COMPETITION COMMISSION

THE PROPOSED ACQUISITION BY CARL ZEISS JENA GmbH OF THE MICROSCOPY BUSINESS OF BIO-RAD LABORATORIES INC

Provisional findings report

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The Competition Commission has excluded from this published version of the provisional findings report information which the inquiry group considers should be excluded having regard to the three considerations set out in section 244 of the Enterprise Act 2002 (specified information: considerations relevant to disclosure). The omissions are indicated by [✂].

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Executive summary

1. On 30 December 2003 the Office of Fair Trading (OFT) referred the proposed acquisition by Carl Zeiss Jena GmbH (Zeiss) of the microscopy business of Bio-Rad Laboratories Inc (Bio-Rad) to the Competition Commission (CC) for investigation and report. We are required to decide whether the proposed merger would give rise to a relevant merger situation, and whether the effect of that merger would result in a substantial lessening of competition (SLC). We are required to publish our final report by 14 June 2004. This document, together with its appendices, constitutes our provisional findings and does not represent a final decision by the CC.

2. Zeiss, based in Germany is part of a group that manufactures and sells products in the field of optics, electronics and precision engineering. Bio-Rad, based in California, manufactures and distributes life science research and clinical diagnostic products. The advanced 3D light microscopy business of Bio-Rad is carried out by its Cell Science Division. This business is centred on a UK subsidiary of Bio-Rad, Bio-Rad Microscience Limited (Bio-Rad UK). Bio-Rad UK undertakes all Bio-Rad research in microscopy, supplies advanced microscope systems, and provides marketing, installation and service facilities in northern Europe. The microscope systems are produced in the UK and sold worldwide.

3. Bio-Rad UK supplies advanced 3D light microscope systems for biological research. These combine optical instruments (microscope stands, supplied by optics manufacturers) lasers (supplied by laser manufacturers) and computer processing. Bio-Rad supplies two main types of system: confocal systems and multiphoton systems. Confocal systems were developed commercially by Bio-Rad and have become standard equipment for advanced biological research. Both confocal and multiphoton systems are classed as ‘optical sectioning’ systems. They are supplied

on a worldwide basis by all the main suppliers of advanced microscopes: Bio-Rad, Zeiss, Leica, Nikon and Olympus.

4. Multiphoton systems use specialist infrared pulsed lasers that emit very short light pulses. The technique for the multiphoton systems used by Bio-Rad (using subpicosecond pulse durations) was patented in the USA, in European jurisdictions and in Japan by Cornell Research Foundation Inc (Cornell) and exclusively licensed to Bio-Rad. An alternative multiphoton technique (using picosecond pulse durations) has been patented by Hanninen and Hell in the USA (with a patent also applied for in European jurisdictions) and exclusively licensed to a competing supplier, Leica.

5. The proposed acquisition by Zeiss of Bio-Rad's microscope business follows a number of disputes, including litigation in the USA, between Zeiss, Bio-Rad, Leica, Cornell and others relating to the multiphoton patents.

6. Zeiss and Bio-Rad entered into an agreement in October 2003 for Zeiss to purchase the assets of the microscope business of Bio-Rad's Cell Science Division. The transaction is subject to a number of conditions, including clearance by the CC. The sale will consist of the transfer of most of the business, assets and liabilities of Bio-Rad UK together with some parts of the Bio-Rad Group in the USA and elsewhere. This includes the transfer of relevant intellectual property rights including the licence under the Cornell US or European patent and the individual designations of Cornell's European patent.

7. The acquisition would result in the enterprises concerned ceasing to be distinct, and the share of supply test is met in respect to the supply of confocal and multiphoton microscope systems. We find that arrangements are in progress which, if carried into effect, would result in a relevant merger situation.

8. In considering the operation of the relevant markets, product innovation is extremely important for the business of the merging firms. The main factor determining customers' choice of system and supplier is functionality, including use of the most appropriate technology to meet very specific needs. It is also important to many customers to have access to the leading edge technology in their specific field. Suppliers have a strong incentive to invest in research and development (R&D).

9. The market for advanced 3D microscope systems has some features of a bidding market. Once a product specification has been satisfied customers consider other factors, particularly reliability, support services and price. The products sold in the market are as a consequence highly differentiated to satisfy the specific needs of different customers, and prices paid for different types of system vary widely. Customers are well informed and exchange information.

10. Having analysed the extent of substitutability between different types of advanced 3D light microscopes, we conclude that advanced 3D light microscope systems are not in the same relevant market as electron, scanning probe or 2D light based systems. We also conclude that within advanced 3D light microscopy there is considerable and variable segmentation based on customers' varying requirements. In particular, the distinction between optical and non-optical sectioning is significant. We conclude that optical sectioning systems are in a separate relevant market from non-optical systems. Also, because of limited demand substitutability and since the substitutability of supply between multiphoton systems and other optical sectioning systems is strictly limited by intellectual property rights, we conclude that multiphoton systems are in a separate relevant market. We also conclude that the relevant markets are worldwide.

11. In considering competition within the relevant markets, we conclude that they are characterized by high product differentiation, with competition depending on product features rather than directly on price. We observe that innovation is crucial in providing a competitive advantage. Technological barriers to entry are surmountable, except where restricted by patent rights. Customers' highly specific preferences and their desire to have the latest technology means that firms spend a relatively high proportion of their income on R&D, essentially competing using their R&D programmes to win market power by making specific innovations. The market is not conducive to collusive behaviour.

12. There is competition in the supply of the relevant microscope systems between several large suppliers with smaller suppliers occupying niche positions and exerting some competitive pressure on the larger suppliers. It is possible for a new supplier to take a significant market share through exploiting an innovation, but it is less certain that it can maintain this market share and operate profitably unless it is vertically integrated (in particular, supplying its own optics).

13. There is steady demand for improvements in advanced 3D microscopy to enable new applications in biological research. The market for such systems (as distinct from standard microscopes) is seen as growing. The relevant markets are characterized by effective competition, within the limits set by patent protection in the case of multiphoton systems.

14. We expect that if the merger were to proceed the market for optical sectioning systems other than multiphoton systems would remain competitive because of the number of strong competitors remaining and the continuing competitive pressure from smaller suppliers. We do not expect that the merger would put Zeiss in a

position to exclude others from this market. In the multiphoton market, we expect that Leica and Zeiss would remain strong competitors, incentives to innovate would remain, and we consider that the market is not conducive to collusion.

15. We expect that if the merger were not to proceed (the counterfactual) Bio-Rad's microscience operation would not continue as an independent business, and Bio-Rad would sell the business to another party. We expect the most likely alternative purchaser to be one of the optics-based companies already supplying advanced 3D microscopes. This sale would include transfer of the patent licence. Although we expect that Zeiss would not supply multiphoton systems for the remaining duration of the patent protection, we expect that Zeiss would continue to compete in the market for other optical sectioning systems.

16. The assessment of whether the merger would result in a substantial lessening of competition accordingly involves comparing the competitive situation in the relevant markets if Zeiss purchased the business with the situation if it were purchased by another firm. An alternative purchaser would be placed in the same position as Zeiss would be in after the merger; that is, with an exclusive licence to make and sell multiphoton systems under the Cornell patents and the ability to make use of the Bio-Rad assets.

17. In the multiphoton market, if the merger were to proceed, this would not lead to a situation which created less competition than if Bio-Rad's business were sold to another purchaser. The same would apply in relation to the market for other optical sectioning systems. If the alternative purchaser were Leica, the competitive situation would be worse than if the merger with Zeiss went ahead, as Leica would be the only supplier able to provide multiphoton systems without infringing relevant patents. We

therefore conclude that the merger with Zeiss would not result in less competition in the relevant markets than if Bio-Rad's business were sold to an alternative purchaser.

18. We conclude that no substantial lessening of competition within any market or markets in the UK may be expected to result from the relevant merger situation.

19. We make two other observations:

(a) In the course of our inquiry Zeiss offered a number of assurances as to their future behaviour should the merger be permitted. Whilst we have not relied on them in reaching our conclusions we have listed them for ease of reference.

(b) It has also been put to us that the licensing of the Cornell patents on an exclusive basis restricts competition, particularly in the supply of multiphoton systems. We do not regard this as a matter that results from the merger under consideration.

Provisional findings

1. The reference

1.1 On 30 December 2003 the OFT referred the proposed acquisition by Zeiss of the microscope business of Bio-Rad to the CC for investigation and report. The reference was made under section 33(1) of the Enterprise Act 2002 (the Act). Our full terms of reference are set out in Appendix A. However, the questions that we are asked in the reference are these:

- whether arrangements are in progress or contemplation…which, if carried into effect, will result in the creation of a relevant merger situation; and
- if so, whether the creation of that situation may be expected to result in a substantial lessening of competition within any market or markets in the United Kingdom.

1.2 Essentially, we are required to decide two questions; whether the proposed merger would give rise to a relevant merger situation, and whether the effect of that merger would result in an SLC. If we answer both questions in the affirmative, we are required by section 36 of the Act to go on to consider whether action should be taken by the CC or others to remedy, mitigate or prevent the SLC or any adverse effects therefrom. If we conclude that action should be taken, we are required to state what action should be taken. Our provisional decisions on the questions that we are required to answer are found in paragraphs 3.9 and 5.88. We are required to publish our final report by 14 June 2004.

1.3 This document, together with its appendices, constitutes our provisional findings and does not represent a final decision by the CC. Further information, including non-sensitive versions of main party and third party written submissions, and summaries

of third party key arguments and views, can be found on our web site. We cross-refer to these documents as appropriate.

2. The companies and their products

Zeiss

2.1 The Carl Zeiss instrument business dates from 1846. The Carl Zeiss Stiftung was set up in succession to the original business as a foundation which was the sole owner of the Carl Zeiss works in Jena, Germany. Following World War II the business was split in two, but was combined again in 1995. Carl Zeiss Stiftung operates as two groups of enterprises, Carl Zeiss Group (Zeiss Group) and Schott Glas Group. Zeiss Group is a worldwide business with turnover of €2,029 million and operating profit of €52 million in 2002/03.

2.2 Zeiss Group manufactures and sells a wide range of high-quality products in the field of optics, electronics and precision engineering. It has developed innovative products, including instrument systems used for diagnosis and therapy in ophthalmology, eyeglass lenses, microscopes for medical research, high precision measuring technology for the automotive and mechanical engineering industries, and optical systems for the high-volume production of microchips.

2.3 Zeiss Group, of which Zeiss is a wholly-owned subsidiary, has six business groups. The only business group relevant to this transaction is microscopy, which splits into three business areas including Advanced Imaging Microscopy (AIM), which produces advanced microscope systems, and Light Microscopy, which provides traditional microscopes, also called wide-field microscopes also sometimes called microscope stands. The light microscopy business division, based in Gottingen, Germany, makes microscope stands including for the advanced microscope systems produced

by AIM. Zeiss also acts as a distribution agent for laser microdissection systems (used to prepare specimens) produced by a German microlaser company, P.A.L.M. Microlaser Technologies AG (PALM).

2.4 Within the UK, sales by the AIM business (and other Zeiss optical products) are carried out on behalf of Zeiss by Carl Zeiss Ltd (Zeiss UK). Zeiss UK's turnover in the year to September 2002 was £41.6 million with an operating profit of £4.0 million. Further information about Zeiss and its AIM business is given in Appendix B.

Bio-Rad

2.5 Bio-Rad is a Delaware corporation founded in 1952 by the Schwartz family, and based in Hercules, California. It manufactures and distributes life science research and clinical diagnostic products. It employs about 4,000 people and had a turnover of US$1,003 million in 2003 with a pre-tax profit of US$114 million. The Life Science Group develops, manufactures and distributes products used for biological research worldwide.

2.6 Within the Life Science Group, the advanced imaging microscopy business of Bio-Rad is carried out by the Cell Science Division. This business is centred on a UK subsidiary of Bio-Rad, Bio-Rad Microscience Limited (Bio-Rad UK). Bio-Rad UK has three main functions. It undertakes all Bio-Rad research in microscopy, it supplies advanced microscope systems, and it provides marketing, installation and service facilities in northern Europe. The microscope systems are produced in the UK and sold worldwide.

2.7 Bio-Rad's microscope business supplies systems for biological research. [✂] per cent of its customers are in higher education and research institutions; the remainder

are in industrial organizations such as pharmaceutical companies, which are also engaged in life science research.

2.8 Bio-Rad UK is also active in the laser microdissection sector with its product Clonis. Bio-Rad told us that this business was not significant. [✂] Clonis systems have been sold in total (of which [✂], under a [✂] agreement with [✂] which has not been renewed).

2.9 In 1986 Bio-Rad bought the businesses of Polaron (previously Matronics (Scientific) Limited) and Dubilier Scientific Ltd, out of which it formed the current microscopy business. The share capital is owned by Bio-Metrics (UK) Ltd, set up as a holding company for Bio-Rad's UK operations. However, Bio-Rad has sold all its other UK instrumentation manufacturing operations (involving electron microscopy and semi-conductors). The only instrumentation manufacturing business it has left in the UK is the microscope business, which it has now agreed to sell to Zeiss.

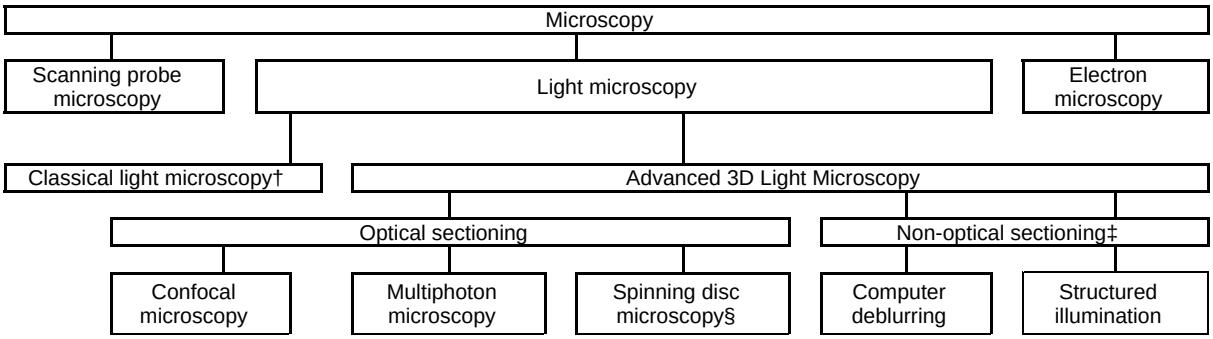
2.10 In 2002 sales of Bio-Rad UK were £12.1 million (of which £1.4 million was in the UK) and it made an operating loss of £0.8 million. It made a similar operating loss of £0.7 million in 2000, although there was an operating profit of £0.3 million in 2001. The results of Bio-Rad UK are, however, sensitive to the allocation of costs and income within the worldwide Cell Science Division. [✂] Further information about Bio-Rad is given in Appendix C.

Advanced 3D light microscopy

2.11 The goods supplied by Zeiss and Bio-Rad are examples of advanced 3D light microscopes. Advanced 3D microscopes essentially consist of systems which link a light source, optical instruments (including the microscope itself, known as the

'microscope stand') and computer processing. We therefore refer to them as 'microscope systems'. These microscope systems are used for research, mainly in universities and other research establishments, for which they represent major purchases of equipment. A more detailed analysis of the market for such microscope systems is given in paragraphs 4.8 to 4.34, and the relevant technology is described in Appendix D.

FIGURE 1
Classification of microscopy*



Source: CC.
*The relative size of the boxes does not indicate their relative significance in scientific terms.
†Also known as wide field microscopy.
‡The term non-optical sectioning does not be taken to mean that optics are not used in these systems; Bio-Rad prefer the term 'computer processed microscopy'.
§We also include in this category similar 'tandem scanning' systems.
¶Computer deblurring can be used with widefield microscopes or with laser scanning systems.

2.12 The classification of types of microscopy is not straightforward because there are several technical principles which are used in various combinations for different applications. There are also many new developments, and different users do not always use the same terms. For the purposes of this report we have adopted those terms which we found most useful to explain relevant distinctions.

2.13 Light microscopy is one of three principal types of microscopy. The other two types are scanning probe microscopy (which scans a sharp tip across the surface of a specimen) and electron microscopy (which produces an image by the use of a high

energy electron beam). Light microscopy uses optics to focus and magnify an image which is derived either from light that is shone on to an image and reflected, or from light that is emitted by the specimen by a process of fluorescence which is stimulated by externally supplied light. Fluorescence techniques are particularly relevant when seeking to obtain high-resolution images of biological samples. Light microscopy can be divided into two principal sub-types: classical light or wide-field microscopy (2D) and advanced 3D light microscopy.

2.14 Advanced 3D light microscopy constructs a composite 3D representation of the specimen that can be manipulated and viewed using a computer system. A major challenge is to remove or avoid blurring of images due to out of focus light. One approach, known as optical sectioning, typically involves scanning the specimen, point by point, with a focused beam of light and either using sophisticated optics to avoid the detection of out of focus light (confocal microscopy) or advanced systems to excite fluorescence only at the required point (multiphoton microscopy). Spinning disc systems are similar to the confocal approach but are able to acquire information on many points at the same time. A very different approach, computer deblurring or deconvolution, involves the construction of a mathematical model of the blurring which enables the light data to be processed in such a way as to substantially reduce the blurring. A further, more recent, approach is structured illumination, which uses a grid-projection system to capture multiple raw images which can then be combined to create an in-focus optical section.

2.15 The main technique used in optical sectioning is laser scanning confocal microscopy. The specimen is scanned, point by point, in three (spatial) dimensions. One or more lasers are focused on to each point to excite light emission from a fluorescent marker (reflection can also be used). This emitted light is taken through a pinhole aperture,

eliminating out-of-focus light before detection. The captured data can be processed into a 3D image. This technique was developed by the Medical Research Council at Cambridge among others and put into commercial production by Bio-Rad and Zeiss in the 1980s. It has since been adopted by Leica and others. (Systems using this technique are known as 'single-photon' confocal microscope systems, to distinguish them from the multiphoton systems described below.)

2.16 Laser scanning confocal systems capture data point by point. An alternative method is to illuminate the specimen with many spots of light by using a perforated spinning disc (also known as a Nipkow disc). This produces faster results than confocal systems but does not in general achieve the same resolution. This technique was developed by Yokogawa in Japan; and is now the core of PerkinElmer systems and is also used by other suppliers including Olympus.

2.17 A further recent development has been the introduction of multiphoton (or two-photon) systems. Whereas in confocal systems a single-photon (light particle) is sufficient to excite fluorescence, in a multiphoton system two photons have to interact with an electron at the same time to produce fluorescence. This is only likely to happen at the point of focus, so there is no need to remove out-of-focus light prior to detection. The multiphoton technique requires a specialized (and expensive) infrared pulsed laser. The main benefit of the technique is that it enables deeper penetration of the specimen; in addition, because it uses infrared light (which is less harmful than visible or ultra-violet light) and because fluorescence is only induced at the point of focus, in an appropriately designed experiment it may also lead to less damage from light irradiation (photo-toxic effects). Multiphoton systems can be classed separately from confocal systems within the broader category of optical sectioning microscope systems.

2.18 Single-photon confocal systems can be upgraded for use as multiphoton systems. Some suppliers of confocal systems prepare them so that they can readily be fitted with the infrared pulsed lasers, and other adjustments made, to equip them as multiphoton systems. These are known as 'multiphoton ready' (MPR) systems. Zeiss classes as MPR those of its systems that can be upgraded on site rather than having to go back to the supplier.

2.19 The multiphoton technique was developed by researchers at Cornell which filed an application for a patent on 14 November 1989. This later became the priority date for patent applications subsequently made by Cornell around the world. A patent (no. 5,034,613) was granted in the USA in 1991 (the Cornell US patent). Similar patents were granted in European jurisdictions (including the UK and Germany) in 1998 (the Cornell European patent) and in Japan in 1998. The technique was put into commercial production by Bio-Rad, which was given an exclusive licence in 1996. The Cornell patents covered the use of laser pulses which were shorter than a picosecond (described as subpicosecond or femtosecond technology).[1] The Cornell US patent expires in 2009 and the Cornell European patent expires in 2010.

2.20 A similar multiphoton technique, varying only in that it uses laser pulses having a pulse duration of a picosecond or longer, was filed worldwide by Hanninen and Hell under German Priority in 1994, and was patented in the USA in 1998 and in Germany in 1998. The German patent was contested and finally revoked in December 2002, after an appeal to the Bundespatentgericht (Federal Patent Court). However, a patent covering European jurisdictions (including Germany and the UK) was applied for at the European Patent Office (EPO) in 1995; it has not yet been

[1]The term 'femtosecond' is widely used but 'subpicosecond' is considered more accurate as a description of the pulse duration and of the technique covered by the Cornell patent.

granted. The use of the picosecond technique was exclusively licensed to Leica in February 1997.

The patent dispute

2.21 The proposed acquisition by Zeiss of Bio-Rad's microscope business follows a number of disputes, including litigation in the USA, between Zeiss, Bio-Rad, Leica, Cornell and others relating to the multiphoton technique. [✂] In 1998 Zeiss sought a declaration in the US Federal District Court for the Southern District of New York that certain activities did not infringe the Cornell US patent, or alternatively that the Cornell US patent was not valid. Bio-Rad and Cornell filed a counter-claim for infringement of the US patent. In February 2002 the court gave judgment on the construction of the patent claims in the Cornell US patent, substantially upholding Bio-Rad's interpretation of that patent. No judgment has yet been given on whether Zeiss has infringed that patent or on its validity.

2.22 The US litigation was suspended once Zeiss agreed to purchase the microscope business of Bio-Rad.

2.23 In 1999 Zeiss filed with the EPO a notice of opposition to the grant of Cornell's European patents. Leica filed its own opposition. In 2001 the Opposition Division of the EPO held that the grant of the Cornell European patent should be revoked. Cornell appealed, and following slight amendment to the patent the Technical Board of Appeal of the EPO upheld the appeal in November 2002; a decision which was finally confirmed in November 2003, maintaining the grant of the patent. (Further details are given in Appendix E.)

Customers

2.24 A list of customers who provided evidence is in Appendix F. Reflecting Bio-Rad UK's customer base, the great majority of the customers who gave evidence to the CC are from universities or research institutions. Customers who gave evidence are predominantly studying biological samples, in many cases using living cells. Many customers work in an environment where the microscope systems are used nearly continuously by a range of scientists doing a range of research. Customers communicate frequently and are aware of alternatives and new product innovations through their networks of other researchers and scientists.

2.25 Customers said that technical characteristics were the most important factor in choosing between products from different suppliers; only then did they consider other factors, particularly reliability, support services and price. Relevant technical characteristics include how much light is needed to generate an image, how fluorescence is detected, the speed of acquisition of the components of the image, the extent to which the light damages the sample, and the time needed to generate an image. Reliability and support services are considered to be essential as customers try to maximize the utility of equipment that they own over time—many microscope systems are expected to last up to ten years. It is also important to some customers to have access to the leading edge technology in their specific field to enable them to stay at the leading edge of research.

2.26 Most customers buy their advanced microscope systems through a tendering process, after arranging funding approval from an institution such as (in the UK) the Medical Research Council or the Wellcome Foundation Trust. We were told [✂] that about 90 per cent of optical sectioning systems are sold through some form of tender process. There is a period of pre-tender dialogue with suppliers, which we were told

by Bio-Rad may take 3 to 12 months. Customers then invite tenders to meet their requirements, either through the formal European public procurement process (in cases where the value exceeds about £150,000) or through private tendering. (Although this process is described from the point of view of the UK, we understand that it is essentially similar in other parts of the global market, although the relevant research is more likely to be publicly funded in the UK than in the USA.)

Other suppliers

2.27 In addition to Bio-Rad and Zeiss, there are three other main suppliers of advanced 3D light microscopy systems; Leica, Nikon, and Olympus. In addition to the main suppliers, there are several suppliers of specialized systems, including PerkinElmer, which supplies spinning disc systems. Other suppliers mentioned by customers and by the main suppliers include (but are not limited to) Atto Bioscience, LaVision, TILL Photonics, Prairie and VisiTech.

2.28 Leica Microsystems is one of three independent companies which share the Leica brand name. It is headquartered in Wetzlar, Germany but has a global presence comprising 11 manufacturing facilities worldwide as well as sales, distribution and service networks in 19 countries. Its microsystems division produces microscopes, imaging systems, specimen preparation and medical equipment. Leica Microsystems has three registered companies in the UK, Leica Microsystems (UK) Ltd, Leica Microsystems Imaging solutions and Leica Microsystems Cambridge. Leica Microsystems (UK) Ltd is the sales and services agent for Leica Microsystems in the UK. Leica Microsystems (UK) Ltd had a turnover of £12.1 million with an operating profit of £0.15 million for the nine months till December 31 2002; the turnover represents a 7.5 per cent increase over the turnover for the corresponding months in 2001.

2.29 Nikon Corporation is a worldwide company with headquarters in Japan. Nikon Instruments, a division within the Nikon Corporation, sells biological microscopes, industrial microscopes, stereoscopic microscopes, measuring instruments and inspection equipment. The net sales and operating income in this division in 2003 was 49.8 billion and 1.841 billion yen respectively. In addition the division spent 2.3 billion yen on R&D in 2003. Nikon UK Ltd. was established in 1979. Nikon Instruments established a division in the UK in 1983; it supplies quality optical microscopes and accessories to professional users throughout the UK, and has both sales and product support service personnel.

2.30 Olympus is a worldwide company also headquartered in Japan. Olympus operates out of three main business centres worldwide, Olympus Tokyo (Tokyo), Olympus America (New York), and Olympus Europe (Hamburg). Olympus UK was formed in 1975 and began to sell and service microscopes in 1985. Olympus UK is accountable to Hamburg, which in turn is accountable to Tokyo. Olympus increased its market share of the light microscopy segment in Europe in 2003 and had sales of €81.9 million.

2.31 Apart from Bio-Rad, all the main suppliers of advanced 3D light microscopes are optics manufacturers which provide their own microscope stands as part of the advanced systems. Bio-Rad supplies systems using microscope stands provided by other manufacturers; these may be purchased separately (see Table 1). Bio-Rad designs and commissions the building of the other physical components and the software.

TABLE 1 **Main suppliers of microscope stands for Bio-Rad systems**

	% of supply
Nikon Olympus Zeiss	[✂]

Source: Bio-Rad estimates.

2.32 Other suppliers of laser scanning microscopy systems include Atto Bioscience, LaVision, TILL Photonics, PerkinElmer, Prairie and VisiTech. Atto Bioscience, VisiTech and PerkinElmer primarily produce spinning disc systems whereas LaVision and TILL Photonics are primarily concerned with the development of innovative optical equipment for life science applications, producing customized solutions for their clients.

2.33 We have been told that some customers with necessary expertise assemble their own systems (so called 'self build'—since they do not make their own major components we have termed this 'self-assembly'). Bio-Rad estimated that [✂] per cent of multiphoton systems worldwide were self-assembled. Zeiss told us of six UK examples of self-assembly of multiphoton systems; self-assembly was a phenomenon of the early development of the multiphoton technique, and some of those involved in self-assembly were involved in that development.

3. The proposed merger and relevant merger situation

3.1 By an agreement, expressed to be entered into as of 14 October 2003, Bio-Rad agreed to sell and Zeiss agreed to purchase at a date to be determined, being not later than [✂], the assets of the laser scanning microscope business of Bio-Rad's cell science division. For Zeiss the agreement resolves the patent dispute referred to in paragraph 2.21. The agreement enables Bio-Rad to [✂]; to divest an unprofitable

business; to generate funding for investment by Bio-Rad in other business areas; and also to resolve the patent dispute.

3.2 Under the agreement the sale and purchase is made subject to a number of conditions, including a condition to the effect that Zeiss's obligations depend upon the CC [✂]. If the sale and purchase is completed, it will result in the transfer to Zeiss of most of the business, staff, assets and liabilities of Bio-Rad UK together with some parts of the Bio-Rad Group in the USA and elsewhere. With some exceptions, this includes the transfer of premises, machinery, materials, trade receivables, inventory, sales data, approvals and permits, pending sales offers, relevant intellectual property rights including the Cornell US patent and the individual designations of Cornell European patent and the associated goodwill, [✂]. Zeiss proposes to use a dormant subsidiary of Zeiss UK, Carl Zeiss Cellscience Ltd, as a vehicle for the proposed acquisition. The agreed purchase price is [✂].

3.3 The first question that we are required to answer under the Act is the jurisdictional question. That is, whether there are arrangements in progress or contemplation which if carried into effect will result in the creation of a relevant merger situation. In summary, section 23 of the Act provides that a relevant merger situation exists where two or more enterprises have ceased to be distinct. In addition, thresholds must be met, either in relation to the value of the turnover in the UK of the enterprise being taken over, or in relation to the share of supply of goods of any description in the UK or a substantial part of the UK, before the existence of a relevant merger situation can be found.

3.4 In relation to the question whether two or more enterprises have ceased to be distinct, we find that the agreement for the acquisition by Zeiss of the microscope

business of Bio-Rad's cell science division constitutes arrangements in progress which would, if carried into effect result in two enterprises ceasing to be distinct within the meaning given to that expression by section 26 of the Act.

3.5 In relation to the thresholds, to meet the share of supply requirements of the Act, a consequence of the merger must be that in relation to the supply of goods of any description at least one-quarter of all the goods of that description supplied in the UK, or in a substantial part of the UK, are supplied by or to one and the same person, or are supplied by or to the persons by whom the merging enterprises are carried on. If that person or persons already supplies at least one-quarter of those goods, then their share of supply must increase as a consequence of the merger.

3.6 For the purpose of determining shares of supply, we consider the appropriate measure to be the share of supply by volume of single-point confocal and multiphoton systems (that is, optical sectioning microscopes and multiphoton systems but excluding spinning disc systems which are not supplied by Zeiss or Bio-Rad). The supply of these goods constitutes the overlapping business in the proposed acquisition in the UK and it is the effect of the proposed acquisition on the supply of these goods that gives rise to questions as to its effect on competition in the UK.

3.7 From information provided by the parties we have calculated their shares of supply of multiphoton and single-point confocal systems, taken together, measured in sales in the UK, in the three years 2000 to 2002. Details are given in Table 2. Zeiss's share of supply was [✂] per cent by number and [✂] per cent by value, in each case exceeding one-quarter. Bio-Rad's share was [✂] per cent by number and [✂] per cent by value. Zeiss therefore already supplies more than one-quarter of the single-

point confocal and multiphoton microscope systems in the UK and as a consequence of the acquisition of the microscope business of Bio-Rad its share of supply of these goods will be increased.

TABLE 2 **UK shares of supply of single-point confocal and multiphoton systems**

By number

Total 2000–2002 share (%)	*Zeiss*	*Bio-Rad*	*Leica*	*Olympus*	*Nikon*	*Other*	*Total*
Confocal	[✂]						100
MPR							100
Multiphoton							100
Total							100

Combined share of supply for Bio-Rad and Zeiss
Total 48

By value ($)

Total 2000–2002 share (%)	*Zeiss*	*Bio-Rad*	*Leica*	*Olympus*	*Nikon*	*Other*	*Total*
Confocal	[✂]						100
MPR							100
Multiphoton							100
Total							100

Combined share of supply for Bio-Rad and Zeiss
Total 52

Source: the companies, CC estimates.

3.8 We find that Zeiss's agreement to acquire the microscopy business of Bio-Rad, with the intention of carrying on that business as part of its own microscopy business through Zeiss UK, constitutes an arrangement in contemplation or progress that would lead to Zeiss UK increasing its share of supply in those systems in the UK from [✂] to 48 per cent by volume and from [✂] to 52 per cent by value, and that the share of supply test is therefore met. We do not therefore have to consider whether the turnover test is met.

3.9 We therefore find that there are arrangements in progress or contemplation which if carried into effect will result in the creation of a relevant merger situation. During the course of our inquiry, neither Zeiss nor Bio-Rad disputed that this was the case.

4. Market definition

General considerations

4.1 As stated in the CC's *Guidelines on merger references* (CC2), an important element in deciding whether a merger would result in an SLC is to define the relevant market or markets. There are normally two dimensions to the definition of a market; the product market and the geographic market. The boundaries of these are determined by substitutability; that is, the extent to which customers can readily switch between substitute products, or suppliers can readily switch their facilities between the supply of alternative products. Substitutability is normally assessed within the framework of a test which measures the extent to which a hypothetical monopolist could profitably impose a 'small but significant non-transitory increase in price' (the SSNIP test).

4.2 However, the CC's guidelines (CC2) also recognize that there can be difficulties in delineating markets and that these can be particularly acute in markets subject to rapid change, in markets driven by new technology or in markets with other distinctive characteristics such as 'bidding markets'.[2] Our guidelines also point out that the CC does not regard market definition as an end in itself, but rather as a framework within which to analyse the effects of a merger on competition.

4.3 Product innovation is extremely important for the business of the merging firms. Customers have told us that the main factor determining their choice of system and supplier is functionality, including use of the most appropriate technology to meet very specific needs, and that this is changing quickly. Once this need is met other factors (reliability, support services and price) are considered. It is also important to many customers to have access to the leading edge technology in their specific field.

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[2]The Guidelines (see paragraph 2.29) state that 'bidding markets tend not to have multiple buyers and multiple sellers over a continuous time period; competition for contracts occurs at particular times only. Applying the SSNIP test in this instance might lead the Commission to consider each contract as a market in itself. This may not, however be very helpful in understanding the dimensions of the market within which rivalry between firms occurs'.

4.4 As a consequence firms have a strong incentive to invest in R&D, as the resulting product innovations can confer a significant advantage in the marketplace. In essence this process of competing through innovations is an important constraint on profits and maintains value for money to the customer. In support of this view, we have observed (see Table 7 at paragraph 5.30) that firms operate at high R&D to sales ratios, and there have been frequent and significant product innovations in the market (see Appendix D). Innovation is further discussed below.

4.5 The process by which the products produced by the parties are sold also has some characteristics of a bidding market. There is normally a public or informal bidding process each time a microscope system is purchased. Systems may be individually configured to meet the specific needs of customers, and competition may take place on the basis of improvements in specification within an agreed price for which grant cover has been obtained. The bidding process is further discussed below in considering the nature of competition in the relevant markets.

4.6 We take these features of the market into account in defining the relevant market. In particular we note that in a context such as the one described it would not be helpful to limit the market definition exercise to conducting a SSNIP test. Because of the individually configured nature of the products sold and the bidding features of the sale process a traditional analysis based on price could lead us to define markets that are too narrow. This would not provide a helpful framework for the competitive assessment in this particular case. Instead it may be more fruitful to analyse the competitive pressure that rival firms exert on one another through their R&D programmes.

4.7 Consequently, in addressing market definition in this case we adopt a two-pronged approach. We consider demand- and supply-side substitutability between different product categories. We also consider the extent to which the firms producing those products compete in their R&D activities in the sense described in paragraph 4.4. Given the specific characteristics of the businesses under consideration this analysis provides us with relevant market definitions that constitute, as expressed in our guidelines, a useful tool for analysing the competitive constraints faced by the parties to the merger from other firms supplying the market.

The product market

4.8 In determining shares of supply, we considered the overlapping products supplied by the parties involved in the proposed acquisition: single-point confocal and multi-photon systems. In considering the relevant product market or markets in which competition takes place, we also need to consider the supply of other products which may be substitutable for those overlapping products.

4.9 We considered whether advanced 3D light microscope systems are part of a wider market; and whether there are separate markets or segments within advanced 3D light microscopy for optical sectioning and computer deblurring and structured illumination systems, within optical sectioning for confocal, spinning disc and multiphoton systems, and within multiphoton for those using subpicosecond and picosecond laser pulse durations.

Advanced 3D light microscopy

4.10 Advanced 3D light microscopy consists of optical sectioning (confocal, spinning disc, and multiphoton) systems together with computer deblurring and structured illumination. They are used in two broad fields of research; biological (particularly

biomedical) research, and materials science. We found general agreement that these systems, taken together, were not substitutable by electron or scanning probe microscopy, at least in biological research. The nature of the work carried out with those techniques was very different; in particular, those techniques could not be used with living cells.

4.11 There is some substitutability between advanced 3D light microscopy systems and traditional 2D light or wide-field microscopy. Wide-field is an acceptable and cheaper substitute for applications where more sophisticated 3D imaging is not required. However, there are many applications where researchers need to see 3D images that go below the immediate surface of the specimen, and for these there is no substitute for advanced 3D techniques.

4.12 We conclude that electron, scanning probe or 2D light based systems are not in the same relevant market as advanced 3D light microscope systems.

Optical sectioning, computer deblurring and structured illumination systems

4.13 Different views have been expressed by customers and suppliers about substitutability between optical sectioning and 'non-optical' computer deblurring and structured illumination systems. We have been told by some that it is difficult or impossible to know from the quality and characteristics of the image which system was used to produce it; the difference lies in the applications to which each is best suited. Also these are new and developing technologies and much experimentation goes on with a view to getting better results from each. The main differences are that optical sectioning systems show the whole image as it is scanned and thus build up a record of changes more easily than with a traditional computer system (deconvolution) which reconstructs the image in a post-acquisition process, which

usually takes longer. It has been suggested that a non-optical system may also give a misleading image, and results may need to be checked on an optical microscope. However, for some applications the computer deblurring systems produce equally useful results and they tend to be cheaper. Structured illumination is a relatively new development which is not yet widely used. Some customers have both optical sectioning and computer deblurring systems. Substitutability reduces as the specification (and price) of the equipment increases to meet more specialized requirements.

4.14 Spinning disc systems are seen as an alternative to confocal systems for some applications. Customers may choose to use a spinning disc system because it is faster, perhaps at the expense of some quality of the image. It is substitutable for a range of applications with other advanced 3D products. Such a system is supplied under licence from Yokogawa by PerkinElmer, but others including Olympus also supply it in various forms.

4.15 Customers will thus readily switch from optical sectioning to computer deblurring systems for some applications but not for others. In general, however, there are relatively few customers for whom these two types of system are readily substitutable. As for supply substitutability, it is in principle not difficult for a firm supplying optical sectioning systems to start providing deblurring software, but it is more difficult and expensive for a firm providing purely software applications to start supplying a full optical sectioning system, as this would involve acquiring production facilities and expertise in a variety of fields, such as optics and precision mechanics. Zeiss, Leica and Nikon supply both optical sectioning systems and deblurring software; Zeiss is the only major optics company that supplies structured illumination systems. The other main suppliers themselves supply only optical sectioning

systems, although customers can add deblurring software to these systems. Such software can be purchased from a number of companies, none of which (apart from Zeiss and Leica) also supplies the optics.

4.16 Both suppliers and customers told us that different categories of 3D microscopes serve different needs; some have broad applications while others are specialized. Customers said that technical characteristics were most important in choosing between products from different suppliers. Relevant factors in determining the choice of a particular product specification include how much light is needed to generate an image (relative to how sensitive to light are the samples to be studied), how deep into the sample measurement can go, how fluorescence is detected, the speed of acquisition of the components of the image, and the time needed to generate an image. Once a product specification has been identified customers consider other factors, particularly reliability, support services and price. The products sold in the market are as a consequence highly differentiated to satisfy the specific needs of different customers and prices paid for different types of system vary widely.

4.17 We received evidence (see Appendix G) that non-optical sectioning products tend to be cheaper than confocal and multiphoton systems; and that confocal systems tend to be cheaper than multiphoton systems mainly because of differences in the price of the laser. There is also significant variability in the prices paid for the same model, presumably also because of differences in the exact product specification, and between different models within the same product category (for example, confocal and multiphoton).

4.18 Table 3 shows prices for confocal and multiphoton models. It is based on data from Zeiss and Bio-Rad and shows average sale prices for confocal and multi-photon models. The prices for multiphoton systems exclude the price of the pulsed laser (which we understand can cost between €100,000 and €200,000). Table 3 shows that the price paid for multiphoton systems is higher on average than the price paid for confocals. Furthermore MPR systems are on average slightly more expensive than confocals but still significantly cheaper than multiphoton systems. In considering Table 3 it is important to note that there is relatively high variability between prices paid within each system category and also to note that for multiphoton systems and MPR systems averages are based on few observations. The price variability within each category may be due to a variety of factors including, for example, differing specifications of the systems sold and the bargaining position of suppliers with respect to different buyers.

TABLE 3 **Average sale prices for confocal, MPR and multiphoton systems**

	Zeiss			*Bio-Rad*				
				Dollar price		*Sterling**		
	Average	*Std dev*	*Obs*	*Average*	*Std dev*	*Average*	*Std dev*	*Obs*
Confocal								
MPR	✂					✂		
Multiphoton†								

Source: main parties, CC calculations.

*To obtain the Sterling equivalent of Bio-Rad prices given in US Dollars, we have used the average exchange rate for the relevant month for each Bio-Rad sale taken from the Financial Times.
†Multiphoton prices do not include the price of the laser.

4.19 Different views were expressed on the extent of substitutability of demand within the field of advanced 3D light microscopy. Some, including Bio-Rad, suggested that there is relatively low substitutability within the types of products because most customers do not consider them very close substitutes for their particular work and would not switch in response to a price rise. Others, including Zeiss, pointed to the interchangeability of the techniques for some applications. Zeiss suggested there was a 'chain of partial substitution' through the market, and that the price of each

model was constrained by the price of others. Non-optical sectioning is seen as a substitute for certain applications (we were told by some customers that this applies at least in some cases for relatively 'thin' samples), but it is clearly not for all.

4.20 On the supply side, as shown in Table 5 (see paragraph 5.5), of the main suppliers of optical sectioning products Zeiss and Leica are the only ones also to produce non-optical sectioning products on their own. Other suppliers (including Nikon) are involved but on the basis of collaborations with other firms. On the other hand, there are many suppliers of non-optical sectioning products that are not active in the supply of confocal systems. Firms in the two categories may also not be competing very closely through their R&D programs. We were told by Bio-Rad that although virtually all confocal manufacturers are involved in the development of software for their products, companies that only supply computer deblurring software are not normally involved in the production and development of other components of a microscope system.

4.21 This suggests that the possibility of supply substitution could be limited for a firm that wanted to move from the supply of non-optical systems to the supply of full optical systems. Firms supplying optical systems may find it easier to diversify into the supply of non-optical instruments.

4.22 We conclude that within advanced 3D light microscopy there is considerable but variable segmentation based on customers' varying requirements. In particular, the distinction between optical and non-optical sectioning is significant. The two categories are substitutable on the demand side only to a limited extent, and on the supply side, although firms are active across the boundary either in isolation or through joint ventures, there are significant differences in the production processes,

and potentially in the R&D programs, conducted by firms operating only in the non-optical segment compared with those conducted by suppliers of optical sectioning systems. As a consequence we concluded that other methods such as computer de-blurring and structured illumination are in a different market from optical sectioning for the purpose of our analysis.

Confocal and multiphoton

4.23 Within optical sectioning techniques, products that use laser scanning systems—confocal (single-photon) systems, spinning disc systems, and multiphoton systems—are products that share a number of similarities. From the point of view of demand, different confocal microscopes are to some extent substitutable as they can all, to some extent, be adapted to meet a customer's requirements. For some customers however substitutability will be limited because they want features that are available only in a specific model. From the point of view of supply, the same core technologies are involved in the production of virtually all optical sectioning systems. Apart from Bio-Rad, which does not supply microscope stands, all major suppliers produce and develop the various elements of a 3D microscope laser scanning system, from precision mechanics and optics to detection technologies and software. Firms conduct R&D programs aimed at innovating to satisfy the same demands of the research community, the bulk of the customer base.

4.24 Multiphoton systems are a development from confocal systems, whose distinctive feature from the customer's point of view is that they are capable of deeper penetration of the specimen and under some circumstances cause less light damage to the specimen. They can be substituted for confocal systems, although this is not done unless the extra functionality of multiphoton is required, for example to study living cells. This is because of the considerable extra cost of the infrared pulsed

lasers (which are provided by specialist third party suppliers) and the complexity of setting up and operating them. Confocal systems can be adapted to dual use (so that they can be switched between lasers for use as either confocal or multiphoton systems) or designed to be MPR.

4.25 We were told by customers that when multiphoton systems were first introduced they were seen as a major step forward and that it was thought that they might become a general requirement for research. They have since been seen more as an important but essentially specialized product, which will supplement rather than replace the confocal systems. Relatively small numbers have been sold compared with confocal systems. Multiphoton systems are said still to be at an early stage of development; and are expected to be further developed to improve functionality and widen potential applications. However, the lasers are not expected to become cheaper, at least in the near future; new solid state lasers are better but more expensive. The price of multiphoton systems is likely to remain high relative to that of confocal systems (the cost of the laser is much greater). Thus there is only limited substitutability of demand between multiphoton and confocal systems.

4.26 The substitutability of supply between confocal and multiphoton systems is strictly limited by intellectual property rights. The technology incorporated in a multiphoton system shares many of the main elements of a confocal system and we understand that a firm which currently supplies confocal systems would be able to start supplying multiphoton systems without needing to acquire significant additional technical knowledge. In the event, supply substitutability is limited by the exclusive licences granted to Bio-Rad and Leica (although Zeiss has also been in the market). Given that the Cornell patent rights are due to expire in 2009–2010, our view is that it would be uneconomic for a firm not currently licensed to supply one of the two multiphoton

technologies to invest in R&D with the aim of circumventing the patent restrictions. Since the patents effectively prevent firms from manufacturing and selling multiphoton products, they also reduce incentives for confocal manufacturers to invest in R&D that is specific to a multiphoton product (such as, for example, optics).

4.27 We therefore find (see paragraphs 4.24 and 4.25) that there is little demand substitutability between multiphoton and confocal systems. We also find that although substitutability of supply would be easy if it were not for the patent restrictions, in the event it is limited by the exclusive licences granted to Bio-Rad and Leica (although Zeiss has also been in the market[3]). R&D investment by confocal suppliers may not be directed at the multiphoton technology. We conclude that multi-photon is currently in a separate relevant market from other optical sectioning systems.

4.28 We have considered the substitutability of the multiphoton systems based on subpicosecond and picosecond methods. The duration of the laser pulses is the only significant difference. Views on the relative merits of the laser pulse durations employed in multiphoton systems are varied. It was suggested to us by some that there was no significant technical difference in application and by others that the picosecond method was less effective. In particular it was put to us that only systems based on femtosecond (that is, subpicosecond) lasers were treated as being the latest state of the art. Our attention was drawn to a conference organized by the International Society for Optical Engineering (SPIE) with the title 'Femtosecond Laser Applications in Biology' and it was suggested to us that members of SPIE, and of many other researchers and scientists are unaware of picosecond systems. We consider that this point is overstated and that it is most unlikely that these scientists are unaware of picosecond systems. We were also referred to certain scientific

[3]A statement by Zeiss concerning their provision of multiphoton systems is in Appendix H.

literature that discusses multiphoton microscopy using subpicosecond lasers; again we do not find it surprising that such literature exists especially given the longer history of subpicosecond systems.

4.29 We were also told that some scientists believed that under certain circumstances picosecond pulses might cause less damage to the specimen and that the picosecond method had advantages, although subpicosecond pulses could penetrate more deeply. We were told that subpicosecond pulses tended to be lengthened as they passed through lenses and that when they met the sample the pulse duration might in fact be longer than a picosecond. We have also noted that in the marketplace there is competition between the systems produced by Leica using pico second laser pulses, and by Bio-Rad (and previously Zeiss) using subpicosecond laser pulses. Table 4 (see paragraph 5.4) shows their shares of supply.

4.30 We conclude that the technical differences between the two methods are not such as to imply different markets for systems using the two patented pulse durations. There is sufficient demand substitutability for the two types of multiphoton system to be regarded as in the same relevant market.

The geographic market

4.31 Products in the markets under consideration are supplied on a worldwide basis without significant national differentiation. Research and development applies to new products on a global basis. Except for niche suppliers, a global presence is needed to generate sufficient sales to maintain this investment. Production is typically concentrated in one country for global distribution. Although Bio-Rad is based in the UK most of its sales are outside the country. The main suppliers are the same throughout the world and their market shares are broadly similar on a UK or

worldwide basis. On the demand side, customers are similar throughout the world, being predominantly universities and other research institutions with very similar needs; our understanding is that the sale processes by which microscope systems are sold are broadly similar throughout the world. These factors suggest a worldwide market.

4.32 On the other hand, it can be argued that the market has a national dimension, on the grounds that customers have a strong preference for local service support. Any supplier needs to be able to provide support of sufficient quality to customers within a short time (we were told two days). Down time on the systems is costly to customers and may threaten live cell experiments. Frequent attention to the equipment can often be needed. This suggests that customers might only switch to suppliers who can provide this service.

4.33 All the major suppliers do provide service of this kind, but it is not necessarily nationally based. It does need to be supplied within the required time, but this can, subject to costs, be done from some distance. Marketing and sales staff are normally locally based and this too can present a non-trivial cost for suppliers. Zeiss explained to us that in particular these costs are higher for suppliers of particularly innovative and advanced products such as Bio-Rad, Zeiss and Leica. For these firms an extra 'layer' is required in the sales force, composed of highly qualified scientists that can act at the interface between the customers and suppliers. We were also told that different suppliers have different strengths in different parts of the

world. Olympus is stronger in Japan and the USA than it is in Europe, while Zeiss and Leica are stronger in Germany where Bio-Rad does not have significant sales.[4]

4.34 Although there are some elements pointing to different competitive conditions across the world, the factors mentioned in paragraph 4.31 indicate that the market is worldwide. This finding permits us to analyse competition in an appropriate way, particularly with respect to R&D. We therefore conclude that, for the purpose of the present analysis, the relevant markets are worldwide.

Conclusions on market definition

4.35 Considering first as the narrowest candidate market the products sold by both merging firms, we conclude that multiphoton systems constitute a separate relevant market. This is because there is limited demand-side substitutability with other systems, and because patent rights prevent suppliers of other systems from producing and marketing multiphoton systems. In this particular case, this has the effect of limiting the incentives for firms not enjoying the same patent rights to invest in R&D that is specific to the relevant technology. We believe that the two types of multiphoton systems are in the same market. As for other optical sectioning systems, we have observed that to a limited extent, these are substitutable on the demand side with other advanced 3D light microscopy systems. On the supply side, however, there is a significant difference in terms of the technologies involved in production between systems using optical sectioning and non-optical sectioning techniques. We conclude that non-optical sectioning systems are in a separate relevant market from optical systems for the purpose of our inquiry. We also conclude that the relevant markets are worldwide.

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[4]It was concluded by the Federal Cartel Office (Bundeskartellamt, reference no. B4-33402-Fe-91/03) in considering this merger in Germany, that the relevant markets were national; however, Bio-Rad does not have significant sales in Germany.

5. Assessment of the competitive effects of the merger

5.1 To assess the competitive effects of the proposed merger, we first assess the nature and extent of competition in the relevant markets (for multiphoton and for other optical sectioning microscope systems). We then consider what would happen if the merger were to proceed and what would happen in the absence of the merger (the counterfactual). We then compare these situations with each other to decide whether the merger would result in an SLC.

Competition in the relevant markets

5.2 We first consider competition in the relevant markets. It is clear that innovation is very important in satisfying the needs of customers and providing suppliers with an advantage. Suppliers and customers agree that product features are the key factor for customers in choosing a supplier, coming ahead of price. In these circumstances product development, and the necessary related investment, are essential to effective competition.

5.3 Having described the process of competition; we consider the immediate or short-term factors involved in that competition for individual sales: price and product features, sales and servicing, and how far customers switch suppliers. We go on to consider the medium- and long-term competitive strategies available to suppliers, product and process innovation, R&D investment, intellectual property rights and business structure; we conclude by looking at the relative market power of customers and suppliers and barriers to entry.

5.4 The five main suppliers (Zeiss, Bio-Rad, Leica, Nikon and Olympus) supply confocal systems worldwide, and all except Bio-Rad also manufacture and supply lenses, and wide-field microscopes. There have been three suppliers of multiphoton systems

(Bio-Rad, Leica and Zeiss). Our calculation of the shares of supply for confocal and multiphoton systems over a three-year period is given in Table 4.

TABLE 4 **Shares of supply worldwide of single-point confocal and multiphoton systems**

By Number

Total 2000–2002 share (%)	*Zeiss*	*Bio-Rad*	*Leica*	*Olympus*	*Nikon*	*Other*	*Total*
Confocal	[redacted]						100
MPR							100
Multiphoton							100
Total							100

Combined share of supply for Bio-Rad and Zeiss

Total	47

By Value ($)

Total 2000–2002 share (%)	*Zeiss*	*Bio-Rad*	*Leica*	*Olympus*	*Nikon*	*Other*	*Total*
Confocal	[redacted]						100
MPR							100
Multiphoton							100
Total							100

Combined share of supply for Bio-Rad and Zeiss

Total	49

Source: the companies, CC estimates.

5.5 Spinning disc systems are supplied by PerkinElmer (which does not supply any other microscope systems), Olympus and some smaller suppliers. Zeiss, Leica and Nikon also supply deconvolution software. Zeiss also supplies structured illumination systems. Structured illumination systems are also supplied by Thales. Other suppliers of deconvolution software for computer reconstruction systems are smaller specialist firms which do not supply light microscopy; for example Applied Precision Instruments, Autoquant, Vaytek and Scientific Volume Imaging. The products offered by competitors are shown in Table 5.

TABLE 5 **Competitors and their product offer**

Multiphoton	*Confocal*	*Spinning disc*	*Deconvolution**	*Structured Illumination*
Leica	Leica		Leica	
Zeiss	Zeiss		Zeiss	Zeiss
	Nikon		Nikon	
	Olympus	Olympus		
Bio-Rad	Bio-Rad			
		PerkinElmer		
		Visitech		
		Atto Bioscience		
LaVision	LaVision			
Prairie	Prairie			
TILL Photonics	TILL Photonics			
				Thales

Source: CC from information supplied by companies.

*Some microscope companies work in partnership, sometimes on a local basis, with suppliers of deconvolution software. Software suppliers include: Applied Precision Instruments, Autoquant, Vaytek, Scientific Volume Imaging etc.

5.6 Those supplying confocal systems have also supplied them configured so as to be readily upgradeable to multiphoton, or MPR. Bio-Rad gave us details of the different materials required and told us that their confocal systems could be converted to multiphoton in the field. Bio-Rad told us that about [✂] MPR systems had been sold. We understand that the numbers have declined and that customers are now more likely to go straight for a multiphoton system when they need one. We also understand that only a small number of MPR systems have actually been upgraded to multiphoton, and virtually none of these is in the UK.

5.7 All the main suppliers except Bio-Rad are optics manufacturers which supply their own microscope stands. All procure and supply lasers as part of confocal systems but these may also be bought separately by the customer; this is the normal practice for multiphoton lasers. Customers (at least in the UK) see Zeiss, Leica and Bio-Rad as being the main competitors at the more specialized and expensive end of the market, with Nikon and Olympus seen as strongest on more standard confocal microscopes.

5.8 In addition to the main suppliers of optical sectioning microscope systems, a number of smaller competitors provide higher-specification systems for specialized use. The latter include Prairie, LaVision, TILL Photonics and Visitech.

5.9 As we have seen, some customers also assemble their own multiphoton systems from separately bought components (self-assembly). Some parties have suggested that self-assembly is a constraint on suppliers, but the small number of customers that can and do assemble their own systems in the UK (including six identified by Zeiss) suggests that this is not a significant factor in assessing the effects on competition in the UK. Although in other parts of the world the propensity of customers to self-assemble may be greater, in general firms are aware which of their potential customers will do this. So self-assembly does not in general place a constraint on prices.

Microdissection

5.10 We have also to consider any possible effects on competition from Zeiss acquiring the microdissection businesses of Bio-Rad (Clonis). Zeiss told us that its own involvement in microdissection is limited to acting as a non-exclusive agent for PALM products in the UK. We were told by Zeiss that Leica sold about [✂] systems a year, and PALM sold about [✂]. Bio-Rad sold only [✂] units in total. Bio-Rad estimated that the total market was worth around $[✂], of which PALM had about 25 per cent. Bio-Rad also explained that the Clonis system is not a good substitute for PALM, because [✂]. We conclude that these matters do not raise issues of sufficient significance to affect our analysis of the competitive effects of the merger.

The sales process

5.11 Optical sectioning microscopes are high-value products which are individually specified to meet customers' requirements. A confocal system rarely costs less than £100,000 and a multiphoton system can cost more than £300,000. The suppliers are competing to sell small numbers of high-value products on infrequent occasions.

5.12 As described in paragraph 2.26, the tendering process involves customers writing a specification which is then put out to tender to a number of suppliers. They may consult suppliers to help draw up the specification. Because discounting is prevalent, list prices are not seen as particularly relevant to customers; nor are they said to be able to work out the prices quoted to other customers given the highly specialized nature of the systems. During the tendering process negotiation primarily takes place on the basis of what equipment and features can be provided for the sum the consumer has available. This is because, in the UK at least, most funders specify the sum available for equipment (which may include an allowance for servicing) and state that if this is not fully spent the balance needs to be returned to the funder.

5.13 We were told by Zeiss that a double-layer sales organization is required to sell high value systems. In addition to a general sales force which could handle standard instruments, including some confocal systems, specialists with knowledge of the scientific applications as well as the technology are needed to sell systems that were intended for more complicated applications. Considerable training is required to enable these specialist sales staff to gain a full understanding of the products and credibility with the customers.

Price competition

5.14 We have been told by customers and suppliers that price is not the most important factor for customers in deciding which supplier's product to choose. What matters most to customers is the effectiveness of the microscope system for the scientific purpose for which it is to be used. The customer arranges funding approval, and sales then take place by individual negotiation within the tender process. List prices are used primarily as a benchmark against which to measure discounts, and price comparisons are at the discounted price levels. Negotiation then takes place on the basis of what features can be provided for the discounted price. To secure sales, suppliers may need to be prepared to improve the specification within the price the consumer is willing to pay; direct price reductions may not benefit the customer because they will then have to accept a lower specification and not take up the full amount of approved funding. Price competition in the relevant markets for individual sales may thus be expressed through improvements in specification rather than actual price reductions. Customers appear to be knowledgeable about the nature of the product and negotiations on specifications are therefore important and effective in creating competition between different suppliers.

5.15 Suppliers (Leica, Nikon and Olympus) have put to us that the tender process does put significant pressure on prices, and that heavy discounting is used to secure sales. This is not inconsistent with the primary focus for competition being on product specification. Pressure on prices can take place at the stage when funding is approved; referees for research grants will have a well-informed view on price. This will provide a price level (which may not be transparent to the suppliers) within which competition to provide the best specification takes place. Since the margins suppliers achieve as a result may not be much different from those they would

achieve if the negotiation were based on price, they may perceive the outcome as one where prices are under pressure.

5.16 There may be other reasons for suppliers to discount; we were told that this could occur in cases where a supplier wanted to establish a new product with a prestigious institution acting as a reference site, or as part of research collaboration.

5.17 We tested the extent to which the price of Bio-Rad's sales of confocal systems were constrained either by the number of competitors in general, or by the presence of Zeiss as a competitor. We analysed the relevant contract awards over a sample period. In this regression analysis we could identify no statistically significant relationship between the value (that is, price) of Bio-Rad's winning bid and either the number of competing bidders or the presence of Zeiss as a competing bidder. This is possibly because negotiations between suppliers and customers take place over product specification as well as price, and also because the available data allowed us only partially to control for differences in product specifications. Nonetheless this result is also consistent with Zeiss not imposing a strong competitive constraint on Bio-Rad in the tender process. This analysis also suggested that neither the procurement process nor the source of funding were significantly related to Bio-Rad's prices. This suggests that customers have similar incentives to bargain whether or not they are using formal tendering procedures. Further details of this analysis are given in Appendix G.

Competition in servicing and support

5.18 The ability to meet high technical quality standards and to set up, maintain and repair equipment is seen as essential by customers. Any supplier needs to be able to provide high-quality components and fast and competent service. High multiple

usage of systems in research establishments, and in some cases the need to work with live specimens and to follow their development over a period of time, make it important to users to have rapidly available service. The equipment needs regular attention which cannot always be provided by those using it. Service contracts are usually charged in addition to the cost of the equipment, although extensions to an initial free service and warranty period may be offered or negotiated. The cost of the service contract is, increasingly, covered by the same funding agreement as for the system itself.

5.19 In virtually all cases service support is provided by the same firm that provided the microscope system. This is because of the need for detailed understanding of the systems (requiring specialist training) and the fact that products (in particular software) are frequently upgraded. Those companies with a higher density of installed microscopy systems can benefit from economies of scale in servicing.

5.20 All the main suppliers maintain service engineers in the UK, but those with main bases elsewhere may call in engineers from those more distant bases to deal with some problems.

Customers' readiness to switch and brand loyalty

5.21 The importance placed by customers on product specification might suggest that they do not place loyalty to a particular brand above specification. We were told by one supplier ([✂]) that the strong brands of the major suppliers at the top end of the market made customers reluctant to switch from them. However there are cases where customers have switched to a rival company despite a long-standing collaborative relationship. We have conducted an analysis of consecutive purchases

by the same institution on the basis of Zeiss's and Bio-Rad's sales data. Table 6[5] presents the results of this analysis and could at first sight be taken to suggest a degree of loyalty to the same suppler.

TABLE 6 **Analysis of consecutive microscope purchases**

per cent

	All	*Previous supplier*	
Current Supplier		*Zeiss*	*BioRad*
Zeiss	[redacted]	[redacted]	[redacted]
Bio-Rad			
Total	100	100	100
Base	[redacted]	[redacted]	[redacted]

Source: the companies; CC calculations.

5.22 We were told that the choice of which supplier to purchase from is heavily influenced by previous experience and by peer recommendation. Customers told us that there was a learning curve in adopting machines from a new manufacturer and there are advantages in being able to interchange parts. However, we have been told of instances where individual researchers joining an institution have insisted on having a particular brand of microscope system, which may be different from that already in use there. Most of the larger institutions have a variety of systems supplied by different manufacturers and can compare their efficacy which may vary for specific research needs.

5.23 It has been suggested by one supplier (Olympus) that the bidding process may act to lock out competitors because specifications may be designed with a preferred system in mind; also that some brands are associated with high quality, which affects

[5]In Table 6 the analysis refers to instances of successive purchases by the same organization. The columns give figures for the frequency with which a purchase of a Zeiss or Bio-Rad system purchase was followed by the purchase of a Zeiss or a Bio-Rad system. For example, in the case of Bio-Rad, there were [redacted] instances in which an institution which had bought a Bio-Rad microscope then went on to buy either a Bio-Rad or a Zeiss system. Of these [redacted], the majority [redacted] bought another Bio-Rad system while [redacted] bought a Zeiss. In considering the implications of these data it is important to note that this analysis does not take into account purchases from other suppliers such as Leica. Bio-Rad also pointed out that three of their purchases are 'upgrades' and therefore do not provide an indication of the likelihood to switch supplier. For these reasons, the figures suggesting consecutive purchases of Zeiss or BioRad machines are likely to be overestimates of the true position, as there may have been a purchase of a different machine between two BioRad or two Zeiss purchases.

demand. However, the bidding process does give other suppliers the opportunity to match or improve any specification advertised and to offer lower prices. Customers are very well informed about alternatives (and inform each other) and it will be seen below that they are responsive to innovation.

5.24 Overall, the evidence suggests that previous sales may provide some competitive advantage in gaining follow-on orders, but that this advantage can be overcome.

Medium- and long-term competitive strategies

Innovation

5.25 Customers expect suppliers to be able to provide equipment which will be well suited to their specific research. Innovation is important because many researchers expect to be able to operate at the leading edge of their particular field. We were told that this is a two-way process; technological advances in microscopy enable new research techniques to be developed. Zeiss told us that innovations can quickly shift market shares. Competition has been characterized by shifting towards suppliers which have introduced new products; for example Bio-Rad's introduction of multiphoton, Leica's introduction of a new spectral scan head, and Zeiss's introduction of its LSM 510 META system. Zeiss said that when it introduced that system, it remained without a close technological alternative for just under one year; Zeiss could realize better prices and the number of systems sold increased. Such innovations can take the form of new products or components, or of improved production processes. (See Appendix D.)

5.26 Since the early 1990s innovations have become more frequent and more firms have been able to bring new products into the market. This is associated with the growth and development of confocal systems as a mainstream technology, related to

developments in life sciences research. This upper end of the microscopy market is seen by suppliers as a growth area in comparison with standard wide-field microscopy, which is static. A number of suppliers have strategies to develop their presence at the higher end of the market. At the same time there is also emphasis on producing cheaper and more standardized confocal systems, exemplified by Bio-Rad's CellMap system.

5.27 It was suggested (by Zeiss) that since multiphoton is the latest 'must-have' technology, the whole market has shifted in favour of those who can supply it, to the extent that those who cannot will find it difficult to compete in the wider market for confocal systems or even advanced 3D light microscopy as a whole. If this argument were correct multiphoton suppliers might have 'leverage' with which they could exclude others from the wider market and other suppliers might be disadvantaged. However, confocal systems, and the confocal technique, have become established as core technology which suppliers must provide. Opinions differ as to whether this has happened, or will happen, with multiphoton. From the evidence we have seen, it appears that most customers and suppliers now see multiphoton as an important but specialized product. We believe that customers will continue to purchase other products from whichever supplier best meets their requirements.

5.28 A further issue related to the leverage argument is the extent to which the system of tendering acts to exclude suppliers which cannot supply a range of systems. It has been put to us (by Olympus) that tenders may require the supply of a number of different microscopes ranging from standard wide-field microscopes to high-specification systems. Where these include multiphoton systems, we were told by Olympus that suppliers which are excluded from that market by patent restrictions are prevented or discouraged from tendering for the other instruments. However, it is

possible for suppliers to compete for part of the tender (known as a 'lot'), and analysis of multiphoton tenders with multiple lots shows that most of the tenders attract several bids for some lots only (see Appendix G).

Research and development

5.29 The importance of innovations in providing a competitive advantage implies that suppliers need to invest in product and process R&D, and to maintain collaborative links with microscopy researchers and knowledgeable customers. There are variations between suppliers in R&D spending and in the R&D/sales ratio (for Zeiss and Bio-Rad (see Table 8). Suppliers differ in what they consider to be R&D investment. As Zeiss has pointed out, much of the most innovative research work is carried out in university departments; unless the firm is paying directly for this research it will not be accounted as R&D expenditure. The R&D activity carried out by suppliers themselves is often directed at adapting previous innovations to bring variant products to market.

5.30 Except in the case of niche suppliers or self-assemblers, which may contribute to specific innovations, a sufficient volume of sales worldwide is required to recover the sunk costs in these R&D activities. R&D costs to sales ratios for Zeiss and Bio-Rad UK are shown in Table 7. Bio-Rad incurs extra costs compared with vertically integrated suppliers, because it invests a significant amount of its R&D spending in ensuring compatibility of its products with microscope stands provided by others. The merged Zeiss/Bio-Rad could be expected not to incur these particular R&D costs, as a result of operating as an integrated manufacturer.

TABLE 7 **Research and development spending and sales ratios**

					€ million	*£ million**
	Years ended 30 September					
Zeiss	*1999*	*2000*	*2001*	*2002*	*2003*	*2003*
Sales/turnover						
Research and development						
Ratio (%)						
					$'000	*£'000†*
	Years ended 31 December					
Bio-Rad	*1999*	*2000*	*2001*	*2002*	*2003*	*2003*
Sales/turnover						
Research and development						
Ratio (%)						

Source: CC from information supplied by Zeiss and Bio-Rad.

*Conversions of the 2002/03 results made from € to £ at the rate on 9 March 2004 of €1:£0.675.
†Conversion of the 2003 results made from $ to £ at the rate on 9 March 2004 of $1:£0.544.

Intellectual property rights

5.31 Intellectual property rights are a very significant factor in competition in the relevant markets. Many of the detailed techniques used in advanced 3D light microscopy have been based on patented inventions, and there has been a constant process of attempts to obtain and to test the validity of patents or their application to particular techniques in different jurisdictions. This process has been constrained by the cost of litigation, so competitors may not often pursue each other that far, although this is what has happened in the case of the Cornell multiphoton patents. Suppliers need to be confident that they will not be subject to a successful infringement claim if they are to compete to supply relevant products. In practice, intellectual property rights have not limited the ability of suppliers to operate in the market for systems other than multiphoton, as suppliers have either found alternative techniques or have not found it cost-effective to pursue possible infringements.

Business structure—integration

5.32 The structure of the business of the main suppliers (except Bio-Rad) puts them in a position to provide integrated systems using their own components. This enables them to control costs, to adopt standardized design features and to minimize

problems of incompatibility of components. However, it means that they may have less flexibility in meeting customers' specific requirements. In particular, Bio-Rad has had an advantage with those customers who wanted to choose their own microscope stand rather than taking the one offered by the supplier as part of a system; but a disadvantage in terms of the extra costs that this imposes [✂]. We have been told that it is necessary to supply integrated systems in order to be able to compete profitably. On the other hand, many customers have said they want flexibility to meet particular research needs and to maximize the utility of equipment they already have.

Buyer power

5.33 In referring the case to us (in its decision given and published on the OFT web site on 30 December 2003) the OFT said that customers did not appear likely to hold any degree of countervailing buyer power. However, much of the evidence we have received is not consistent with this view. Customers appear very well informed about the products and are frequently involved in product development. Some of them, particularly in prestigious institutions, are in an especially strong position because they act as reference sites, and test new developments. The customers form a relatively small group with strong international contacts and they are ready to exchange information about products and prices with each other. This enables customers as a whole to share the advantages of those which have the most buying power.

Coordinated effects

5.34 The parties have put to us arguments that several features of the market make any collusive behaviour difficult if not impossible. Apart from buyer power, which we have discussed above, there is a relatively large number of suppliers of confocal systems and they are not aware of the terms of the contracts won by their competitors. The

products are highly differentiated, and change quickly as a result of innovation. The sales process means that sales are irregular in frequency and value, making the value of any future contracts very uncertain.

5.35 The evidence we have seen supports these arguments, at least as far as confocal systems are concerned. Our analysis of Bio-Rad sales data suggests that the number of competitors does not determine the price of confocal systems. An analysis of the frequency and value of European tenders between 2000 and 2003 (see Appendix G) supports Bio-Rad's view that the contracts come up irregularly and are of varying value. We have seen no indication of collusion in the industry.

5.36 There remains a question whether tacit collusion can operate in the market for multiphoton systems, where the number of competitors is limited by the enforcement of intellectual property rights. Although the scope for this is greater because of the patent protection, the other factors outlined above still apply. Particularly important in this respect is the strong way in which customers respond to innovations. Furthermore, innovations will also come from outside the relevant markets, for example from universities. These factors make the market for multiphoton systems one where even just two suppliers will have strong incentives to compete both in R&D investment and for individual contracts. We therefore conclude that at least under present market conditions the scope for tacit collusion is also limited in this market. We note that the German Federal Cartel Office[6] took the view that competition between Zeiss and Leica has been and can be expected to continue to be fierce.

[6]Bundeskartellamt reference no B4-33402-Fe-91/03.

Market entry

5.37 The main barriers to entry to the markets we have identified are the non-recoverable costs of being able to supply the microscope systems and of setting up and running a service operation, the need to set up or get access to R&D, and (for the next few years) intellectual property rights.

Supplying systems

5.38 The set-up cost of being able to supply a system would be high if a new entrant wanted to start manufacturing its own integrated product; however, entry would be relatively easy if the entrant were an assembler rather than a manufacturer. Such an entrant could use a business platform in lasers or IT, instead of in optics; although all current main suppliers except Bio-Rad are optics companies. A number of smaller businesses such as Prairie and LaVision assemble microscope systems. Others have done so in the past and left the market (see Table 8). It is not clear how easy it would be for a smaller firm to grow its market share, given the advantages of being an integrated supplier.

TABLE 8 **Entry and exit in advanced 3D light microscopy 1982–2003**

	Year										
	1982/83	*1984/85*	*1986/87*	*1988/89*	*1990/91*	*1992/93*	*1994/95*	*1996/97*	*1998/99*	*2000/01*	*2002/03*
Entry	Zeiss	BioRad Heidelberg Instruments	Olympus	Aria Leica	Mole.Dyn Noran Meridian	Nikon	TIC	Yokogawa	Atto	Per Elmer	Visitech
Exit			Heidelberg Instruments*		Aria		TIC	Mole Dyn	Meridian Noran		

Source: the companies.

*Heidelberg Instruments then renamed in Leica.

5.39 Leica has put to us that entry is possible if the entrant can differentiate its offer from existing products on price, speed, resolution or application. On this basis, it expects entry within the next five years.

Service requirements

5.40 Meeting customers' service requirements would incur costs; Zeiss estimated that it would cost £[✂] to set up a service site in the UK if only one service engineer were required, and approximately £[✂] for three engineers. Bio-Rad estimated that a UK three-engineer operation would cost about £[✂] based on their current Northern European arrangements. It is not considered practicable for servicing to be done by a third party because of the need for expert and up to date knowledge of the equipment. Some costs could be recovered through customer charges, but most existing suppliers see servicing as a cost rather than a profit centre.

5.41 High set-up costs of servicing could deter new entrants in any geographical area unless they already had a dense installed base in their area. However, suppliers can provide support more remotely, and the set-up costs may not in fact be high enough to deter new entry.

R&D

5.42 The need to have access to expertise and to invest in R&D could act as a barrier to new entry. A new entrant would need to differentiate its product, to establish its credibility with customers, and to invest in product development and links with product researchers. To be active in the innovative part of the market requires sufficient market share to cover the fixed cost investment of R&D.

5.43 Small firms have found niches which enable them to enter the market and exert some competitive pressure on the larger suppliers. In theory such an entrant could use a 'must-have' innovation to take a large market share. The example of Bio-Rad suggests that, although this is possible, it may not be sustainable in the longer term. Although Bio-Rad has brought to market the two main developments (confocal and

multiphoton) it has still not been able to compete profitably with the large integrated suppliers over time.

Intellectual property

5.44 Intellectual property rights can present a barrier to new entry, as it is their function to protect the interests of inventors and licensees. Nevertheless, except in the case of multiphoton, the experience has been that alternatives have been found, in some cases by innovating around the patents. For example, Leica introduced its TCS SP2 AOBS as a response to Zeiss's LSM 510 META.

5.45 The fact that the market is characterized by innovation suggests that it would be possible for an existing or new supplier to introduce a new product using a new technical development. Zeiss has argued that entry can take place through innovation in one of the contributing technologies (optics, precision mechanics, detectors, or computer processing). PerkinElmer has become recently established as a significant although specialist competitor in this way with its spinning disc system licensed from Yokogawa, although it does not have an exclusive position.

5.46 New entrants will not, however, be in a position to supply multiphoton systems which infringe the Cornell patents until they have expired in 2009–2010. Nor, in contrast to the position with other patented methods, has an alternative with similar functionality to the Cornell multiphoton methods yet been found by suppliers, other than the picosecond method which is patented in the USA and licensed to Leica. Although the German patent on that method has been revoked, a patent has been applied for, corresponding to the US patent, covering European jurisdictions, designated for the UK, France and Germany. (see Appendix E).

5.47 We were told by suppliers and customers that although it was possible, it was unlikely that a substitute for the multiphoton technology could be invented, developed and brought to market during the next five years.

Conclusions on competition in the relevant markets

5.48 The relevant markets are characterized by high product differentiation, with competition focusing on product features. This implies that innovation is crucial in providing a competitive advantage. Technological barriers to entry are surmountable, except where protected by patent rights.

5.49 The high degree of product differentiation, together with innovation, means that firms can be in a position to charge high gross margins on individual products sold. Customers' highly specific preferences and their desire to have the latest technology means that firms spend a relatively high proportion of their income on R&D, essentially competing using their R&D programmes to win market power on specific innovations. There is some price competition in this market, for example through negotiations on specifications. Competition to introduce product innovations supplements this price competition in driving overall profit margins down. We have seen that suppliers are constrained by the buyer power of expert consumers in a bidding market. The market is not conducive to collusive behaviour.

5.50 There is competition between several large suppliers, with smaller suppliers occupying niche positions and exerting some competitive pressure on the larger suppliers. It is possible for a new supplier to take a significant market share through exploiting an innovation (as happened with Bio-Rad and PerkinElmer), but it is less certain that it can maintain this market share unless it is vertically integrated.

5.51 There is steady demand for confocal and multiphoton systems, and for improvements in the technology to enable new applications in biological research. The market for such systems (as distinct from standard microscopes) is seen as growing. The relevant markets are characterized by effective competition, within the limits set by patent protection in the case of multiphoton systems.

Effects of the merger on competition

5.52 In assessing the effects of the proposed merger on competition in the relevant markets, we need to compare the competitive situation that would result from the proposed merger between Bio-Rad and Zeiss with the situation in the absence of the merger (the counterfactual). We first consider what would happen if the merger proceeds; we then identify the likely counterfactual, and finally we draw the comparison.

5.53 As a preliminary point, it has been put to us that the licensing of the Cornell patents on an exclusive basis restricts competition particularly in the supply of multiphoton systems. We do not regard this as a matter that results from the merger under consideration.

What would happen if the merger proceeds

5.54 In referring the merger to us, the OFT (in paragraph 36 of the its published decision) gave its assessment that 'Zeiss and Bio-Rad are leading suppliers of single and multi photon confocal laser scanning microscropes'. We note that customers see Zeiss, in principle, as a supplier of both such systems. We will see below in considering the counterfactual that other factors have to be taken into account before drawing any conclusions about whether there would be an SLC and we draw no such conclusions before we have made the appropriate comparison. However, we start by considering

what would happen if the merger were to proceed, and Zeiss were to stay in (or re-enter) the market for multiphoton systems as a merged entity with Bio-Rad.

5.55 This situation, following the OFT assessment, could result in a reduction in the number of suppliers compared to the situation before the merger. However, a change in the number of suppliers is only conducive to a lessening of competition if it translates into direct or indirect effects on competition in the relevant markets. Our analysis of the markets has shown the importance of innovation. Market power here implies not only the ability to raise prices, but the ability to reduce investment in technological innovation and R&D. It may be as important or even more important to examine how the merger would affect incentives to innovate as to consider its effects on short-term prices.

Effects of the merger on the markets for multiphoton and other optical sectioning microscope systems

5.56 We start by looking at the effects of the merger on the market for optical sectioning systems other than multiphoton, before going on to look at the special factors involved in assessing the effects on the market for multiphoton systems. We summarize the views of customers and suppliers. We then go on to explain our own views of the effects of the merger on the market for optical sectioning systems, looking first at non-multiphoton systems and then at multiphoton systems, where special factors are involved.

Customers' views

5.57 Customers have expressed differing views on the effects of the merger. Some are concerned that they would have less choice. In particular, they believe that although Zeiss would go on supporting existing Bio-Rad systems for some time, any new

system would be supplied by Zeiss, with Bio-Rad options being phased out. They would prefer to have Bio-Rad products still available (including the new Cellmap systems). In particular, they expect that new systems would all be supplied with Zeiss microscope stands, removing the current choice and flexibility they have in the use of stands provided by different manufacturers. (The views of customers on the proposed merger are summarized on the CC web site.)

5.58 Other customers take a different view. They believe that Zeiss would provide an improved service compared to Bio-Rad, competing more effectively with other suppliers, and that integrated systems like those provided by Zeiss are inherently superior.

5.59 It has been suggested that the merger would result in a loss of service particularly for UK customers because the centre of operations would, it is said, move to Germany, and local servicing arrangements would be lost. Others have suggested that it would be in Zeiss's interest to maintain the servicing and to satisfy their UK customers. Zeiss told us that it would seek to support and maintain the Bio-Rad systems to an equal or greater extent than it does for Zeiss systems. In particular, it will offer and perform service and maintenance for at least eight years following the merger on commercial terms for all those Bio-Rad systems installed in the UK that Bio-Rad currently offers to service and maintain.

5.60 It has also been suggested that local research and development contacts will be lost and that Zeiss would be likely to cut down on R&D in the UK compared to what has been done by Bio-Rad. Zeiss told us that it would continue to liaise with UK research institutions and saw them as essential for future innovation.

Competitors' views

5.61 Zeiss's view was that Bio-Rad was not an effective competitor in the existing market. A merged Zeiss/Bio-Rad would compete more effectively than Bio-Rad with Leica.

5.62 Bio-Rad's view was that the merger would enable Bio-Rad UK to develop within the framework of an optics company.

5.63 The views of competitors (Leica, Nikon, Olympus) are that the loss of Bio-Rad would give rise to an SLC because Zeiss would become by far the strongest supplier and would be able to exclude others from at least parts of the market.

Market shares—the installed base

5.64 In the context of this proposed acquisition, an increase in market shares would take the form of an increase in the installed base of systems supplied to customers. Clearly Zeiss would gain access to the Bio-Rad installed base. This would give Zeiss advantages in dealing with those customers, but would also carry costs of having to service their systems in a specialized way. The fact that customers tend to stay with the same supplier would not necessarily give Zeiss an advantage with Bio-Rad customers for future purchases. We do not expect that gaining the Bio-Rad installed base would increase Zeiss's market power against remaining competitors, because they would still be in a position to compete as they do now for new contracts.

Innovation

5.65 Given the nature of the market, the acquisition would not provide Zeiss with an opportunity to reduce its investment in R&D or to slacken its efforts in collaboration with researchers. It will still face competition from others, including niche suppliers, to innovate and supply the latest technology. Nor would gaining access to Bio-Rad's

R&D work and contacts place it in such a superior position as would discourage others from entering or remaining in the market.

The multiphoton market

5.66 In the supply of multiphoton systems, Zeiss/Bio-Rad and Leica would become the only main suppliers for the duration of relevant patent rights. They would have no incentive to sub-license the rights to market multiphoton systems to a major competitor; we would expect them to pursue any major competitor which attempted to infringe the patent by supplying either multiphoton or MPR systems. Zeiss has told us that it would grant sub-licences under the Cornell patent, for a reasonable fee and/or royalty, to all commercial customizing organizations (ie those that adapt laser scanning microscope systems to meet the specific requirements of a commercial customer, for example La Vision, TILL Photonics, Prairie, etc). It would also grant sub-licences under the Cornell patent, for a reasonable fee and/or royalty, to any commercial organization for the purpose of research and development only. Zeiss also told us that it would not institute patent infringement proceedings against so-called 'self builders' of multi-photon microscopes or those who upgrade confocal systems to multi-photon in any non-commercial context and will offer all such non-commercial organizations a free sub-licence under the Cornell patent if they contact Zeiss; this offer will be published on the Zeiss web site.

5.67 If there were a reduction of multiphoton suppliers from three to two, that could in principle result in less customer choice and could reduce competition. The remaining suppliers could have a reduced incentive to innovate. However, as discussed above (see paragraph 5.36), the features of the market indicate that even two suppliers could have significant incentives to invest in R&D and to compete for sales. Furthermore, given that microscopy is developing technology subject to patent

protection, there would be a question whether any reduction in competition in multiphoton supply following the merger would be substantial. Given the position on the counterfactual discussed below, we have not needed to draw a conclusion on this question.

5.68 There is a further question whether both the variants of multiphoton will continue to be seen as marketable. At present products using the alternative laser pulse durations are competing effectively; both have been securing sales. Whether this continues will depend on customers' views of the relative merits of the systems rather than any effect of the merger. While there are different views, we expect that it is most likely that both variants will continue to be valued and to compete with each other at least for the duration of the patent restrictions.

5.69 A related question is whether Leica would be able to compete as effectively with Zeiss alone to supply multiphoton as it had with Bio-Rad in the market. We see no reason to believe that this will not be the case. Leica has competed effectively with Bio-Rad, with its own particular design features, and we expect this to continue.

5.70 Nor, in contrast, do we see any reason to expect that Leica and Zeiss would be in a position tacitly to collude in the supply of multiphoton systems, for the reasons given above in concluding that the market was not conducive to such behaviour.

Leverage

5.71 One potential effect of the merger suggested by some parties was that if Zeiss were the only supplier of multiphoton systems, it would be able to extend this market power to confocal systems or more generally. It would be in the unique position offering a clear upgrade path for confocal customers who wanted access to

multiphoton. We believe that multiphoton is now seen as a specialized application rather than something which is needed by a majority of confocal users. Sales of MPR systems are low in comparison with ordinary confocal systems, and there are few if any cases of MPR systems actually having been upgraded. It has been suggested that the leading R&D in the next few years will relate to improvements in multiphoton applications; whether or not this proves to be the case, Zeiss has told us that it would be prepared to sub-license others, including competitors, to undertake relevant R&D if the merger proceeds. In any case, we do not expect that Zeiss would be the sole supplier of multiphoton, since Leica would remain in competition.

Vertical effects

5.72 If Zeiss moves to a position where it supplies only its own microscope stands as part of its systems, this will affect other suppliers of stands. In particular Nikon, which has the bulk of the supply of microscope stands for Bio-Rad systems, will no longer be able to supply stands to Bio-Rad for its systems. Nikon has estimated that it would lose business amounting to [✂] worldwide as a result. However, any such effect will be felt primarily in the microscope stand market rather than in the market for confocal and multiphoton systems. Given the strength of Nikon as a supplier of microscope stands, we consider this effect to be marginal. Also, Nikon will still be able to compete to supply confocal systems using its own microscope stands as part of integrated systems.

Summary of the effects of the merger

5.73 We expect that if the merger were to proceed the market for optical sectioning systems other than multiphoton systems would remain competitive because of the number of strong competitors remaining and the continuing competitive pressure from smaller suppliers. We do not expect that the merger would put Zeiss in a

position to exclude others from this market. In the multiphoton market, Leica would remain a strong competitor, incentives to innovate would remain, and we consider that the market is not conducive to collusion.

The counterfactual

5.74 Having examined what would happen if the merger were to proceed, we now consider the counterfactual—what would happen if it did not proceed. In this context, we have considered the position of the main parties and other competitors.

5.75 We should note first of all that Zeiss and Bio-Rad have argued that, the correct comparison for the multiphoton sector is between a pre-merger situation where only Bio-Rad and Leica are selling multiphoton and a post-merger situation where only Zeiss and Leica are selling multiphoton systems. While we note this view, the comparison we need to draw is between what we expect would happen with and without the merger. Bearing this need in mind, we consider the counterfactual in terms of the options open to Bio-Rad, Zeiss and others if the merger did not proceed.

Bio-Rad

5.76 We consider that the options for Bio-Rad are to continue as at present; to sell the business (including the Cornell licence) to another competitor; to transfer or sub-license the Cornell US and European patents to Zeiss without selling the business; or to wind up the business.

5.77 We have been given evidence by Bio-Rad that leads us to believe it will dispose of the Bio Rad UK business for a number of financial and strategic reasons. We expect that whatever the outcome of the merger proposal, Bio-Rad's microscience operation

will not continue as an independent business. An assessment of the financial position of Bio-Rad and Bio-Rad UK is given in Appendix C.

5.78 We consider that it is unlikely that Bio-Rad would transfer or sub-license the Cornell US and European patent rights to Zeiss or to another competitor, without also disposing of the business of which they are a major asset. We expect that the outcome of the merger not proceeding would be that Bio-Rad would seek to sell the business to another party. Potential purchasers can be identified among the main competitors in the relevant markets (Leica, Nikon, Olympus) and in markets that are closely related to the relevant markets. We expect the most likely alternative purchaser to be one of the optics based companies already supplying advanced 3D microscopes; we have seen that it is not so easy for a non-integrated supplier to compete. Any such sale would in our view include transfer of the patent licence, and might or might not involve transfer of the costs and benefits of any continuing patent dispute with Zeiss.

Zeiss

5.79 In this situation, we consider the position of Zeiss. Having carefully assessed the evidence in relation to the patent issues (see Appendix E), we expect that in the absence of the merger, Zeiss would not supply multiphoton systems for the duration of the patent protection. In coming to this view we have considered the commercial judgements Zeiss would have to make and the likelihood of an agreement being reached on transferring the licence under the Cornell patents or granting a sub-licence or of a successful challenge to the patent.

5.80 We then consider Zeiss's competitive position in the market for other optical sectioning systems. Our analysis of competition above shows that the market for

optical sectioning systems is very competitive even in a situation where only a few competitors can strongly provide multiphoton systems, and that although it may provide some advantage, possession of rights to the multiphoton method does not exclude others from the market for other optical sectioning systems. We expect that in the absence of a merger Zeiss would continue to compete in the market for other optical sectioning systems.

Competitive position resulting from the counterfactual

5.81 We have concluded that, in the absence of the merger, Bio-Rad would try to sell the relevant business to another competitor, most likely to be an optics-based advanced 3D microscope supplier. Such an alternative purchaser would be placed in the same position as Zeiss would be in after the merger; that is, with an exclusive licence to make and sell multiphoton systems under the Cornell US and European patents and the ability to make use of the Bio-Rad assets. That purchaser, as we have seen, would not have Zeiss as a competitor in the multiphoton market, but it would still have Zeiss among its competitors in the market for other optical sectioning systems.

Comparison between the counterfactual and the merger situation

5.82 As we have said, the assessment of whether the merger would result in an SLC involves comparing the competitive situation in the relevant markets if Zeiss acquired the Bio-Rad UK business with the situation if it were purchased by another firm.

Effect of a sale to Leica

5.83 If the alternative purchaser were Leica, the result would be that Leica would be the only supplier able to provide multiphoton systems without infringing relevant patents. There could thus be substantial negative effects on competition to provide

multiphoton systems, compared with the situation where Zeiss, having merged with Bio-Rad, also supplied those systems.

5.84 However, in relation to other optical sectioning systems, given that we expect Zeiss to continue to compete to provide such systems in the absence of the merger, and to conduct R&D, there would be no significant difference in the conditions of competition if Leica bought Bio-Rad's business than if Zeiss did so.

Effect of a sale to a purchaser other than Leica

5.85 The effect of the sale of Bio-Rad's business to a competitor other than Leica would be that only the purchaser would be able to compete with Leica to provide multiphoton systems, and to maintain patent protection to prevent others from supplying subpicosecond systems. This would place it in the same position as Zeiss would have been in had the merger gone ahead. We do not believe than any alternative competitor would be in a position to provide stronger competition for Leica than would Zeiss. If the purchaser were not an existing integrated supplier, competition against Leica could in any event be weaker, because of the time it would take the purchaser to develop an integrated business. Nor do we believe that Zeiss would be in a position to exclude Leica if the merger went ahead. We therefore conclude that the merger with Zeiss would not lead to a situation in the multiphoton market which created less competition than if Bio-Rad's business were acquired by an alternative purchaser.

5.86 In relation to other optical sectioning systems, given that we expect Zeiss to continue to compete to provide such systems in the absence of the merger, and to conduct R&D, there would be no significant difference in the conditions of competition if

another competitor (other than Leica) acquired Bio-Rad's UK business than if Zeiss did so.

Conclusions on the comparative competitive position

5.87 In sum, under all these possible scenarios, we conclude that the merger with Zeiss would not result in less competition in the relevant markets than if Bio-Rad's business were sold to an alternative purchaser.

Provisional conclusions on the competitive effects of the merger

5.88 We conclude that no SLC within any market or markets in the UK may be expected to result from the relevant merger situation.

Assurances by Zeiss

5.89 Whilst our conclusion is not based on the assurances offered to us in the course of our inquiry by Zeiss as to their behaviour should the merger be permitted, we have nevertheless noted them and we set them out below for ease of reference:

- Zeiss will seek to support and maintain the Bio-Rad systems to an equal or greater extent than it does for Zeiss systems. In particular, it will offer and perform service and maintenance for at least eight years following the merger on commercial terms for all those Bio-Rad systems installed in the UK that Bio-Rad currently offers to service and maintain (see paragraph 5.59).
- Zeiss will continue to liaise with UK research institutions and sees them as essential for future innovation (see paragraph 5.60).
- Zeiss will not institute patent infringement proceedings against so-called 'self builders' of multi-photon microscopes or those who upgrade confocal systems to multiphoton in any non-commercial context and will offer all such non-commercial

organizations a free sub-licence under the Cornell patent if they contact Zeiss; this offer will be published on the Zeiss web site (see paragraph 5.66).

- Zeiss will grant sub-licences under the Cornell patent, for a reasonable fee and/or royalty, to all commercial customizing organizations (ie those that adapt their own laser scanning microscope systems to meet the specific requirements of a customer, for example La Vision, TILL Photonics, Prairie etc) (see paragraph 5.66).
- Zeiss will grant sub-licences under the Cornell patent, for a reasonable fee and/or royalty, to any commercial organization for the purpose of research and development only (see paragraphs 5.66 and 5.71).