. Even if I am being too hard on him in interpreting his words, as I indicated earlier, I do not feel I can rely on such assertions in the face of more convincing evidence to the contrary.

59 As for exhibit 9, Dr Young does state that once he had located this paper (and I take that to mean once he had found it while researching documents that might be useful in these proceedings), he did remember seeing it before, in March 1992. All I can say is that the paper must have made precious little impression on him, because I cannot believe he would have put his name to the statement quoted above in the October 1993 issue of Optical Engineering if he had recognised at the time that this was the device he needed for

his Brite-Euram B hybrid correlator.

60 Following on from this, I will go one step further and say that, on the evidence, I am satisfied the defendants had not contemplated using any SLM, not just a smart one, for correlation peak detection before Dr Young joined DERA.

61 In conclusion, the weight of evidence points strongly to the idea of using an SLM to detect correlation peaks in the hybrid correlator emerging during Dr Young's period at DERA, not before this. It follows that this idea belongs to DERA, not the defendants.

62 There was some discussion of exactly what the DERA smart SLM involved. From the invention notes and the bid for funding development of the SLM, I am satisfied it included non-linear thresholding circuitry on each pixel addressing a liquid crystal layer, and that it contemplates various types of detector, including photoconductors, photodiodes, phototransistors and CCDs. I have no obvious evidence that it contemplated using micro mirrors, which is one of the alternatives mentioned in the patent specification. The specification also mentions the possibility of using saturable absorbers. It is not clear to me quite how these would work, but the parties confirmed at the hearing that this option is not an issue in dispute between them, so I will say no more about it.

Conclusion and relief

63 I have found that, as between the claimant and the defendants, patent rights in the idea of using binary plus binary in the type of hybrid correlator with which the patent specification is concerned belongs to the defendants, but rights in the idea of using a smart SLM - or indeed, any SLM - to detect correlation peaks belongs to the claimant. I must now consider what specific order would be appropriate as a result of those findings.

64 The relief sought by the parties was never set out in their statements of case, but has appeared in the correspondence at various stages during these proceedings. Both sides also included statements of relief sought in their skeleton arguments, but so far as the claimant is concerned, even that was not the final word because concessions made by the other side after the skeleton had been written made some of the relief unnecessary. Because of the confusion, at the end of the hearing I asked each side to clarify the relief it now sought. However, I also said that if my decision did not go wholly in favour of one side or the other, I would probably allow the parties an opportunity to make submissions on what order I ought to make.

65 I have decided that the best approach is for me to go through the relief sought by each side now and say which parts of it I would grant and which I would not grant in the light of my findings. I will then allow the parties time to make submissions on what my final order should be. Whilst the parties have shown very little sign of cooperating so far until immediately before the hearing, I very much hope their representatives will be able to agree the form of an order between them because, quite frankly, an agreed order will be much more satisfactory for both sides than an order drawn up and imposed by me. However, if they cannot agree, I will prepare what I consider an appropriate order myself.

66 The first item in the relief sought by the claimant is a ruling that:

> "Dr Young was not aware prior to his employment by DERA that, combining the binarised FT *(ie Fourier transform)* of a scene pattern with the binarised FT of a reference pattern digitally displaying the combined pattern on a binary spatial light modulator in a hybrid binary/digital modulator described in claim 1 of UK Patent application 2317487 was a practical possibility and accordingly this invention is owned by DERA."

This is effectively the binary plus binary point, and since I have found against the claimant on this, I am not prepared to include anything along these lines in the order.

67 The second item sought by the claimant is a ruling that:

> "Dr Young was not aware prior to his employment by DERA that a spatial light modulator of a pixellated type in which each pixel has a photodetector, [non-linear thresholding] circuitry and a liquid crystal layer could be used in the hybrid binary/digital modulator as described in claim 1 of UK Patent Application 2317487, as a thresholding SLM to transmit or reflect light that encounters individual pixels if the intensity of the light is above a threshold, but became so aware during his employment by DERA and accordingly this invention is owned by DERA."

The words in square brackets are an optional addition. Because of my finding that the defendants had not contemplated using an SLM as the correlation peak detector before Dr Young went to DERA, I am prepared to include this or something along these lines, either with or without the words in brackets.

68 The third item sought is a ruling that:

> "The disclosure in line 8 of page 3 of UK Patent Application 2317187 that 1 bit of phase modulation can be used effectively in pattern recognition applications of a hybrid digital/optical correlator as described in claim 1 of that patent application was in breach of a duty of confidence owned by Dr Young to DERA as his former employee."

The claimant wants this ruling because they are worried that the publication of this patent specification may cast doubt on the validity of their own patent application, made after publication of the defendants' application. However, I see three problems. Firstly, I have found that the defendants had the idea of "binary plus binary" before Dr Young went to DERA. Secondly, this is an entitlement dispute, not an enquiry into breach of confidence or into the validity of another patent application. I cannot see that I have the *vires* to make this sort of ruling under section 8 or 12 because it has nothing to do with ownership of, or rights under, the patent application in dispute. Thirdly, even if I had the *vires* I would need to have been addressed by the parties on the law in relation to breach of confidence, and I was not.

69 The claimant also wants a similar "breach of confidence" ruling in respect of the use of a smart SLM. Whilst the first of the three problems I have just recited in respect of "binary plus binary" does not apply to this, the other two do. I am therefore minded not to make either of the rulings sought. However, if the claimant wishes to press for them,

I am willing to hear arguments about the *vires* and the law on breach of confidence. I will decide how to handle any such arguments when I know whether the claimant wishes to pursue this point, but it may well require a further hearing.

70 The claimant also wants a ruling that:

> "Dr Young was not aware prior to his employment by DERA of the invention that is the combination of features (i) binary FFT of scene combined with binary FFT of reference combined and inverse Fourier transformed; and (ii) pixellated thresholding SLM prior to detector, with each pixel having a sensor and control circuitry to control the optical transmissivity or reflectivity of the pixel, as part of the pattern recognition correlator, and accordingly that this invention is owned by DERA."

Whilst my finding that the idea of using a smart SLM in the hybrid correlator belongs to the claimant suggests I should be willing in principle to make a ruling along these lines, I have to say I do not find the suggested wording very satisfactory. The type of correlator is not explained properly, the double use of the word "combined" under (i) is unclear and the reference to "thresholding" under (ii) too cryptic to be meaningful. If the claimant does want a ruling like this, he will need to come up with a better way of expressing it.

71 Finally, the claimant also wants an order:

> "The Comptroller is requested to order Dr Young and, if necessary, Professor Chatwin to sign any forms (for example Powers of Attorney, Declarations and Oaths, Assignment Forms) necessary for the prosecution, maintenance and transfer to the ownership of DERA of any invention that the Comptroller finds belongs wholly or in part to DERA, including such forms for overseas applications."

I think this is in part tied up with what the parties now want to do about patent application 2317487, which includes some features that I have found belong to the defendants and some that belong to the claimant. The parties need to think about this, and come back with a draft order that reflects the findings I have made and their intentions in respect of this, and any other, patent application.

72 So far I have looked only at the relief sought by the claimant. However, I can dispose of the relief sought by the defendants very briefly, because it is much simpler and shorter. First, they want a ruling that none of the subject matter disclosed in UK Patent Application 2317487 is owned by DERA. In the light of my findings, clearly I cannot make that ruling. Secondly, they ask for a ruling that Dr Young has committed no breach of confidence owed by him to DERA. That stands or falls with the corresponding relief sought by the claimant, so it is an issue on which I need further submissions if the parties wish to pursue it.

73 So where does that leave us? I have made certain findings on where entitlement to the patent rights in various aspects of the subject matter in question belong, and indicated the extent to which I would be willing to include in my order relief along the lines sought by the parties. However, the outcome on the substantive issues is one for which neither party argued, and I am sure they will want to reflect on just what order they now wish to seek from me. Accordingly, I allow both sides six weeks in which to propose what my final

order should contain. As I indicated earlier, now that the substantive issue of who owns what is resolved, I very much hope that their legal representatives will be able to reach agreement on this. Should they fail to do so, however, they should copy their submissions to the other side at the same time as they send them to the comptroller, and I will then decide how to proceed from there.

74 The parties should also, within the same time, tell me whether they wish to pursue the issue of breach of confidence. If they do, I will then decide how to take that matter forward, though it would be helpful if they could make written submissions on the question of *vires* at the time of responding.

Costs and appeal

75 At the hearing I agreed that I would not make any order as to costs until the parties had had an opportunity to make submissions on the matter in the light of my findings. Accordingly, both sides should make their submissions on this question within the same six week period.

76 This decision is, of course, subject to appeal to the High Court. As it does not relate to maters of procedure, under the relevant High Court Practice Direction the appeal period is six weeks.

77 I am aware that the appeal period is the same as the period I have set for submissions on the form of order. Normally I might have set a slightly longer period for the latter so that both sides would know whether there was going to be an appeal before they spent time sorting out the form of order. However, I am conscious of the fact that the normal period prescribed under rule 34 of the Patents Rules 1995 in respect of the patent application in issue will expire next month, and whilst I do not know at this stage whether either side will wish to pursue that application or any parts of it, in case they do I feel it would be unwise to allow more than six weeks for the submissions. Indeed, ideally I would have allowed less than this, but that would not have sat well with a six week appeal period.

78 Finally, I must apologise for the delay in issuing this decision, which was caused by my having to attend to other duties.

Dated this 12th day of February 2001

P HAYWARD

Divisional Director, acting for the comptroller

THE PATENT OFFICE