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Review: Martin Kemp, *The Science of Art*, (New Haven: Yale University Press, 1990), *Kunstchronik*, Munich, Jg. 44, Heft 5, (May 1991), pp.285-290.

This is an important, beautiful and complex book. Professor Kemp is concerned with affinities between science and art in the period 1400-1880 which "centred upon the belief that the direct study of nature through the faculty of vision was essential if the rules underlying the structure of the world were to be understood" (p.1). Each of the book's three parts is devoted to a specific theme: perspective (7-162), mechanical devices (165-257) and colour (261-331). A coda discusses philosophical problems. There are appendices on principles of perspectival construction and Brunelleschi's demonstration panels, copious notes, a select bibliography and an index which tends to omit authors of secondary literature. At a later date he plans to write a companion volume which will "embrace the organic sciences of anatomy and natural history" (p.2).

Professor Kemp's lasting merit lies in making accessible the results of specialized scholarship in both science and art, presenting these as a whole that is greater than its parts. He establishes that perspective was much more than a Renaissance phenomenon: that it developed gradually in the 16th and 17th centuries and continued to do so in the 18th and 19th centuries. He shows that the camera can be seen as an outgrowth of perspectival instruments (cf. 219) and that "all the major elements in Seurat's 'peinture optique' can be found either in earlier theory or previous pictorial practice" (315). The cumulative picture that emerges is a real contribution. Earlier literature on perspective focussed on specific individuals or problems. For instance, artists were seen as forerunners of descriptive geometry (e.g. Gerhardt 1877) or early modern science (e.g. Panofsky 1927, Cassirer 1927, Kline 1953, Randall 1957 and Santillana 1959) leading to undue attention on origins for which Brunelleschi emerged as a symbol (cf. Edgerton, 1975). The only real exceptions were Poudra (1864), Panofsky (1927), and Vagnetti (1979) addressed to specialists, and Wright (1983) who emphasized architectural aspects. By contrast, Professor Kemp's approach is both more balanced and accessible to non specialists.

To provide a big picture omissions are necessary. Even so some of the omissions in this book are disturbing. No mention is made, for instance, of standard editions of Leonardo such as Dr. Keele's *Corpus of Anatomical Studies* or Marinoni's *Codex Atlanticus* or Sinisgalli's new edition of Guidobaldo del Monte (1985). In discussing Fabritius' View of Delft an interpretation is given (213) without reference to debates between two authorities on the matter, Liedtke and Wheelock. In discussing the famous Baltimore, Berlin and Urbino panels (347 n.85, 348 n.38) no reference is made either to Conti's (1976) bibliography nor a stance taken to Damisch (1987) although this is cited elsewhere (363). Omissions of primary literature are sometimes misleading. We are told, for instance, that "the main body of written evidence" in the 15th century has been examined (35) while Alberti's *Ludi geometrici*, the treatises of Filarete, Francesco di Giorgio Martini and Luca Pacioli have been omitted. Much is made of a manuscript by Galileo's friend Cigoli (177-180), while no mention is made of Giorgio Vasari Jr's manuscript (Florence, Riccardiana Ms. 2138, c.1600) of all the instruments for measuring with sight in the collection of the Medici, nor of Pfintzing's published compendium of instruments (1599, 1617). Rieger's (1756) work on military perspective is called a pioneer work (223) without mention of Dubreuil's work (1663). Porta's work on natural magic is emphasized although, as Battisti has made clear in his edition, this goes back to

Fontana (cf. 347 n.81). There are more serious omissions. Almost nothing is said of the archaeological tradition of Roman ruins which began seriously with Brunelleschi and Donatello and led via Francesco di Giorgio, Peruzzi, Scamozzi, and Cock to Piranesi. Whence he can suggest that the "veduta may not unreasonably be regarded as a fusion of the Northern genre of perspective townscapes...with the native Italian tradition of perspective architecture" (144).

We are told that "after about 1630" the linear perspective machine becomes "of far less significance" (184) than before and that the camera obscura becomes dominant as a perspectival aid. In fact, perspective machines continued to be important (cf. pl. 365-368, 372-373) in the encyclopaedic tradition first among Jesuits such as Bettini, Dubreuil, Kircher and De Chales and later among authors such as Ozanam, Leupold and Wiegleb. Two problems of method lurk here. One is that the story of perspective involves the emergence of different kinds of texts: some at the level of high mathematics, some technical, others of a summary nature. The decline or even the disappearance of a theme from one level need not mean that it has ceased to be significant. Indeed Professor Kemp tells his story as if there were only one level of communication.

The second problem is that he implicitly retains an ideal of artistic creativity which condemns all mechanical aids as unworthy. Consequently Alberti's claim that artists need these instruments is misquoted (169) and curious contradictions emerge. The significance of perspective machines in Leonardo (170) and others is downplayed because these machines were merely mechanical (188). Yet we are told that they became obsolete because the camera obscura gained higher verisimilitude mechanically (184). We are not told about an important strand of the aesthetic tradition which aimed at quantitative matching with whatever mechanical means available: cf. Lambert's *Photometria* (1760), which would have strengthened his important attempt to relate perspectival machines with the emergence of the camera.

The explanation of Lanci's instrument is confusing at best (176 pl.342). On rare occasions claims are wrong. We are told that Leonardo dealt with the principle of reversibility "on one occasion" (45) on CA 251va. This and a second passage on A 42r were analysed by Veltman (1986, p.85). Lambert (1759) supposedly put the proportional compass to a new use (223) in applying it to perspective. This overlooks Vaulezard (1630), Bosse (1648), and Huret (1670) who are cited elsewhere. Have they actually been read? Some references to sources are also wrong. The figure in pl. 83 is not based on CA 191ra but rather CA 35va (or CA 98r in the new edition). The reference to A Bv (347 n.89) should read A 8v , BL 66r (347, n.97) should read BL 62r. Giovanni Fontana did not write *Liber Pompili Azali...* (347, n.81). Rather this work by Azalus is our only reference to a now lost work on [aerial?] perspective by Fontana. Courtonne's book (355, n.20) appeared in 1725 not 1728. Stoer's perspective (62) may have been written in 1556 but the first edition that has been found is 1567. Similarly (68) no edition of Cousin's *La vraye science* has been found before 1595. The reference on 309b 1.6 should read pl. 537. The caption to pl.179 should read 1610 not 1510 and similarly pl. 180 should read 1610-12. There is also an unfortunate habit of misspelling well known names. For instance: Caracci (137) should be Carracci, Juvara (144) is Juvarra, Jeurat (227,355) is Jeurat, Farrish (233, 245) is Farish, Priestly (234,357) is Priestley, Depuis (239-241, 356) refers to the brothers Alexandre and Ferdinand (without an e as on 240) Dupuis, J. Drake (349) is Stillman Drake, Meilke (350) is Mielke, Bourgoign (351) is Bourgoing, Elefers (354) is Elffers, Leidtke (355) is Liedtke, Anderson (355,363) is Andersen, P. Desargues (356) is Pierre

Descargues, Maltesen (358) is Maltese, Schülling (363) is Schüling, Sandstrom (363) is Sandström. Typographical errors of which "xperienced" (240) is an example will not be listed.

The section on colour is presented as if it were an entirely different theme. Close links between the development of linear perspective and colour or aerial perspective are not mentioned. Hence while Leonardo's linear perspective is stressed, a summary of his six contributions (44) makes no mention of colour and aerial perspective to which he devoted over 200 pages of notes. Standard works such as St. Morien (1779) are not cited. The importance of Field (300) and Humbert de Superville (319-320) for colour theories is mentioned without reference to their books on perspective. More problematic is the characterization of colour theories as Aristotelian (268) vs. Newtonian, as surface vs. light (311). The ancient heritage was much more complex as we know from basic studies such as Beare (1906) and Stratton (1917). So too were currents in the 16th century as we know from MacLean (1967 etc.) and others.

The author appears to have a narrow view of science when he claims that Chevreul's law "was not primarily a product of a scientific notion of the origin of colours" (306). Historians of science today are likely accept that technology and science go hand in hand. The author's view of artistic creativity again leads to other tensions. We are told that concepts of colour developed outside the academic tradition (283) and individuals such as Caspar David Friedrich are described as moving "away from scientific theory" (299). Yet we are assured that by the second half of the 19th century these concepts of colour were "part of the general baggage of any reasonably well-educated artist" (299). Much more could be said on colour.

There are deeper problems. Professor Kemp claims that by the end of the 19th century "philosophical and psychological theories of visual perception had seriously weakened confidence in the direct relationships between seeing, knowing and representation." (322). Accordingly the period 1630-1680 becomes the "golden age of the perspective treatise" (119) and in Italy the late 18th century becomes a "last flowering" while new literature is constantly going "beyond the range of art" (e.g. 131). Study of perspective did not stop in 1880. Although there was a brief decline, over 2800 treatises have been published since. Professor Kemp only acknowledges this indirectly as a paradox (cf.221) partly because he assumes that perspective lost its significance in artistic circles by c. 1880. He offers two main reasons. One involves developments in aesthetics which claimed that features "such as imagination...could not be circumscribed by rules" (165, cf.237-238, 249). The second relates to optics. He claims that there was a growing awareness of the "flexibility of the visual process, particularly with respect to the mobile eye and two eyes operating in conjunction" (165). The French debates surrounding Bosse are cited (165). This is problematic because the French Academy's rejection of Bosse was based on traditional theories from Euclid's *Optics* without reference to post Keplerian developments. As for the binocular problem, this is based on the assumption that one point perspective only works for one eye (50, 215). Recent work in psychology, notably (Kubovy 1986 who is cited on 362) has brought to light the notion of robustness in perspective which challenges this older view.

Indeed a fundamental question is never explicitly tackled: does perspective relate to optics or geometry? The author does not believe that optics played a central role in the invention of perspective. He believes "that mediaeval optical science created far more problems than it solved for Renaissance artists" (345). Yet the whole story is told as if the equation between optics and

representation only gradually dissolved (e.g.237). Interest in cylindrical and spherical perspective with Parsey, Herdman and Hauck (247-249) is presented a) as partly responsible for erosion of links between vision and representation and b) as ideas which did not gain "a secure hold". In fact alternative methods of perspective have become ever more important and have brought about a whole new set of relations between vision and representation. Nothing is said, for instance, of Dalrymple Henderson's (1983) work on cubism and the fourth dimension, P. Heelan's *Space Perception and the Philosophy of Science* (Berkeley 1983) or the historical introduction to R. Hansen's English edition of A. Flocon and A Barre's *Curvilinear Perspective* (Berkeley 1988). Meanwhile, Helmholtz and the psychological tradition are presented simplistically. No mention is made either of Mach's *Analysis of Sensations* (1879) or its impact on *Knowledge and Error* (1905).

As a result the continuity of these themes since 1880 in mathematics and science is strikingly neglected. The importance of Hilbert's *Geometry and the Imagination* (1932) is not mentioned nor are more recent concerns of mathematicians such as Coxeter and Emmer with visual problems in Escher and other psychological illusions. No mention is made of Marey's classic *The Graphic Method in Experimental Sciences* (1878), nor Miller's recent *Imagery in Scientific Thought* (1986) which, although controversial, contains a wealth of material from the 20th century. Indeed visualization in science which reached an impasse with quantum theory in the 1920's has once again become a serious issue through Mandelbrot (1983 p.21) and applications of fractals to chaos theory. This makes the historical dimensions of the present book all the more significant.

Throughout Professor Kemp focusses on examples of science in art and only mentions in passing the reciprocal theme of art in science (334). Many of the individuals he cites in fact practiced both. For example, the same Maignan who painted anamorphic saints scientifically in one room of Santa Trinità in Monte (211) painted an extraordinary sundial artistically in another room. The author repeatedly warns that a responsible historian (e.g. 281) should not insist on links between science and art. He seems to be at pains to deny the evidence that he is presenting (e.g. 130, 211, 238, 276-77), and yet disappointed when he thinks that he has found confirmation of these links: "Much as we might like it not to be so, the visions of space in science and art are some two hundred years out of step" (162).

For all this, the author's central assumption "that works of art are fundamentally though not exclusively shaped by the conscious intentions of their creators and that the written evidence of these intentions has a high value amongst the interpretative strategies available to us" (334), i.e. that actual works and texts are important, has led to a book that is infinitely preferable to those based solely on speculative theories, ideologies, hidden agendas and subtexts. We live in a world where too many persons limit themselves to writing "safe" books about insignificant topics.

Congratulations to Professor Kemp for the courage in tackling a truly significant problem. While some details are wrong, and many are open to criticism, the thrust of the book is right. It will endure because it makes us aware in a new way of the continuity, complexity and ultimately the beauty of the European ideals which have linked art and science since the Renaissance and given western culture its unique place in history. The global picture that he has provided of specialized scholarship during the past century will provide excellent groundwork for further detailed research, prompting historians of science and art alike to reflect anew upon the many mysterious connections between science and art, not only then but also now.