Neutral Citation Number: [2015] EWCA Civ 607

Case No: A3/2014/0284

IN THE COURT OF APPEAL (CIVIL DIVISION)
ON APPEAL FROM THE HIGH COURT OF JUSTICE
CHANCERY DIVISION (PATENTS COURT)
The Hon Mr Justice Birss
[2013] EWHC 3955 (Pat)

Royal Courts of Justice
Strand, London, WC2A 2LL

Date: 24/06/2015

Before:
LORD JUSTICE KITCHIN
LORD JUSTICE BRIGGS
and
LORD JUSTICE CHRISTOPHER CLARKE

- -

Between:

Smith & Nephew plc	**Respondent /Appellant**
- and -	
ConvaTec Technologies Inc	**Appellant**
-and-	
(1) T J Smith & Nephew Ltd	**Third**
(2) Smith & Nephew Medical Ltd	**Parties**

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Piers Acland QC and Thomas Alkin (instructed by Bird & Bird LLP)
appeared on behalf of the Appellant
James Mellor QC and Charlotte May QC (instructed by Bristows LLP)
appeared on behalf of the Respondent/Appellant and Third Parties

Hearing dates: 16/17 April 2015

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Approved Judgment

Lord Justice Kitchin:

Introduction

1. This appeal concerns the scope of a patent claim which contains a numerical range. It forms the next stage of a long running dispute between the claimant and third parties (together, "Smith & Nephew"), on the one hand, and the defendant ("ConvaTec"), on the other.

2. ConvaTec is the owner of European Patent (UK) No 1,343,510 ("the Patent") which is concerned with a process for the silverisation of gel-forming fibres used in wound dressings. Silver is a known antimicrobial agent but a problem with silver-containing materials is that they are often sensitive to light and discolour on exposure to it for any length of time. The patented invention is said to solve this problem by providing a method of making light stabilised silverised antimicrobial materials. In broad terms, the method comprises three steps. The first involves preparing a solution comprising an organic solvent and a source of silver. The second involves subjecting gel-forming fibres containing particular polymers to the silver solution. The third (which may be carried out during or after the second) involves subjecting the gel-forming fibres to an agent, such as a chloride salt, which facilitates the binding of the silver to the polymers. Importantly, the relevant patent claim says that the agent must be present in a concentration of "between 1% and 25% of the total volume of treatment". It is the meaning of this phrase which has given rise to these proceedings.

3. In earlier proceedings between the parties, Smith & Nephew sought an order for revocation of the Patent so as to clear the path for a new range of silverised gel-forming wound dressings which they wished to sell under the brand name Durafiber Ag. Those proceedings came on for trial before Birss J. He allowed an amendment of the Patent and rejected the claim for revocation ([2012] EWHC 1602 (Pat), [2013] RPC 8), and his decision was subsequently upheld by this court on appeal ([2012] EWCA Civ 1638, [2013] RPC 9). This outcome was, as Birss J observed, a blow to Smith & Nephew because they had by this time developed a process for making Durafiber Ag and had obtained a CE mark regulatory approval to sell products made in accordance with that process in the European Union, and they were now at risk that it might be found to infringe the Patent.

4. Smith & Nephew responded to this set-back by developing a new process ("the Modified Process") which they thought would not infringe the Patent. This process comprises the steps of the patented method save that the concentration of binding agent is no more than 0.77%, and in January 2013 they began these proceedings for a declaration of non-infringement.

5. ConvaTec counterclaimed that the Modified Process did infringe the Patent, and that so too did an earlier process Smith & Nephew had used in various experiments carried out by way of process development. This further allegation, arising as it did from the use of the earlier process ("the Original Process"), was said to be a serious matter because the data generated from carrying that process out were relied upon by Smith & Nephew in support of their application for marketing approval. ConvaTec originally complained about over 80 different experiments but, at the end of the day, only four remained in issue and the concentration of binding agent used in them ranged from 0.93% to 0.97%, depending on how it was calculated.

6. The trial came on before Birss J in November 2013 and in his judgment given on 12 December 2013 ([2013] EWHC 3955 (Pat)) he held that the Modified Process did not infringe the Patent but that the Original Process did. In order to understand the issues arising on the appeal, I must explain in outline how he arrived at these conclusions.

7. The judge began by construing the patent claim. The critical phrase to which I have referred gave rise to two issues, namely the numerical boundaries of the claim and the meaning of the words "total volume of treatment".

8. On the numerical boundaries issue, ConvaTec contended that the expression "between 1% and 25%" did not define precise values but would be seen in terms of whole numbers and so, applying the basic rounding convention, the claim encompassed all concentrations greater than or equal to 0.5% and less than 25.5%. By contrast, Smith & Nephew's primary contention was that the expression meant what it said and that it defined a range of concentrations, with a lower limit of precisely 1% and an upper limit of precisely 25%. But Smith & Nephew also had a fall back position, namely that the 1% and 25% limits would be read in terms of significant figures, and that 0.95% and above would be understood to round up to 1%, and that 25.49% and below would be understood to round down to 25%, and so the claim encompassed all concentrations greater than or equal to 0.95% and less than 25.5%.

9. The judge rejected ConvaTec's contention that the lower limit of the claim was 0.5%, and he also rejected Smith & Nephew's primary contention that its lower limit was precisely 1%. He concluded that the skilled person would look at the limits in terms of significant figures and that the claim therefore included concentrations greater than or equal to 0.95% and less than 25.5%. This conclusion has been heavily criticised by both ConvaTec and Smith & Nephew on this appeal, as I shall explain.

10. The dispute about the meaning of the words "total volume of treatment" arose because, as was common ground, the process of the invention may be carried out in two different ways. The first, referred to as "the during process", involves exposing the material to the silver solution and the binding agent sequentially in the same vessel. The total volume of treatment is then the volume of silver solution and the volume of binding agent solution added together. The second, referred to as "the after process", involves exposing the material to the silver solution first, and then to the binding agent solution. The material may, for example, be removed from one vessel containing the silver solution and transferred to another vessel containing the binding agent solution, or the silver solution may be drained away before the binding agent solution is added. But in either case, the nature of the material is such that a good deal of the silver solution is likely to be carried over from the one stage to the other. The question for the judge was whether this residual silver solution, referred to as "carryover", forms part of the "total volume of treatment". He held that it does, despite the fact that determination of the volume of carryover may prove difficult, as it did in this case. Neither side has appealed against this conclusion.

11. The judge then came to the issue of infringement. It followed from his findings on construction that the Modified Process, using as it does a concentration of binding agent of no more than 0.77%, does not infringe. The volume of carryover could not make a difference to this conclusion and the judge so held.

12. The Original Process, as used in the four experiments which remained in issue, was not so straightforward. Without taking into account carryover, the concentration of binding agent certainly fell within the Patent claim for it was in all cases in excess of 1%. But once carryover was taken into account it fell much closer to the lower boundary line. In Smith & Nephew's process description, the concentration was said to vary from 0.96-0.97%. These figures were derived by considering the theoretical absorbency of lyocell, one of the kinds of fibre found in the material, and so, on the judge's construction, each of the experiments infringed. But at trial Smith & Nephew contended that a more accurate assessment of carryover could be derived from measuring the volume of liquid contained in the fibre material at the end of the process. This method, referred to as the empirical method, yielded a higher value for carryover than the theoretical method and hence a lower concentration of binding agent. Indeed for each of the four experiments in issue, the empirical method yielded a concentration of binding agent of 0.93-0.94%, that is to say below the lower boundary of the claim as the judge had construed it.

13. The judge heard a good deal of evidence on this issue but concluded that the figures based upon the empirical method were not dependable and that he could not be sure that they were sufficiently conservative for him to disregard any uncertainties inherent in them. He held that the only reliable figures before him were those contained in Smith & Nephew's product and process description and so the four experiments did infringe the Patent. Upon this appeal Smith & Nephew contend that this conclusion was contrary to the evidence.

14. These appeals therefore gave rise to two principal issues:

    i) the correct construction of the phrase "the agent being present in a concentration of between 1% and 25%". As I have mentioned, both sides have mounted a spirited attack on the judge's conclusion. ConvaTec contends that he ought to have found that it encompasses all concentrations greater than or equal to 0.5% and less than 25.5%. Smith & Nephew contend that he ought to have found that it encompasses all concentrations greater than or equal to precisely 1% and less than or equal to precisely 25%. However, and despite their assault on the judge's reasoning, Smith & Nephew's fall back position is, once again, that the judge's conclusion was correct. This would obviously be a more palatable result for them than the interpretation for which ConvaTec contends;

    ii) whether the judge fell into error in rejecting the empirical approach to the calculation of carryover. As both sides accept, this issue falls away if the judge fell into error on the first issue. If ConvaTec is right on that first issue then both the Modified Process and the Original Process infringe. If, on the other hand, Smith & Nephew are right on that issue then neither process infringes.

15. At the hearing of the appeals we heard full argument on the first issue. At the end of that argument we came to the conclusion that the judge's interpretation of claim 1 is not sustainable. It followed that we did not need to hear argument on the second issue, and we so indicated to the parties. We also informed the parties that we would give our judgments on the first issue in writing in the usual way. That I now do.

The approach to interpretation of a numerical range

16. The general approach to be adopted to the interpretation of a patent claim was considered by Lord Hoffmann in *Kirin Amgen Inc v Hoechst Marion Roussel Ltd* [2004] UKHL 46, [2005] RPC 9. As he explained, the exercise of interpretation is objective and the question is always what a skilled person would have understood the patentee to be using the words of the claim to mean. The principles which emerge from Lord Hoffmann's speech were summarised by Jacob LJ giving the judgment of this court in *Virgin Atlantic Airways Ltd v Premium Aircraft Interiors UK Ltd* [2009] EWCA Civ 1062, [2010] RPC 8 at [5] in these terms:

> "(i) The first overarching principle is that contained in Art.69 of the European Patent Convention;
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> (ii) Art.69 says that the extent of protection is determined by the claims. It goes on to say that the description and drawings shall be used to interpret the claims. In short the claims are to be construed in context.
>
> (iii) It follows that the claims are to be construed purposively—the inventor's purpose being ascertained from the description and drawings.
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> (iv) It further follows that the claims must not be construed as if they stood alone—the drawings and description only being used to resolve any ambiguity. Purpose is vital to the construction of claims.
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> (v) When ascertaining the inventor's purpose, it must be remembered that he may have several purposes depending on the level of generality of his invention. Typically, for instance, an inventor may have one, generally more than one, specific embodiment as well as a generalised concept. But there is no presumption that the patentee necessarily intended the widest possible meaning consistent with his purpose be given to the words that he used: purpose and meaning are different.
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> (vi) Thus purpose is not the be-all and end-all. One is still at the end of the day concerned with the meaning of the language used. Hence the other extreme of the Protocol—a mere guideline—is also ruled out by Art.69 itself. It is the terms of the claims which delineate the patentee's territory.
>
> (vii) It follows that if the patentee has included what is obviously a deliberate limitation in his claims, it must have a meaning. One cannot disregard obviously intentional elements.
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> (viii) It also follows that where a patentee has used a word or phrase which, acontextually, might have a particular meaning (narrow or wide) it does not necessarily have that meaning in context.

> (ix) It further follows that there is no general "doctrine of equivalents."
>
> (x) On the other hand purposive construction can lead to the conclusion that a technically trivial or minor difference between an element of a claim and the corresponding element of the alleged infringement nonetheless falls within the meaning of the element when read purposively. This is not because there is a doctrine of equivalents: it is because that is the fair way to read the claim in context.
>
> (xi) Finally purposive construction leads one to eschew the kind of meticulous verbal analysis which lawyers are too often tempted by their training to indulge."

17. I would add the following two principles which are also drawn from Lord Hoffmann's speech and which have a particular bearing on this appeal. First, the reader comes to the specification with the benefit of the common general knowledge and on the assumption that its purpose is to describe and demarcate an invention. Second, the patentee is likely to have chosen the words appearing in the claim with the benefit of skilled advice and, in so far as he has cast his claim in specific rather than general terms, is likely to have done so deliberately.

18. It seems to me that all of these principles are just as applicable to a claim containing a numerical range as they are to a claim containing descriptive words or phrases. In both cases the critical question is what the skilled person would understand the author to have been using the words or numerals appearing in the claim to mean.

19. At this point it may be helpful to say a little more about the meaning of numbers in a scientific context. Of particular relevance to this appeal, it is standard practice for scientists deliberately to express numerical values to a particular degree of accuracy and, as a result, the degree of precision with which any particular number is written conveys to the reader how the author intended the number to be understood. This may be important for a number of reasons. It may, for example, allow the author to convey the level of accuracy with which a calculation needs to be performed or it may indicate the experimental uncertainty in a measurement which needs to be taken. In all such cases the precision with which the number is expressed is understood by the reader to be dictated by the number of significant figures or decimal places the number has. It is also generally accepted that in order to compare one number which is expressed to a particular degree of precision with another which is expressed to a different and apparently greater degree of precision then it may be necessary to round the second number to the same degree of precision as the first, and to do so in accordance with the standard rounding convention in which the number 5 is always rounded up. Thus, as Professor Burrell, Smith & Nephew's expert, explained, the number 25% is expressed to two significant figures and, as such, would be understood from a scientific perspective to encompass all numbers in the range from 24.50% to 25.49%. It is also, I would add, expressed as a whole number and to zero decimal places.

20. These number conventions have been recognised in a series of cases in this country involving the interpretation of patent claims with numerical ranges. But before turning

to those cases, I would emphasise that we are not here concerned with the yet more ambitious interpretation of a claim with a numerical range for which patentees have sometimes contended, namely that the range should simply be regarded as some kind of general guide or descriptive indication of the boundaries of the claim. Perhaps the high water mark for patentees seeking to advance such a case is the decision of Aldous J (as he then was) in *PLG Research Ltd v Ardon International Ltd* [1993] FSR 197 in which the claim called for a junction to have a thickness of "not less than 75 per cent" of the thickness of the mid-point of a strand passing through the junction. Aldous J said this at page 213-214 :

> "There is no evidence that the 75 per cent limitation, as opposed to, say, 76 per cent or 74 per cent, was crucial, nor that it would be seen to be crucial by the skilled addressee. Thus, variants close to 75 per cent limitation for a minor part of the junctions would not have a material effect upon the way the invention worked and that would have been obvious to the skilled addressee. Further the patentee would not be thought to have intended to exclude such variants from his monopoly. The skilled addressee would realize that the manufacture of plastics net structures by biaxially stretching was a process in which variations of thickness were certain and that the edges of the junctions could not be vertical. Thus, there would be some variation apparent when measuring the strands and the junctions, and also the measurements taken at the extreme edge would not be the place contemplated for the patentee."

21. A little later (at page 217) Aldous J considered the issue of infringement and explained that the claimants had carried out measurements at the part of the junction that lay in line with the strands and had found its thickness exceeded 75% of the mid-point of the strands, whereas the defendants had measured the maximum strand thickness and the minimum junction thickness, and had found that the mean junction thickness lay between 60% and 72% of that of the strands. In the event the judge found the claim was not infringed for other reasons, but he held that, had the defendants' products only differed from the claim in terms of their junction thickness, he would have found infringement.

22. It seems to me that the approach adopted by Aldous J to the numerical limits of the claim in *PLG Research* must be seen in the light of the particular circumstances of that case. The net the subject of the claim was made by stretching (uniaxially or biaxially) a substantially uniplanar starting material having a pattern of holes or embossed impressions. This stretching would inevitably produce some variations in thickness and the skilled person would have realised it was not necessary for the 75% limitation to apply to the whole of the junction. To the contrary, that person would have realised that variants close to the 75% limitation for a minor part of the junctions would not have a material effect upon the way the invention worked. Accordingly, I do not understand Aldous J to have been saying that the numerical range should be understood as simply a guide or a general indication of the boundaries of the claim and I anticipate that in light of the guidance given by the House of Lords in *Amgen* it will be rare indeed for a claim with a numerical range to be given such an expansive interpretation. In that connection I would endorse the reasoning of Mr Peter Prescott

QC, sitting as a deputy judge of the High Court, in *Auchincloss and anor v Agricultural & Veterinary Supplies Ltd and ors* [1997] RPC 649. He said this at page 664:

> "… It is a descriptive word or phrase to which the concept of an immaterial variant applies. In the cited case [*Catnic Components v Hill & Smith Ltd* [1982] RPC 183 (HL)] the 'descriptive' phrase was "extending vertically". If, instead, the claim had said "extending at an angle between 87.0º and 93.0º", this would not have been a descriptive phrase, but a specification of a precise range. It would be a unilateral statement in words of the patentee's own choosing informing the reader what he claimed to be an essential feature of his invention. If a product fell outside that range it would not be a question of a 'variant' at all, minor or otherwise. It would be a failure to adopt an essential feature. Even if an angle falling somewhere outside that range would work just as well, and this were obvious to all concerned, to hold non-infringement would not be to deny 'a fair protection for the patentee' in terms of the Protocol to the Convention; for the range he chose to specify was one which he himself must have considered to be fair at the relevant date. On the contrary, to hold otherwise would be to deny 'a reasonable degree of certainty for third parties'…"

23. The deputy judge developed his reasoning at pages 689-690 in these terms:

> "… Where the patentee has expressed himself in terms of a descriptive word or phrase there may be room for supposing that he was using language figuratively, and did not intend to restrict himself to the purely literal meaning. But where the patentee has defined an integer of his claim in terms of a range with specified numerical limits at each end, his purpose must be taken to have been to claim thus far and no further. His reason for doing so may not be apparent, but it may exist all the same, for instance it may lie 'buried in the prior art'. Further, in this case I believe that there are evident reasons of convenience and certainty which would have led him to claim in this way, as I have observed."

24. In the present case it has not been suggested that the numerical range in the claim has been used figuratively or descriptively. The issue is rather whether the skilled person would have understood the figures defining the range to have been expressed to a particular degree of exactitude. This question arose in *Lubrizol Corporation v Esso Petroleum Co Ltd and ors* (13 November 1996 and reported at [1997] RPC 195, though not on this point) where the patent in issue related to lubricating oil containing a carboxylic derivative produced using a substituted succinic acylating agent and, by claim 1, called for the succinic acylating agent to have within its structure an average of "at least 1.3 succinic groups for each equivalent weight … of substituent groups". At trial a dispute arose as to the meaning of the number 1.3, with Lubrizol contending that it included 1.27, and Esso that it meant precisely 1.3. Jacob J (as he then was) held (at page 31) that the patentee meant what a scientist would conventionally mean

by expressing a number to two significant figures, namely that it included all numbers which round up to 1.3:

> "That does not quite end the dispute over construction of integer H. Quixotically there is a dispute over the number 1.3 itself. What about a case where the SR [succination ratio] is, say 1.27 (on either party's formula)? Lubrizol say that 1.27 is, by the ordinary conventions of scientists, 1.3. The convention is simple: you should only refer to numbers to the number of figures which are reliable – "significant" as the scientists say. Thus in giving the ratio to only two figures the patentee must be regarding only those two figures as significant. A scientist would say there is a difference between "1.3" and "1.30", the latter being more exact.
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> Exxon say that this is contrary to the language of the claim: 1.27 is simply not "at least" 1.3. I do not agree. I think Lubrizol are right here. The ratio is a lower limit. There is no reason why that should be particularly precise – the effects of oversuccination increase with the ratio, but the exact cut-off below which a monopoly is not worth claiming need not be that precise. I think the patentee, by "1.3", means what a scientist would conventionally mean, namely "1.3 to two significant figures"."

25. On appeal, Esso again maintained that the expression "at least" meant that the figure 1.3 was the lower limit of the claim so that 1.28 or 1.29 would not fall within its ambit, but this court agreed with Jacob J's conclusion ([1998] RPC 727). Aldous LJ (with whom Roch and Brooke LJJ agreed), said at page 748:

> "The notional skilled man would read the claim and the specification using conventions adopted by scientists, one of which was that numbers are given to the number of figures that are significant. It follows that in giving the ratio in two figures, the patentee was indicating that only those two figures were significant."

26. Not long thereafter, a similar issue came before the court in *TH Goldschmidt AG v EOC Belgium NV* (25 January 2000). The patent in suit was directed to a process for the preparation of amidobetaines and, by claim 1, required the process to be carried out in alkaline solution which had a "pH of 5 to 8". The critical question was whether these numerals limited the scope of the claim to a pH window of 5.0 to 8.0, as EOC contended, or whether they meant a pH window of 5 to 8 rounded to one significant figure, as TH Goldschmidt argued. Mr David Young QC, sitting as a deputy judge of the High Court, was in no doubt they meant the latter. He had regard to the context and the body of the specification and said (at page 16):

> "The evidence is that pH is generally measured by a pH meter and in an industrial plant to one decimal point. The pH values for each of the examples in the patent are also recorded to one

> decimal point. This is to be contrasted with the claimed pH range of from 5 to 8."

27. In light of these matters, the deputy judge reasoned that the patentee cannot have intended to exclude pH values below 5; had it wished to exclude values such as 4.6 to 4.9 "the claim would have been more precise and claimed a range of 5.0 to 8.0".

28. Much the same approach was taken by Pumfrey J (as he then was) in *Halliburton Energy Services Inc v Smith International (North Sea) Ltd* [2005] EWHC 1623 (Pat), [2006] RPC 2. Here the relevant claim was directed to a roller cone drill bit comprising three arms and with one rotatable cutting structure mounted on each of the arms. The invention was characterised in that the "axial force on each of the cutting structures is between thirty-one percent and thirty-five percent of the total of the axial force on the bit when the drill bit is drilling into a formation" and that "the volume of formation drilled by each of the cutting structures is between thirty-one percent and thirty-five percent of the total volume drilled by the drill bit when the drill bit is drilling into a formation". All such drill bits were designed and manufactured using CAD/CAM techniques and, against this background, the judge reasoned at [91]:

> "… I see no reason to construe 31 per cent and 35 per cent as meaning anything other than the specified number to two significant figures, so including 30.5 per cent to 35.4 per cent, or 30.50 per cent to 35.49 per cent, or 30.500 per cent to 35.499 per cent. These are implied statements about the precision of the measurement, no more. They are not statements about its accuracy."

29. More recently, in *FNM Corporation Ltd v Drammock International Ltd* [2009] EWHC 1294 (Pat), Arnold J was required to construe a patent claim to a water-based non-flammable mixture for cooling the body during hot weather or after exercise in the context of a specification which explained that a non-flammable composition was one in which the flammable content did not exceed 45% by weight. The judge held the precision to which the figure of 45% was expressed was to two significant figures and that it followed that the claim embraced compositions with a total flammable content of up to 45.4%.

30. Similarly, *Zeno Corporation and anor v BSM-Bionic Solutions Management and anor* [2009] EWHC 1829 (Pat) concerned the scope of a patent claim to a hand held unit for the treatment of insect stings and bites in which a hot plate for application to the skin was heated to a maximum temperature "in a range from 50 to 65°C". Lewison J (as he then was) rejected the submission of the patentee that these stated limits had a tolerance of 3°C with the result that the upper limit of 65°C would include 68°C, and he did so because the paramount consideration of the skilled reader would have been safety, and so he or she would not have read the temperature limits as unimportant or imprecise. Nevertheless, the skilled reader would still have applied the standard number convention. As the judge put it, the temperature was expressed in terms of whole degrees (ie 65°C rather than 65.0°C) and so it was not difficult to understand that the upper limit of 65°C embraced temperatures between 64.5°C and 65.4°C.

31. The Boards of Appeal of the EPO have also considered the issue of rounding in a series of decisions concerning novelty. In decision T74/98 *Dispersant/EFKA*

Chemicals (19 October 2000) the claim in issue required a solution containing a 5-50 mol% of one or more defined monomers. The prior art disclosed compositions having all the features of the claim save that the defined monomers were present in amounts of 4.96 and 4.98 mol%. The Board rejected the opponent's argument that since the claim defined the range without any indication of decimals, the lower boundary of 5 included the values of 4.96 and 4.98, and it did so for two reasons: first, the application of the rounding rule would expand the scope of the claim beyond the specified limits; and second, the values of 4.96 and 4.98 corresponded to mol% amounts which had been calculated from the original monomer compositions expressed in weight% and, in the particular circumstances of this case, any rounding-up following the conversion of the figures into molar amounts would affect the definition of the prior art composition. As the Board explained at 3.2:

> "It is evident that the true meaning of a specific disclosure cannot be influenced by the units used to express it and that the present objection of lack of novelty relies on an ambiguity introduced artificially by the Appellant [opponent]."

32. A similar approach was taken by the Board in decision T820/04 *Nickel-molybdenum alloys/Hayes International* (28 September 2006). Here the claim in issue called for a crystalline metal alloy of nickel and molybdenum containing no more than "0.1 atom percent" of carbon in the context of a specification which taught that the carbon was an undesirable interstitial element which should be kept as low as possible. The prior art described an alloy composition of these same metals but expressed in weight%. A re-calculation suggested it contained 0.135 atom% of carbon. The Board rejected the novelty objection, holding that to interpret the upper limit of 0.1 atom% so as to include all the values which, upon application of the rounding rules, would yield that figure would expand the scope of the claim beyond its indicated limits. Further, the re-calculation from weight% to atom% implied an impermissible modification of the original disclosure.

33. By contrast, in decision T708/05 *Polymeric films/Treofan* (14 February 2007) the invention lay in the field of polymeric films and the claim in issue called for a film comprising five coextruded layers biaxially oriented together with outer layers having a thickness of from 1-2µm. The prior art described such a film but the outer layers had a calculated thickness of 0.9625µm. The Board agreed with the opponent that, in this field, layer thicknesses were, in general, stated to an accuracy of one decimal place and the skilled person would therefore round up the calculated value to 1.0µm. Accordingly, the claim lacked novelty.

34. Nevertheless, the narrower approach to claim interpretation was again adopted by the Board in decision T646/05 *Vehicle alternator/Denso Corporation* (26 October 2007). The patent claimed an alternator in which the ratio of particular dimensions of the rotor core was required to fall within the range of 0.54-0.60. The prior art disclosed all of the features of the claim save that the ratio of the relevant dimensions of the rotor core was 0.539. The Board could see no justification for rounding this ratio to a value of 0.54 and so upheld the novelty of the claim. Rounding the ratio would, so the Board said, constitute an additional step beyond what had been made available to the public.

35. The Board made some attempt to rationalise these conflicting decisions in decision T1186/05 *Multilater films/Cryovac* (6 December 2007). The claim was directed to a multilayer film capable of withstanding heat sterilisation and comprising an interior layer of a copolymer having a density of from 0.89 to 0.92 grams per cubic centimetre. The prior art disclosed such a film save that the density of the interior layer was 0.885 grams per cubic centimetre. The Board held that this value should be rounded to 0.89 for the following two reasons. First, the patentee had chosen to express the numerical limits of the claim to an accuracy of two decimal places and so an appropriate comparison could only be made with the prior art if its disclosure was rounded to the same degree of accuracy. Second, polymer densities of this kind were usually stated in the art to an accuracy of three decimal places and so the use by the patentee of two decimal places in the patent claim indicated that rounding had been used. The Board went on to explain that the circumstances of this case were therefore different from those in T74/98, for in that case rounding of a component's molar percentage having two decimal places, calculated by conversion from its weight proportion, was not justified because (i) this would lead to a broadening of the claimed range and (ii) reconversion of the rounded molar percentage to the corresponding weight proportion would have altered the true meaning of the earlier disclosure.

36. The approach adopted in decision T1186/05 has been followed by the Board in two more recent decisions. In the first, decision T871/08 *H_2O_2 production/Akzo* (8 December 2011), the claim was to a process for making hydrogen peroxide by an anthraquinone method involving a molar ratio of tetrahydro anthraquinones to alkyl-substituted anthraquinones of from 3:1 to 9:1. The prior art disclosed all of the features of the claim save that the molar ratio was 2.996:1. The Board held the claim lacked novelty because, for comparison purposes, the prior art had to be rounded to 3:1, that is to say, to an accuracy of zero decimal places.

37. Finally, in decision T234/09 *Mineral wool/Saint-Gobain* (1 June 2012) the Board considered a claim to a mineral wool having a magnesium oxide content of between 0% and 5%. The prior art had all the features of the claim save that its magnesium oxide content was 5.2%. This, said the patentee, fell outside the claimed range. The Board did not agree. In this particular claim, the patentee had chosen to express the range in terms of whole numbers and so the range included all numbers which fell within it when rounded to the same degree of accuracy as that to which it was expressed.

38. As I have said, the approach to be adopted to the interpretation of claims containing a numerical range is no different from that to be adopted in relation to any other claim. But certain points of particular relevance to claims of this kind do emerge from the authorities to which I have referred and which are worth emphasising. First, the scope of any such claim must be exactly the same whether one is considering infringement or validity. Secondly, there can be no justification for using rounding or any other kind of approximation to change the disclosure of the prior art or to modify the alleged infringement. Thirdly, the meaning and scope of a numerical range in a patent claim must be ascertained in light of the common general knowledge and in the context of the specification as a whole. Fourthly, it may be the case that, in light of the common general knowledge and the teaching of the specification, the skilled person would understand that the patentee has chosen to express the numerals in the

claim to a particular but limited degree of precision and so intends the claim to include all values which fall within the claimed range when stated with the same degree of precision. Fifthly, whether that is so or not will depend upon all the circumstances including the number of decimal places or significant figures to which the numerals in the claim appear to have been expressed.

The Patent

39. I have summarised the nature of the invention and the art in which it was made at the outset of this judgment. All of this is set out in some detail in the body of the specification from [0002] to [0016]. There follows a detailed description of the invention and at [0023] the specification says this about the quantity of silver to be used in the method of the invention:

> "The quantity of silver should be sufficient to provide a desired silver concentration in the material. The final concentration of silver in the material is between 0.1% and 20% by weight, for example, by weight of the resultant dressing. In some embodiments, the concentration of silver is between 0.1-10%, 1-10%, 10-20%, 5-20% or 0.1-1%. In one preferred embodiment, the final concentration of silver is between 1 and 5% by weight of the dressing. Preferably, the concentration in the treatment solution is from 0.001 g/g of polymer to 0.2 g/g of polymer, more preferably from 0.01 g/g of polymer to 0.2 g/g of polymer, more preferably from 0.01 g/g of polymer to 0.05 g/g of polymer. Preferably, where the source of silver is most facilely initially dissolved in water rather than the neat organic solvent, then added in an appropriate amount to give the desired concentration of silver in the final weight of the polymer."

40. Details are then provided of the use of water, the length of time for which the material should be subjected to the silver solution and the temperature at which the process should be carried out. There is also important teaching about the quantity of binding agent at [0028]:

> "The quantity of agent used will depend upon the amount of polymer-containing material being prepared and the total volume of solution. Preferably, the agent is present in a concentration between .01 and 50% of the total volume of treatment. In some embodiments, the concentration of agent is between .01-25%, .01-10%, .01-5%, .1-5%, .1-25%, .1-10%, 1-25%, 1-10%, 1-5%, 5-25%, 10-25%, or 25-50% of the total volume of treatment. "

41. There is a single example at the end of the specification in which ConvaTec's non-silverised product, Aquacel, is subjected to a silver nitrate solution and then, preferably after this treatment, sodium chloride (the binding agent) is added in a concentration between 0.01 and 50% (preferably between 1 and 10%). This further treatment is continued for another 5-30 minutes.

42. That brings me to claim 1 which reads:

> 1. A method of preparing a light stabilized antimicrobial material, characterised in that the method comprises the steps of:
>
> (a) preparing a solution comprising an organic solvent and a source of silver in a quantity sufficient to provide a desired silver concentration in said material;
>
> (b) subjecting a material which includes gel-forming fibres containing one or more hydrophilic, amphoteric or anionic polymers to said solution for a time sufficient to incorporate said desired silver concentration into said polymer, wherein said polymer comprises a polysaccharide or modified polysaccharide, a polyvinylpyrrolidone, a polyvinyl alcohol, a polyvinyl ether, a polyurethane, a polyacrylate, a polyacrylamide, collagen, or gelatin or mixtures thereof; and
>
> (c) subjecting said polymer, during or after step (b) to one or more agents selected from the group consisting of ammonium salts, thiosulphates, chlorides and peroxides which facilitate the binding of said silver on said polymer, the agent being present in a concentration between 1% and 25% of the total volume of treatment, which material is substantially photostable upon drying, but which will dissociate to release said silver upon rehydration of said material.

43. As I have explained, the critical phrase in the claim is this: "the agent being present in a concentration between 1% and 25% of the total volume of treatment" and it now gives rise to two questions: first, whether the skilled person would believe the patentee intended the values of 1% and 25% to be taken as exact values so that any concentration of binding agent less than exactly 1% or greater than exactly 25% falls outside the scope of the claim, or whether the skilled person would understand that the patentee has used a standard number convention to express the limits of the claim to a lesser degree of accuracy and so intended to include within the scope of the claim concentrations falling within the range when expressed with the same degree of precision; second (and on the assumption the numerical limits in the claim do not define exact values) whether the skilled person would understand the numbers to be expressed in terms of whole numbers (zero decimal places) or in terms of significant figures. It is convenient to consider these two questions in turn although ultimately the exercise of interpretation must be a unitary one.

Exact values

44. In assessing whether the skilled person would understand the patentee to have intended that the upper limit of the concentration of binding agent should be understood to be exactly 25% and its lower limit exactly 1%, it seems to me the following matters are material.

45. First, it was and remains common ground that in this field the skilled person can measure concentrations of binding agent to a high degree of accuracy, and certainly to two decimal places. Mr James Mellor QC, who has appeared on this appeal with Ms Charlotte May QC, as he did below, has placed considerable weight on this aspect of the common general knowledge. He contends that the skilled reader would therefore consider the patentee intended the numbers in the claim to be understood as denoting the absolute and unqualified limits of the claim. There is, he says, no need for rounding to take into account experimental error or limitations in the ability to measure concentration accurately.

46. In my judgment Mr Mellor's submission goes too far. I accept that, at least in the general case, the skilled person *can* ascertain the concentration of binding agent with a high degree of accuracy. But that does not mean to say he *must* do so. Further and for reasons to which I shall shortly come, I think it is clear from the teaching of the specification that the binding agent concentration is not critical in the method of this invention. In these circumstances I am unable to accept that this is a factor which supports Smith & Nephew's favoured interpretation. Indeed it seems to me to point in the opposite direction. Had the author of the specification intended the limits to be understood in the precise manner for which Mr Mellor contends then I think he could and likely would have made that clear by expressing those limits to a relatively high degree of accuracy, such as to one or two decimal places.

47. Second, it is apparent from the body of the specification that the patentee had well in mind the possibility of expressing numerical values with a very high degree of precision. Thus, in paragraph [0023], the patentee has identified a series of different silver concentration ranges using limits expressed, on some occasions, to an accuracy of zero decimal places but, on other occasions, to an accuracy of one decimal place. Similarly, in describing the permissible ranges of binding agent concentration in paragraph [0028], the patentee has used limits expressed with degrees of precision which range from zero decimal places to two decimal places. I believe this to be a powerful factor in favour of the interpretation of the claim for which ConvaTec contends. Against this background, I think the skilled person would understand that the patentee has chosen to express the numerical limits of the range in the claim to only a limited degree of accuracy.

48. Third, the reader is taught by paragraph [0028] and from the example at the end of the specification that the invention can (and preferably should) be performed with a binding agent concentration between 0.01 and 50%. This is a very wide range and it extends significantly beyond the limits of the claim. Once again this is a factor which undermines Smith & Nephew's favoured interpretation of the claim. It teaches the skilled person that there is no technical reason to read the claim as requiring the use of a binding agent concentration which falls between the exact numerical values of 1% and 25%.

49. Fourth, I recognise that the concentration limits which appear in the claim have in a sense been chosen by the patentee as opposed to calculated by him or determined by experiment. Further they have been introduced into the claim by amendment. These are both matters upon which Mr Mellor has placed particular reliance but I do not believe they take him very far. However the patentee may have derived the numerical limits, the skilled reader seeking to put the invention into practice or satisfy himself that his process falls outside the scope of the claim must calculate his binding agent

concentration or measure it. Either way he must do so with a particular degree of precision and the question is still whether the reader would understand the patentee intended the 1% and 25% limits of the claim to be understood as exact values or in a less precise way.

50. Fifth, Mr Mellor submits that the claim must be read as a whole and that the numerical limits appear in the expression "*between* 1% and 25%". Further, he continues, the word "between" qualifies both the 1% and 25% limits and makes clear that they are exact values. I readily accept that the claim must be read as a whole in the context of the specification and in light of the common general knowledge but I reject the submission that the use of the word "between" has the significance for which Mr Mellor contends. In my view it simply denotes that 1% and 25% are the outer limits of the range, but of itself it says nothing about the degree of precision with which those limits are expressed.

51. Sixth, Mr Mellor also seeks to derive support from the Protocol to Article 69 EPC. This says that claims are to be construed in such a way as to combine fair protection for the patentee with reasonable certainty for third parties. However, as Lord Hoffmann explained in *Amgen*, that is achieved by giving to the patentee the full extent of the monopoly which the person skilled in the art would think he was intending to claim. So, in the context of the present case, I do not think the Protocol advances the case of one side or the other.

52. I believe that it follows from the foregoing that the judge was right to reject Smith & Nephew's primary case that the limits of the claim are exactly 1% and 25%. Taken as a whole, the matters to which I have referred leave me in no doubt that the skilled reader would not believe that is how the patentee intended the claimed limits to be understood. To the contrary, in the light of the common general knowledge and the teaching of the specification, the skilled reader would believe that the patentee intended the limits to be understood in a less precise way. Just how precisely is the question I must now consider.

Decimal places or significant figures?

53. The parties' positions were explained through their experts. Professor Kennedy, for ConvaTec, considered the numerical limits of the claim were stated to the nearest whole number or to zero decimal places. Professor Burrell, for Smith & Nephew, took the view that they were expressed in terms of significant figures, and that the lower limit of 1% was expressed to an accuracy of one significant figure and that the upper limit of 25% was expressed to an accuracy of two significant figures.

54. The whole number approach needs little further elaboration. At the bottom of the range, 1% includes all those values which round to 1% when expressed to the nearest whole number or to an accuracy of zero decimal places, that is to say all values $\geq$ 0.5% and $<$ 1.5%, a broadly symmetrical distribution. At the top of the range, 25% includes all those values which round to 25% when expressed to the nearest whole number, that is to say all values $\geq$ 24.5% and $<$ 25.5%, another broadly symmetrical distribution. And looking at the claimed range as a whole, it therefore embraces all values $\geq$ 0.5% and $<$ 25.5%.

55. The significant figures approach is a little more complex. In order to explain the effect it has on the scope of the claim, I must first summarise the relevant rules, all of which formed part of the common general knowledge. They are as follows:

    i) non-zero digits are always significant;

    ii) zeros between non-zero digits are always significant;

    iii) leading zeros are never significant; if a decimal point appears in a number then trailing zeros are significant (before or after the decimal point);

    iv) in the absence of a decimal point, trailing zeros are not generally significant unless stated otherwise either expressly or with a bar over the zero.

56. Application of these rules to the claimed range produces what was described in the proceedings as a mathematical quirk. Taking first the bottom of the range, 1% (which has one significant figure) includes all those values which round to 1% when expressed to an accuracy of one significant figure, that is to say all values $\geq 0.95\%$ and < 1.5 %. This is a far from symmetrical distribution and the reason is this: the relevant rule means that 0.5% is already expressed to an accuracy of one significant figure, as is 0.9%. So the lowest value that rounds to 1% when expressed to an accuracy of one significant figure is 0.95%. On the other hand, 1.4% has two significant figures, and so rounds down to 1% when expressed to an accuracy of one significant figure.

57. Turning now to the top of the range, application of these same rules means that 25% (which has two significant figures) includes all those values which round to 25% when expressed to an accuracy of two significant figures, that is to say all values $\geq 24.5\%$ and $< 25.5\%$. And looking at the claimed range as a whole, it therefore embraces all values $\geq 0.95\%$ and $< 25.5\%$.

58. This asymmetry is a feature of the application of the significant figures approach to the number 1 and all powers of the number 10, but not to numbers in between. So, if the bottom of the claimed range had been 2% rather than 1%, there can be no doubt that, on this approach, the claim would have included all values $\geq 1.5\%$ and $< 25.5\%$, another broadly symmetrical distribution.

59. The significant figures approach also produces very strange results if applied to the teaching in the body of the specification, as Mr Piers Acland QC, who has appeared with Mr Thomas Alkin on behalf of ConvaTec, as he did below, demonstrated to us during the course of the appeal hearing with the assistance of some helpful diagrams. So, for example, paragraph [0028] discloses one range of 1% to 25% and another of 5% to 25%. Application of the significant figures approach to the first range means it encompasses all values $\geq 0.95\%$ and $< 25.5\%$, but its application to the second means it encompasses all values $\geq 4.5\%$ and $< 25.5\%$. So also and even more strikingly, this paragraph describes one range from 1% to 10% and another from 10% to 25%. Application of the significant figures approach to the first range (on the assumption that 10 is regarded as having two significant figures) means it encompasses all values $\geq 0.95\%$ and $< 10.5\%$, but its application to the second (also, on the assumption that 10 is regarded as having two significant figures) means it encompasses all values $\geq 9.95\%$ and $< 25.5\%$. Focussing on the error margin around

the 10%, it can be seen that in the one case it is an order of magnitude higher than it is in the other.

60. In my judgment there can be no logical basis for preferring the significant numbers approach over the whole number (or zero decimal places) approach in construing the claim in issue. The purpose of expressing numbers to a particular degree of precision may be to convey to the reader the degree of accuracy with which he needs to make a particular measurement or carry out a calculation. In the context of the claimed method, it is to convey to the reader the range of permissible binding agent concentrations and the accuracy with which those concentrations need to be determined. There is no reason to suppose that this can vary depending upon whether the bottom of the range is 1%, 2% or 5%, or whether 10% is at the top or bottom of the range. It seems to me that Professor Kennedy therefore put it entirely correctly in saying as he did in his first expert report that it is not the number of significant figures that is important in this context, and instead it is the precision with which a number is written. I consider that Professor Kennedy was also right to say that the skilled person would understand the 1% and 25% limits to have been expressed to the nearest whole number.

61. How then did the judge arrive at the opposite conclusion? In my judgment he fell into error in the following three important respects. First, he considered that the skilled person would reject the whole numbers approach because he would see that many of the ranges in paragraph [0028] of the specification are defined by limits that are not whole numbers. The judge was plainly correct that some of the ranges in paragraph [0028] are defined by limits expressed in whole numbers and that others are not, and Professor Kennedy did not at any stage suggest otherwise. Some of those limits are expressed to an accuracy of zero decimal places (that is to say, in whole numbers), others are expressed to an accuracy of one decimal place, and yet others are expressed to an accuracy of two decimal places. But all this shows is that the author knew full well how to express numbers with different degrees of precision, and that when it came to the claim, he chose limits expressed to an accuracy of zero decimal places.

62. Second, the judge considered that the anomalies which arise from the application of the significant figures approach were of little significance. I think he fell into error here too. Those anomalies are significant because they highlight that the application of the significant figures approach to the claim produces a result that bears no relationship to the distribution of random error in practice. The skilled reader would have no reason to suppose the patentee intended the numerical limits of the claim to be understood in such a way.

63. Third, the judge appears to have attached some importance to the relative error margins at the top and bottom of the range. As he explained, the whole numbers approach means that at the bottom of the range the error margin is as high as 50% whereas at the top of the range it is only 2%. I accept that this is so, but the skilled reader would appreciate that this is the inevitable consequence of the adoption by the patentee of such a wide range of permissible concentrations. Accordingly, it is not a matter which carries much weight in favour of the significant figures approach.

64. I therefore believe the judge was wrong to construe the claim in the way that he did. He ought to have found that the skilled reader would understand that the patentee

intended the claim to embrace all concentrations of binding agent ≥ 0.5% and < 25.5%.

Conclusion

65. For all the reasons I have given, I would allow ConvaTec's appeal but dismiss Smith & Nephew's appeal.

Lord Justice Briggs:

66. I agree.

Lord Justice Christopher Clarke:

67. I, also, agree.

68. To a person not possessed of the relevant common general knowledge and not skilled in the art, in which category I would until now have placed myself, the proposition that 0.75 (or 0.5) falls between 1 and 25 appears obviously incorrect. To jump to that conclusion would, however, ignore the fact that figures, no less than words, may take their meaning from the context in which they are used. A linguist may regard the word "one" as meaning "one" - no more and no less. To those skilled in the art it may, however, in context, imply a range of values extending beyond the integer. For the cogent reasons contained in the judgment of Lord Justice Kitchin, I agree that in the patent in suit the words "between 1% and 25%" extend to all values ≥ 0.5% and < 25.5%.