Kazimierz Bartel (1882-1941)

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Zusammenfassung: *Kazimierz Bartel (1882-1941) war ein beschreibend arbeitender Mathematiker, der gründliche und innovative psychologische Untersuchungen zur Perspektive in Bildern durchführte. Zu diesen Untersuchungen gehörten mehrere Experimente zur visuellen Wahrnehmung von Bildern und zu zeichnerischen Fähigkeiten eines einfachen Konstrukteurs. Es wird begründet, daß Bartels posthum veröffentlichtes Buch - der Verfasser wurden von den Nazis erschossen - "Perspectywa Malarska" (Malerperspektive) welches Berichte über seine Untersuchungen enthält, größere Beachtung verdient als es bislang erhalten hat, und daß hierdurch Bartels Beitrag zur Untersuchung des Wahrnehmungsprozesses mit besonderer Berücksichtigung der Wahrnehmung von Bildern eine umfassendere Würdigung erhält.*

Abstract: *Kazimierz Bartel (1882-1941) was a descriptive geometer who conducted thorough and innovative psychological studies of perspective in pictures. These studies included several experiments concerned with visual perception of pictures and with drawing skills of an unsophisticated draughtsman. It is suggested that Bartel's book „Perspectywa Malarska" (Painterly Perspective) containing reports of his work which was published posthumously, the author having been summarily shot by the Nazis, deserves closer attention than it has hitherto received and that this is likely to result in fuller appreciation of Bartel's contribution to investigations of perceptual processes with special relevance to perception of pictures.*

Prof. Kazimierz Bartel, who was murdered by the Gestapo half a century ago, has left a bequest of scientific papers and books including a little known magnum opus of great interest to psychologists concerned with studies of vision, especially with perception of real and depicted space. This opus is a fruit of rather an unusual life led by an uncommon man in the unique circumstances of Central Europe at the time of great upheavals which affected Bartel's motherland, Poland, more severely than any other country.

Kazimierz Bartel was born in 1882 in Lwów, one of the eastern cities of the rambling and polyglot Austrio-Hungarian empire. His father was a railwayman and prudently arranged that young Kazimierz should, after a brief period of rudimentary primary education, be apprenticed to a fitter, a friend of the family. This fitter happened also to work as an instructor in a craft school. This happy coincidence ensured that Bartel whilst working for his journeyman's certificate attended classes in the craft school, thus continuing his formal education. Indeed

he continued with his studies beyond the craft school level and eventually, in 1901, matriculated as an external student and enrolled in the Faculty of Mechanical Engineering at Lwów Technical University. Thus began both his academic and his political careers; for once a student he became much involved in social and political student activities. His progress in the academic sphere was rapid; on graduating summa cum laude from the Department of Machine Construction he was appointed an assistant to Prof Doenirot at the Technical University. At the same time he enrolled as a student of mathematics at the University of Lwów; mathematics, especially geometry was, he felt, his true calling. A travel grant enabled him to visit Munich and to attend the lectures of Prof Dochlemann (on history of art) and Prof Voss and Prof Pringsheim (on mathematics). Dochlemann impressed him greatly and imbued him with an aesthetic interest in art and with a desire to understand works of art in a precise, mathematical manner. This analytic drive pervades Bartel's magnum opus, a book on perspective, the most thorough treatise on the topic ever written, to an examination of which we shall presently turn. Meantime, however, Bartel in addition to teaching began independent scientific researches and published several technical and mathematical papers (see bibliography). In 1913 he was appointed professor of descriptive geometry at Lwów Technical University. His scientific activities were retarded but not entirely stopped by the outbreak of the first world war. Bartel's first book, a textbook of descriptive geometry, was written whilst he served as a reluctant conscript in the Austrian imperial army. The collapse of the Central Powers, which brought an end to major hostilities, did not bring an end to Bartel's military service. Indeed, this very collapse led to the eruption of a bloody conflict between Poles and Ukrainians centred on the city of Lwów. Bartel volunteered for the Polish Army and as a qualified engineer was given the responsibility for maintenance of the railway track as well as for the rolling stock which included two home-made armoured trains, one of these commanded, one may parenthetically note, by another young man of academic promise Kazimierz Ajdukiewicz (1890 - 1953), a philosopher. Bartel's performance of his duties was outstanding, and earned him the award of the Virtuti Militari Cross, a Polish decoration for valour, at the end of the hostilities.

In the inter-war period Bartel pursued two careers, that of a politician and that of a scientist. As a politician he was prime minister thrice and vice-prime minister twice, held several ministerial offices and was a senator. As a man of politics he was a great admirer of Pilsudski. As a man of science he continued his academic work, both teaching and research and in 1928 published the first volume of the magnum opus, Perspektywa Malarska (Painterly Perspective). As a man of politics and a man of science he took particular interest in educational matters (Bartel, 1926).

The outbreak of the second world war brought about the collapse of Poland and its partition between the two invaders, Germany and the Soviet Union. The eastern part of Poland together with the city of Lwów became Soviet booty. In spite of alien occupation, arrests and mass deportations the Technical University attempted to function normally and although Bartel was briefly arrested by the N.K.V.D. he suffered no greater harm than the loss of a valuable gold watch of which he was particularly fond. This was confiscated in the course of a search of his flat together with all his medals and decorations. On Bartel's release the decorations were returned to him but not the gold watch. It was retained, presumably for further investigation; the N.K.V.D. knew gold when they saw it. In June 1941 Germany attacked her former ally and Lwów was occupied by German troops on 1st July. On 2nd of July Bartel was unexpectedly arrested whilst at a discussion meeting with his co-workers at the University. During the following night 36 other professors, Bartel's colleagues, were likewise arrested. This group, according to Auschwärtiges Amt documentation (Weinstein, 1982) included several internationally acclaimed academics such as the surgeon Prof. Tadeusz Ostrowski and a petroleum specialist Prof. Pillat. (This accorded with the practice of systematic destruction of Polish intelligentsia begun already in November 1939 by arrest of 183 academic and scientific workers in Cracow (Garlinski, 1982)). Of those arrested only Prof. Franciszek Groer was released after being brutally treated, perhaps because he was an internationally known specialist in children's diseases and was especially highly regarded in the USA, and the USA were still precariously neutral. The remaining 35 were summarily and immediately shot. Bartel was not murdered with them. He was kept in prison without any explanation being given for his imprisonment and his wife was permitted to bring him his mathematical books and papers and was required daily to deliver his food. On the 26th June, however, her delivery of food was not accepted and she was debarred from entering the prison office to find out why. The 26th June, being Saturday, she had to wait till Monday before she could see the officer in charge of the prison. She was then told that her husband had been shot two days ago.

Since she knew what importance her dead husband attached to his work on perspective she decided to rescue the manuscript, which was in her flat from which she was expelled at the time of her husband's arrest. Thus she had no access to her husband's study. She was therefore obliged to beg repeatedly for the manuscript from the new German occupiers, and in the end she succeeded. All the other books in Bartel's library, which contained a collection of rare books on geometry, were divided by the new owners into those which they found of scientific and antiquarian interest, and those which, in their eyes lacked such merit. The former were packed and together with selected items of furniture were

despatched to Germany. The latter together with Bartel's personal papers were unceremoniously burnt in the yard, but for some photographs which were saved by Jewish students and given to Bartel's widow. They did this, she remarks (Bartlowa 1981), by risking their lives.

Bartlowa's reminiscences of her husband which provided much of the biographical data reported above understandably describe him as an upright man and a dedicated scientist, but since these reminiscences contain many inaccuracies (chiefly about Polish political life) these descriptions can be questioned. However other sources support Bartlowa's opinion. Bartel's former political opponents Drobner (1965) and Nagórski (1964) do so. The latter goes out of his way to stress that Bartel was an honourable man, of great intellectual capacity and well intentioned, his only fault being, it seems, his at times faulty judgement of men; a characteristic, according to Nagórski, unfortunately common among men with scientific training and bent of mind.

The magnum opus

New ideas seldom arise in a social vacuum; Bartel's interest in pictures and their perception did not flourish in isolation. There was a great interest in these matters in the Poland of his time, which spanned the essentially academic and the essentially artistic. Thus a noted logician, mathematician and gifted amateur painter, L. Chwistek (1884-1944), published in 1921 a long and innovative essay concerning the multiplicity of reality in art and in life in which he argues that the style of artistic expression in a particular epoch is associated with the concept of reality then entertained, and Strzeminski (1893 - 1952) who, like Bartel, was an engineer by education but also a practising artist and art theoretician, was concerned with the role of the visual system in art. Strzeminski's work was published only in 1957 (third edition, 1974) although it was prepared for publication in the late 1940's. In it a number of interesting ideas are served to the reader in clearly detectable ‚socialist sauce'. (The subterfuge, incidentally, did not work, it did not render his post at Academy of Art secure. He was accused of formalism and dismissed.) This work like that of Bartel and Chwistek is unfortunately available in Polish only and hence not generally accessible. The fourth and most colourful figure of the group was Witkiewicz (1885 - 1939) (who signed himself Witkacy). A painter, a playwright, a philosopher and an art theorist, but above all an eccentric whose life came to an abrupt and self-inflicted end at the news of the Soviet invasion. He is the most widely known of the quartet as his plays have been translated into several languages. His controversies about art (he invariably and passionately opposed Chwistek) are less well known. The mutual influences within the quartet cannot be easily traced but their existence

is scarcely questionable.

Bartel attached much importance to his magnum opus, his work on perspective. His interest in the topic awakened, as we have seen, by Dochlemann's lectures grew and became a major scientific preoccupation. He spent most of his holidays on visits to galleries and museums of France, the Low Countries, Italy, Switzerland and Austria and both in 1921 and 1934 spent six months on research trips to Italy, France and Germany especially concerned with studies of art. He made notes and he photographed, accumulating a sizeable collection of data, and a photographic archive.

The result of this activity was a book whose fate was as complex as that of its author though, fortunately, not as tragic. The first volume of Perspektywa Malarska was published in 1928 by a Polish publishing house Ksiaznica-Atlas in Lwów, in 1934 its German translation was published by B.G. Teubner who used the negatives prepared by Ksiaznica-Atlas on the understanding that the second volume would be published first in German and that Teubner would prepare the negatives which would then be lent to Ksiaznica-Atlas. The negatives were indeed prepared but printing was delayed by the war and towards the end of it all the materials including the typescript perished in the air raid. Neither the author nor, it seemed, his work survived the war.

However, in 1950's Professor F. Otto of the University of Gdansk using a surviving transcript and the printer's proofs of negatives which Teubner had sent to Bartel for approval reconstructed the second volume, and both volumes were reissued in a uniform edition by Polskie Wydawnictwo Naukowe, the second volume first in 1958 and the first volume in 1960.

Thus the work survives and so does the memory of its author.

The first volume (343 pp, in the 1960 edition) is of lesser direct interest to the psychologist than is the second, but it is important as it lays down the foundations for the full understanding of the latter. It is concerned with basic issues of perspective and with its application to architecture and, by implication and extension, to art. It begins by considering the perspective of geometric elements such as lines and planes, and the construction and measurement of their projections, then it proceeds to review the perspective of conic sections, of solids of revolution, perspective and mirrored images and the construction of shadows, and ends with examination of the relationships between the perspective of architects and the perspective of painters, axometric perspective and devices including La Fresnaye's Perspectigraph, which can assist in drawing objects in perspective.

The second volume (1958; 589 pp) presents a unique, and in the present author's view as yet unmatched, analysis of the development of linear perspective in the context of the history of art which takes full account of the relevant aspects of those disciplines which are necessary for the proper comprehension of the phenomenon, viz. physiology, optics, psychology and geometry. An attempt will be made to examine this volume from a psychologist's stance and to relate it to other literature on the subject.

The thread running through the book is, as one would expect from a Professor of Geometry, that of the geometrical analysis of pictures and its relationship to the percepts which the observer has under differing conditions of viewing, with special attention paid to those instances when geometrical restitution and the observer's percepts are at variance. Geometric restitution answers two fundamental questions: (i) What real three-dimensional objects would yield percepts associated with a particular view of a particular picture? It can, therefore, once the notional position of the painter's eye is located, also answer the question (ii) Has the artist abided by the rules of perspective when making the picture? Clearly, when the notional position of the eye cannot be located then either the artist did not attempt to use perspective at all, or the picture fails to provide sufficient data for the location of the eye, because it represents, say, a single object of uncertain shape. Application of one of Bartel's methods can yield surprising results. For example, application of his method to determine whether a layout of depicted objects within pictorial space is consonant with the rules of perspective reveals that many pictures which appear to portray the space correctly do not, in fact, do so (for relatively easily accessible examples of the use of Bartel's method of restitution see Deregowski 1989, and Parker and Deregowski 1991). It can, of course, be disputed whether any particular instance of deviation from the rules of perspective in a picture is deliberate or accidental; whether the artist was attempting to create a certain definite effect or whether the effect created is simply evidence of lack of competence. Bartel in agreement with Hauck recognises both possibilities. Hauck (1879) in his unjustly neglected work on the Doric Style, and concerned especially with ‚distortions' found in Doric temples, distinguished two vectors as affecting perception; the tendency to see straight lines as straight and the tendency to judge lengths of segments by the angles supported by them at the eye. In consequence, Bartel points out, ‚percepts derived by observing straight lines are in constant conflict with percepts that are functions of the angles at the eye'. The normally suppressed tendency not to see straight lines as straight is demonstrated, Bartel says, by such common experiences as the appearance of a long building facing an observer or the appearance of a long, horizontal row of lights in his fronto-parallel plane. Both a horizontal moulding on the building and the line of lights appear to the

observer to be bent so that when they are above the level of the line of sight their ends appear to droop, but when they are below that level their centre seems to be lower than their ends (it is assumed that the observer's line of sight is in the vertical plane normal to the lines in question and passing through their centres). Such homely and readily experienceable demonstrations of visual phenomena abound in the book, but Bartel's demonstrations are not confined to these. He also considers more rigorous investigations of the phenomena and indeed reports his own investigations carried out with full scientific rigour.

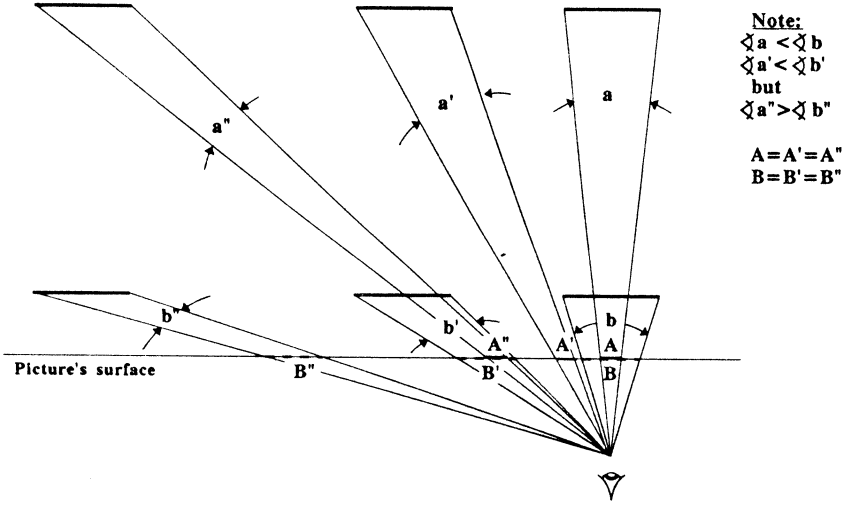

Fig. 1. *The essence of Hauck's and Bartel's conundrum of the two equal and parallel lines placed directly in front of the cyclopean eye in which the more distant supports a smaller angle. This decrease of the angle with distance is indeed what viewers generally experience and expect. (A version of this diagram occurs in practically all introductory texts on perception.) However when the two lines are displaced laterally the ratio of the two angles changes and eventually the more distant line supports a larger angle than the less distant.*

One such investigation consisting of a series of experiments was concerned with perception of a row of staves laterally displaced from a subject and in a plane parallel to his sagittal plane. Subjects were required, for example, to draw a row of equispaced staves, or to instruct a laboratory technician how to space the staves so as to equispace them. It was found that real distances and depicted

distances are not commensurable; drawings supposedly showing equispaced staves did not really do so, and staves which were supposedly equispaced were not in fact so. Bartel concludes that ‚Transformations of visual objects A1 (arrived at in consequence of observation of real objects) into a picture and re-transformations of pictures into visual objects A2, are not under normal conditions reversible i.e. they do not lead to perfect identity of objects A1 and A2.'

This investigation is supplemented by another in which subjects were required to make, from imagination, drawings of equispaced telephone poles standing along a receding straight road. Here as in the previous experiments Bartel's geometrical restitution showed that the distances between the poles at greater pictorial depth were relatively larger than the rules of perspective would require. There was a systematic increase of the distances, which were supposedly equal. Deviations from the rules were greater in the case of the drawing experiment than they were in the case of the ‚spacing' experiment. It appeared that about correct prediction of the ‚spacing' response could be derived from the ‚drawing' response by averaging the drawing response with the perspectivally correct response.

The relation between the percepts of pictures and percepts of depicted objects is thus empirically explored. This approach, which to an experimental psychologist is the only truly meaningful approach, is almost unique to Bartel's work on perspective; all other writers on the topic shy away from empirical investigations preferring comfortable armchairs to complex laboratory work. The only noteworthy exception to this rule is ten Doesschate.

The relation of Bartel's findings to Hauck's notion of the importance of the angle which a given segment supports at the eye is made apparent in Figure 1. It illustrates both the effect of real and the effect of depicted lateral displacement. The effects, it appears, are similar (albeit not equal) and the pictorial effects are obtainable with small true lateral displacement (as measured by the relationship between the observer's eye and various elements of the picture in question). The effects seem to be neurologically central rather than peripheral in origin. Bartel's observations agree with those obtained by ten Doesschate, an opthalmologist (ten Doesschate & Kylstra, 1955; ten Doesschate, 1964), in the course of his investigations of apparent convergence of parallel receding lines carried out in the Netherlands 25 years later. Ten Doesschate found that an observer facing three parallel receding luminous tubes and standing so that two of them are equidistant from him does not see all three tubes as converging to a single point. Contrary to the rules of linear perspective he sees the laterally displaced tube as converging towards the imaginary point of convergence of the other two, but far too sluggishly to pass through it. Imaginary convergence of all three tubes can only be achieved by inclining the asymmetrically placed tube so that it is

physically converging towards the point of intersection by an amount sufficient to compensate for its ‚natural sluggishness'. These results as well as Bartel's observations suggest that perspectival convergence occurs naturally, and have led some authors to regard apparent convergence of receding lines as natural and therefore as the only correct way of drawing such lines. Those who do so inevitably encounter a scruple in the form of inverted (divergent) perspective, which frequently occurs in some works of art (notably in Byzantine icons) and which is also to be found in the drawing of certain individuals. Indeed Bartel reports that a student of his, ‚a good draughtsman', assured him that whenever he had to draw a picture in perspective he had to resist the tendency to draw in divergent perspective. Is divergent perspective also ‚natural'? Bartel obtained drawings of parallelopipeds from a large number of children differing in educational attainment and social origin and from a number of illiterate adults. Since his findings are presented in a readily accessible form elsewhere (Deregowski, 1986) they will not be discussed here. It will suffice to mention that the drawings of the adults were very poor indeed and that those of the children did not differ materially from those obtained more recently by other workers.

The use of divergent perspective in icons has been the subject of much speculation, attributing the effect to as diverse origins as Euclid's writings (Mathew, 1963) and highly cognitive and symbolic considerations (Uspenskij, 1971; Uspienski, 1976; Szolc, 1973). Bartel's experiments suggest that it is probably safer to seek the explanation in the operation of the perceptual mechanism, and a recent experiment (Deregowski & Parker 1992) supports this view. The Byzantine reversal' it suggests, is the result of drawing in the central field of view an object as it would appear when viewed peripherally.

In addition to the experimental investigations just briefly described Bartel also draws our attention to various real life situations in which understanding of perspective is important and deals meticulously, providing thorough geometric analysis, with perspective of theatrical sets, of panoramic pictures, of relief sculpture, and of photographs and stereographs.

Having considered these issues and, as it were, honed his critical acumen on them he reasserts that in his opinion Hauck was correct and after reviewing Gehler's (1912) views, and finding them wanting, observes rather testily that ‚the lucidity and logic of his arguments are inversely proportional to the number of words used by him'. The evidence adduced by Bartel and the evidence since obtained by others support Hauck's view.

Given the potential of perspective in evoking percepts similar though never identical with those evoked by the depicted spatial arrangements one can legitimately trace its history in art using the method of restitution to see with what

rigour its tenets were adhered to by those resorting to it, and compare the theory of the time with practice.

As befits a geometer Bartel begins with Euclid and Greek and Roman art and finds that although works of geometry and optics offer much of interest their relationship to works of art is uncertain. Works of art, which frequently use inverse perspective, do not encode sufficient spatial information and therefore cannot be made subject to geometric restitution. It is a pity that Beyen's (1938, 1939, 1960) archeological work on the Pompeian and other frescoes appeared so late that it could not have been considered by Bartel. Some of Beyen's frescoes show apparent convergence of receding lines, which is one of the characteristics of perspective pictures, although curiously this convergence is often confined to their upper halves. This convergence has been noted by Beyen and he used the least sophisticated and not at all conclusive method of checking for linear perspective of the frescoes; he simply extended these apparently convergent lines to see whether they intersect at a single point. Bartel's more sophisticated method of restitution would have almost certainly provided him with more interesting data. Lepik-Kopaczynska (1956, 1959) attempted to extend Beyen's analysis but her attempt was hindered by her obvious unfamiliarity with Bartel's work. Mediaeval times, Bartel observes, do not bring significant advance in the art of perspective, but the study of optics continues to flourish, and is given a new impetus by the investigations of Arab scientists of whom Alhazen (Ibn Al-Haitham), who died in 1038, was the most prominent. Roger Bacon (1214 - 1294) and John Pisanus (1240 - 1292) both of whom flourished in England were influenced by Alhazen. Their contemporary Vitellion (1230-1275) published an influential treatise in Nuremberg in 1535. Vitelus's contribution attracts Bartel's special attention, in part, one suspects, because Vitelus wrote of nostra terra, silicet Poloniae (our land called Poland) (Book X; Section XIII).

However, indications of pictorial space in a form susceptible to geometric analysis do begin to show in art; a fact partly due to the frequency and prominence with which buildings are depicted. This enables Bartel to begin his systematic analysis. The first picture so analysed is a mosaic by Piero Cavalini (ca 1259 - 1344) showing the Annunciation in St. Mary's Church in Rome. Bartel concludes that the picture shows a notion of the horizon. Works of Giotto (1267 - 1337) are examined next and open a systematic examination of European works of art up to and including the eighteenth century. Considerations of the works of Antonio Canaletto, Francesco Guardi and Bernardo Bellotto close the main body of this part of the work, which covers nearly 250 works of art, all of which are reproduced (from Bartel's own photographs) and subjected to geometrical analysis. It would not be appropriate to present Bartel's conclusions about

individual artists or even about distinct schools of art here, but a brief conspectus of his findings can be found below.

The geometric analysis is accompanied by examination of the historical development of the theory of perspective from almost secret techniques of the cognoscenti through the great proselytising movement, to the perspective ‚wars' of Paris in which pamphlets and posters were used by the passionate antagonists. Two glimpses of the process should perhaps be given. Dürer, whose engravings showing how to draw in perspective are reproduced regularly in modern books on perspective, appears to have been an undistinguished practitioner of the skill. Such an assessment clearly applies to the young Dürer and is apparent from his early woodcuts. For example, the bier and the table shown in one of the woodcuts of the Ein allerhailsamste Warnung vor der falschem Lieb dieser Welt (Figure 15 Kurth, 1927) are clearly in non-convergent perspective. One can be forgiven, perhaps, for thinking that once the great master had embarked on teaching others how to draw in perspective his own drawings would have complied with his teaching. Certainly the present author thought so. Geometric restitution, however, contradicts this. Dürer was not a perspectivist of the order of Piero della Francesca, either in his grasp of the theory or in his practice, which does not of course mean that he was not a great artist. In reaching his conclusion Bartel endorses an earlier verdict of Schuritz (1919).

The Parisian perspective wars, in which human vanity and human temper were in contest began with the publication of an attempt to simplify a method of drawing suggested by an outstanding geometer Desargues (1636), but published under the cryptonym G.D.L. The original pamphlet in which Desargues put forward his method was thought by the nineteenth century writers (Poudra, 1864, Wiener, 1885; for a recent English translation see Field and Gray 1987), to have been lost. Its contents were known only because Bosse (1636) appended a modified version of the pamphlet to his own work. This view now seems untenable because Bartel, in the course of his research, found in the Bibliothéque Nationale in Paris a fourteen page pamphlet (Cat. No. V1537) whose title and substantive contents (but not extent) correspond to that of the appendix to Bosse's volume. The find obliges one to acknowledge mastery of yet another discipline by Bartel; the discipline of bibliography.

The closing chapter of the opus contains a discussion of Ponzo's work (1706, 1709), the gist of which Pirenne (1970) has recently and enthusiastically presented to the modern reader. This work is thought by Bartel to fall short of Schluber's (1719, 1720) treatise. Again it appears, as in the case of Dürer's work, that popular acclaim of the artistic designs has overshadowed critical evaluation of the technical arguments put forward.

This seems to be a general malaise of much writing on perspective. Painters do not fare much better than theoreticians, it seems. Bartel observes that ‚the entire stock of knowledge about perspective, which was used by even the greatest of painters', can be described by the terms the line of the horizon, the central vanishing point, and the distance points. Even the perspective of the circle was never fully understood by painters! Distortions of perspective occur in circumstances where their presence cannot be justified by aesthetic considerations; they clearly derive from ignorance of the rules. ‚Very few amongst the painters', according to Bartel, attempt to solve perspective problems of the kind attempted by M. Munkascy in decorating the ceiling of the Vienna Museum of History of Art and manage to do so in an equally impressive manner.

The lessons which concern the value of proper understanding of the geometric basis of perspective and its proper historical appreciation (Bartel presents the most comprehensive bibliography of works on perspective hitherto published in any monograph), and which artists and art historians may learn from Bartel's opus, are somewhat different from those which can be learned by students of the psychology of perception. The importance of his findings obtained in rigorously conducted experiments (some of which were briefly described above and are not reported by anyone else) is obvious. But he should also be given credit for his accurate description of the manner of operation and not, as is often the case, mere reproduction of illustrations of various optical devices and also for his geometrical analyses of various unusual visual circumstances such as the viewing of panoramic pictures presented on cylindrical surfaces and observed from a position close to the cylinder's axis.

The most important lesson for psychologists is however probably that in studying perception they have conveniently confined themselves, by and large, to the central zone of the visual field. A kind of scientific tunnel vision developed, in which happily the relation between the angle supported at the eye and the distance of an object are constant and predictable. Many psychological issues of perspective have thus been conveniently forgotten. Such issues do not concern only those interested in the art of picture-making or pictorial perception; they have implications, neglected and unexplored implications, for the working of the perceptual system in general.

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Appendix

Publications on Geometry, Perspective and Related Matters by K. Bartel

(This bibliography is derivative from M. Bartlowa's (1981) memoirs. It does not include Bartel's numerous publications on political issues and other matters of public interest.)

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