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SHORT HISTORICAL REVIEW

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Eduard Pernkopf's Atlas: morphological innovation and ethical legacy in the history of anatomical illustration

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Abstract

Eduard Pernkopf (1888–1955), a prominent representative of the Viennese Anatomical School, produced one of the most detailed and visually refined anatomical atlases in the history of medicine: *Topographische Anatomie des Menschen*. Despite its exceptional scientific and artistic value, the Atlas remains deeply controversial because of its association with National Socialist ideology and the probable use of bodies of executed prisoners during its production. This study provides a historical, morphological, and ethical analysis of Pernkopf's life, scientific work, and enduring influence on anatomical education. Special attention is devoted to the morphological and methodological innovations of Pernkopf's topographical dissection technique, including his systematic layer-by-layer anatomical stratification and the unprecedented three-dimensional realism of his anatomical illustrations. Through analysis of the historiographical and bioethical literature, the study examines the epistemological significance of Pernkopf's anatomical method, the historical context of Nazi-era anatomical science, and the ongoing debate regarding the Atlas's contemporary use. Pernkopf's Atlas emerges as both a landmark in morphological representation and a lasting ethical warning for the anatomical sciences. Its legacy underscores both the enduring methodological influence of Pernkopf's topographical anatomical approach and the necessity of integrating scientific excellence with ethical accountability in modern anatomical science.

Keywords: Eduard Pernkopf, anatomical illustration, topographical anatomy, history of anatomy, medical ethics, Nazi medicine.

Introduction: Vienna between two worlds

Early 20th century Vienna represented one of Europe's foremost centers of anatomical and biomedical research. Within this scientific environment, the Viennese Anatomical School consolidated a tradition of rigorous topographical dissection and morphological scholarship that profoundly influenced modern anatomy [1]. This environment favored the development of increasingly sophisticated approaches to regional and topographical anatomy, culminating in the work of Eduard Pernkopf.

Into this world was born Eduard Pernkopf (1888–1955), who graduated in Medicine in 1912 and soon became assistant to Ferdinand Hochstetter, the eminent Director of the Institute of Anatomy at the University of Vienna. Hochstetter's devotion to descriptive clarity and topographical method deeply marked Pernkopf's scientific identity. His early work, characterized by meticulous dissections and attention to the relations between structures, already mirrored the pedagogical style that would later define his monumental Atlas.

Pernkopf's academic rise was meteoric: Associate Professor in 1926, full Professor and Director of the Institute in 1933. Yet 1933 was also the year of his formal adhesion to the National Socialist Party, aligning his fate with the dark currents of his era. His appointments as Dean of the Faculty in 1938 and Rector of the University in 1943 were politically facilitated by these affiliations [2]. In post-war Austria, this same political record led to his imprisonment and eventual professional isolation.

Thus, the biography of Eduard Pernkopf encapsulates the coexistence of scientific advancement and ethical compromise in 20th century European biomedical science.

Materials and Methods

This study was conducted as a narrative historical review of primary archival documentation, institutional reports from the University of Vienna, and peer-reviewed historiographical, anatomical, and bioethical literature concerning Eduard Pernkopf, the production of his anatomical Atlas, and its subsequent scientific and ethical reception. Sources were selected based on relevance to the historical, morphological, methodological, and ethical dimensions of Pernkopf's work.

Scientific contributions: the Atlas and its legacy

Pernkopf's lasting fame rests on his *Topographische Anatomie des Menschen* – a multi-volume work begun in 1933 and continued until the 1950s. Over the course of two decades, he and his collaborators produced nearly **800 color plates** of unprecedented precision. The artistic team – **Erich Lepier**, **Karl Endtresser**, **Franz Batke**, and **Ludwig Schrott** – worked directly under his supervision, rendering each layer of the human body with an almost reverential attention to texture, tone, and spatial relation (Figure 1).

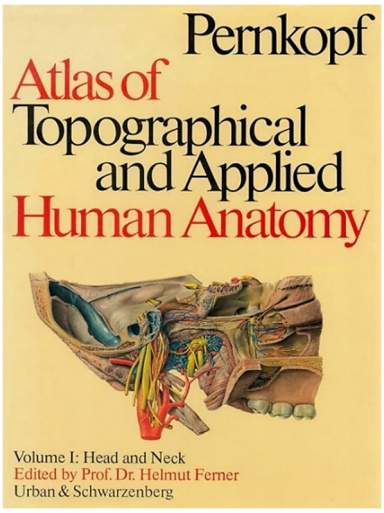

Figure 1 – ***Cover of Eduard Pernkopf's Atlas of Topographical and Applied Human Anatomy, Volume I: Head and Neck (Urban & Schwarzenberg, Munich, 1937). The image is reproduced exclusively for scholarly and educational purposes to illustrate the visual and historical significance of the Atlas within the context of 20th century anatomical science. Source: Reproduced from publicly available archival material for scholarly and educational purposes; copyright status verified by authors where applicable.***

From a morphological perspective, the Atlas introduced a level of anatomical stratification and regional depth representation that exceeded most contemporary anatomical atlases. Rather than presenting isolated structures, Pernkopf emphasized continuous spatial relationships between fascial compartments, muscular planes, neurovascular bundles, and visceral interfaces, thereby providing an integrated topographical understanding of regional anatomy.

The resulting Atlas transformed anatomical illustration. Its plates integrated scientific exactitude with aesthetic luminosity: fascia and vessels gleamed under transparent washes; muscular fibers appeared tactile, almost alive. Medical historian **Loris Premuda** later described the Atlas as an artistic triumph of "luminosity, brilliant vividness, and expressiveness", though he remained largely silent on its ethical implications [3]. The developmental history and publication chronology of the Atlas have been extensively reconstructed by Williams [4].

Despite its artistic quality, the Atlas remains inseparable from the ethical concerns surrounding its production. Investigations after the Second World War revealed that **Vienna's Institute of Anatomy** had received the bodies of more than **1300 executed prisoners** during the Nazi regime [2, 5]. Many scholars believe that some of these cadavers served as the subjects for Pernkopf's dissections, including political prisoners and other individuals executed under the Nazi regime; the precise identity of all cadaveric subjects remains incompletely documented. The suspicion is reinforced by the presence of swastikas and SS runes in the signatures of several illustrators [2].

Thus, the Atlas embodies a paradox: it stands as one of the most accurate depictions of human morphology ever achieved, and simultaneously as a product of severe ethical misconduct. It may therefore be interpreted as an example of scientific excellence developed within a profoundly unethical institutional framework.

Nevertheless, Pernkopf's technical contributions are undeniable. He refined **surgical topographical anatomy**, introducing a new visual logic that allowed students and surgeons to perceive spatial relationships between fascia, muscles, and neurovascular structures. The Atlas became a standard reference in European and American surgical training throughout the mid-20th century [5].

From a strictly scientific standpoint, Pernkopf's work extended the lineage of **Vesalius**'s *De Humani Corporis Fabrica* (1543), integrating empirical dissection, artistic precision, and pedagogical ambition. But while Vesalius's vision was born of Renaissance humanism, Pernkopf's was developed within the ideological and political framework of the Third Reich.

Methodological characteristics of Pernkopf's anatomical approach

A defining feature of Eduard Pernkopf's work was his highly systematic approach to anatomical observation and representation. His methodology was grounded in the principles of classical descriptive and topographical anatomy, emphasizing the precise spatial relationships between anatomical structures through progressive layer-by-layer dissection. Pernkopf's dissections followed a rigorously sequential layer-by-layer approach, preserving the anatomical continuity of fascial envelopes and intermuscular septa. This technique allowed visualization of the body not as a collection of isolated structures but as an organized three-dimensional (3D) stratified system.

Pernkopf required meticulous preparation of cadaveric specimens in order to preserve fascial continuity, neurovascular trajectories, and natural topographical planes. This approach differed from many contemporary anatomical illustrations, which often simplified or schematized anatomical relationships for didactic clarity. By contrast, Pernkopf sought maximal fidelity to the dissected specimen, prioritizing morphological realism over schematic abstraction.

Particular emphasis was placed on preserving fascial integrity during preparation, thereby maintaining natural compartmentalization and enhancing the understanding of surgical planes and regional anatomical boundaries.

A further distinctive element of his method was the close collaboration between anatomist and illustrator. Pernkopf directly supervised the artistic process, ensuring that each plate accurately reproduced not only individual structures but also their depth relationships, textural variation, and chromatic differentiation. The resulting illustrations achieved an unprecedented degree of anatomical stratification and 3D visual coherence.

From a methodological perspective, this approach represented the culmination of the Viennese tradition of morphological empiricism, in which anatomy was conceived primarily as an observational and descriptive science grounded in direct dissection. Pernkopf's Atlas therefore stands as one of the most refined expressions of 20th century topographical anatomical methodology.

At the same time, the extraordinary technical rigor of this approach highlights a central paradox of Pernkopf's legacy: exceptional methodological precision coexisted with profound ethical failure regarding the provenance of the anatomical material employed.

Anatomy and ideology

The Nazi regime's ideology of *Rassenhygiene* – racial hygiene – profoundly shaped medical institutions in 1930s Austria. Anatomy was no longer merely descriptive; it became a tool for demonstrating racial typologies and biological hierarchies. Pernkopf, as Dean and later Rector (Figure 2), participated in the administrative purges of Jewish faculty members and in the broader reorientation of Viennese medicine toward ideological conformity [5].

Figure 2 – ***Eduard Pernkopf (1888–1955), Rector of the University of Vienna (1943), photographed in academic regalia. This archival image is reproduced for historical and ethical discussion regarding the scientific and moral legacy of Pernkopf's Atlas. Source: University of Vienna Archives. Reproduced from publicly available archival material for scholarly and educational purposes; copyright status verified by authors where applicable.***

His Atlas, though apparently apolitical in content, was produced within this context. The Atlas predominantly depicts idealized male anatomical specimens, which some scholars have interpreted within the broader aesthetic and ideological framework of Nazi-era biomedical culture. The visual language of the atlas has been interpreted by several historians as reflecting broader aesthetic and ideological tendencies of Nazi biomedical culture, including idealization of the anatomically "perfect" body.

After 1945, Pernkopf was imprisoned for his Nazi affiliations and removed from his official positions. Released in 1947, he returned quietly to work at the University of Vienna's Department of Neurology until he died in 1955. He was never reinstated as a full faculty member [2].

The broader integration of anatomical science into National Socialist biomedical policy has been comprehensively analyzed by Hildebrandt [1].

Ethical reappraisal of Pernkopf's Atlas

The ethical controversy surrounding Pernkopf's Atlas emerged prominently during the late 20th century, when historians, anatomists, and bioethicists began to investigate the provenance of the cadavers used in its preparation. Particular concern arose regarding the possibility that the anatomical material employed for Pernkopf's dissections derived, at least in part, from individuals executed by the National Socialist regime, including political prisoners and other persecuted persons.

Subsequent archival investigations conducted by the University of Vienna confirmed that the Institute of Anatomy received the bodies of numerous executed prisoners during the Nazi period, thereby substantiating the institutional context in which Pernkopf's work was produced [2, 6]. Although the precise correspondence between individual cadavers and specific Atlas plates cannot be definitively established in all cases, the available historical evidence strongly supports the conclusion that at least some of the anatomical preparations used in the Atlas were derived from victims of Nazi judicial executions.

These findings generated substantial debate regarding the ethical legitimacy of the Atlas's continued use in anatomical and surgical education. Riggs [5] argued that the Atlas should neither be uncritically preserved nor entirely suppressed but rather employed only with full historical contextualization and explicit acknowledgment of the victims involved in its production. Similarly, Hildebrandt [2] proposed that Pernkopf's Atlas should serve not only as an anatomical resource of exceptional technical quality, but also as an educational instrument for ethical reflection within the anatomical sciences.

Subsequent surgical literature further complicated this debate. Yee *et al.* [7] described clinical circumstances in which Pernkopf's illustrations provided anatomical detail of a quality not readily replicated in other contemporary atlases, particularly in highly specialized reconstructive procedures. A later survey of peripheral nerve surgeons confirmed that some experienced clinicians continue to regard the atlas as uniquely valuable in selected operative contexts [8]. These findings underscore the persistent tension between the Atlas's technical utility and its ethically problematic provenance.

Accordingly, Pernkopf's Atlas occupies a singular position in the history of anatomical science: it represents a work of extraordinary morphological and pedagogical refinement whose scientific value cannot be dissociated from the ethical violations embedded in its historical production. Its continued use, where deemed justifiable, requires explicit acknowledgment of this context and careful ethical framing. Pernkopf's case thus remains one of the most significant examples in modern anatomical history of how scientific excellence may coexist with profound moral failure.

This paradox has been described by Hartsock & Beckman as a "human paradox" inherent in the coexistence of scientific beauty and moral atrocity within a single scientific artifact [9].

Influence on modern anatomy

Despite the ethical controversy surrounding its origins, Pernkopf's Atlas profoundly shaped modern topographical anatomy. Its visual clarity, depth perception, and layered dissection technique anticipated the logics of **radiological cross-section** and **3D reconstruction** used in contemporary imaging [7, 8]. In digital anatomy and virtual dissection platforms, the same principles of spatial stratification – from superficial fascia to deep musculature – mirror Pernkopf's didactic structure.

At the same time, the Atlas's controversy stimulated a renewal of ethical consciousness within the anatomical sciences. Educational programs now integrate discussions of body donation, consent, and the historical misuse of human remains. "Pernkopf's case" has become a pedagogical tool for teaching students that anatomical knowledge is inseparable from moral responsibility [1, 5].

Moreover, the Atlas had a profound influence on the aesthetics of medical illustration, extending far beyond its historical moment. The careful chromatic differentiation of tissues, the dynamic portrayal of anatomical layers, and the spatial precision of its compositions set a visual standard that persists in both printed and digital atlases today [3]. In this respect, Pernkopf's work represents the pinnacle of a tradition that unites scientific observation with artistic craft – a lineage extending from Leonardo and Vesalius to Netter and contemporary biomedical visualization.

Conclusions

Eduard Pernkopf's Atlas remains one of the most technically accomplished and visually sophisticated achievements in the history of anatomical illustration, while simultaneously representing one of the most ethically problematic products of 20th century biomedical science. Its enduring scientific value cannot be considered independently from the historical and moral conditions under which it was created. Pernkopf's case demonstrates with exceptional clarity that technical mastery in anatomical investigation, however extraordinary, does not in itself confer ethical legitimacy.

Beyond its historical significance, the legacy of Pernkopf's Atlas continues to inform contemporary anatomical education and professional ethics. It serves as a powerful reminder that the study of human morphology is inseparable from questions of dignity, consent, provenance, and moral accountability. Modern anatomists are therefore called not only to preserve technical rigor in the study of the body, but also to maintain full awareness of the ethical responsibilities inherent in working with human remains and anatomical representation.

Morphologically, Pernkopf's Atlas remains one of the most technically sophisticated representations of regional human anatomy ever produced, marking the apex of 20th century topographical anatomical illustration.

In this dual capacity, Pernkopf's Atlas endures as both a landmark in the history of morphological science and a permanent ethical warning within the medical humanities. Its continued examination offers an opportunity not merely to reflect on past abuses, but to reaffirm that the advancement of anatomical knowledge must always proceed in parallel with respect for human dignity and ethical transparency.

Conflict of interests

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Ethical Approval

This article does not contain any studies with human participants or animals performed by the authors.

Authors' contribution

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Figures

All figures reproduced in this article are of historical and educational nature and are used under the principles of academic and educational fair use. No identifiable living individuals are depicted, and the images are included solely for scholarly documentation of the historical, ethical, and anatomical context of Eduard Pernkopf's Atlas of Topographical and Applied Human Anatomy.

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