
ESTUDIOS / STUDIES

WILLIAM PREYER AND THE ORIGIN OF THE TERM BIOMECHANICS

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Recibido: 3 marzo 2021; Aceptado: 5 mayo 2022; Publicado: 3 diciembre 2022

Cómo citar este artículo/Citation: Muñoz, Juan Carlos; Vales Flores, María del Mar; Montané, Favio Martín (2022) "William Preyer and the origin of the term Biomechanics", *Asclepio*, 74 (2): p606. <https://doi.org/10.3989/asclepio.2022.19>

ABSTRACT: Many Biomechanics texts and courses begin with a historical introduction. This usually describes the contributions of a large number of people who, over many centuries, have been fundamental to the development of this science. In these presentations it is often stated that the term Biomechanik (Biomechanics) appears to have been used for the first time in 1887 by Dr. Moriz Benedikt, in *Über Mathematische Morphologie und Biomechanik*. However, this term was previously used by the physiologist William Preyer in 1873 and 1883. In this short article, we show these first mentions and frame them in the context of other terms, Biostatik (Biostatistics) and Biodynamik (Biodynamics), used at that time. Finally, as a secondary result of the research, we found what could be the first textbook that specifically addresses Biomechanics as a new object of scientific knowledge.

KEY WORDS: History of Biomechanics; Biomechanik; first mention; first book; Vitalism and Mechanism.

WILLIAM PREYER Y EL ORIGEN DEL TÉRMINO BIOMECÁNICA

RESUMEN: Muchos textos y cursos de Biomecánica comienzan con una introducción histórica. Esta suele describir las aportaciones de un gran número de personas que, a lo largo de muchos siglos, han sido fundamentales para el desarrollo de esta ciencia. En estas presentaciones se afirma a menudo que el término Biomechanik (Biomecánica) parece haber sido utilizado por primera vez en 1887 por el Dr. Moriz Benedikt, en *Über Mathematische Morphologie und Biomechanik*. Sin embargo, este término fue utilizado previamente por el fisiólogo William Preyer en 1873 y 1883. En este breve artículo, mostramos estas primeras menciones y las enmarcamos en el contexto de otros términos, Biostatik (Biostática) y Biodynamik (Biodinámica), utilizados en ese momento. Finalmente, como resultado secundario de la investigación, encontramos el que podría ser el primer libro de texto que aborde específicamente la Biomecánica como un nuevo objeto de conocimiento científico.

PALABRAS CLAVE: Historia de la Biomecánica; Biomechanik; Primera mención; Primer libro; Vitalismo y Mecanicismo.

INTRODUCTION

It is very common that university texts and courses in Biomechanics begin with a historical introduction to this science. In this presentation, the ancient Indian text *Śrīmad Bhāgavata Mahā Purāṇa* and the *Edwin Smith Papyrus*, the only surviving copy of a portion of an ancient surgical text are often mentioned, as well as a large number of people who, over many centuries, have been fundamental for the conformation of this science. This group includes Aristotle, the anonymous Chinese author of the *Nei Jing*, Archimedes, Galen of Pergamon, Ibn Sina (Avicenna), Leonardo Da Vinci, Vesalius, Galileo, Harvey, Descartes, Borelli, Hooke, Newton. Also the Weber brothers, Muybridge, Jules Marey, Nikolai Bernstein, Vsévolod Meyerhold¹, and some others in recent times, such as Jacquelin Perry (1918 - 2013) and Judith Burnfield. (Fung, 1993, pp. 2-15; Winter, 2009, p. 1; Abu-Faraj et al., 2015, pp. 2-16; Steinmetz and Benzel, 2016, pp. 1-35; Whiting, p. 2018, 184).

In this context, the current historiography assigns the origin of the term “Biomechanics” to Dr. Moriz Benedikt, who mentioned it in *Über Mathematische Morphologie und Biomechanik*, within the framework of the Congress of Naturalists in Wiesbaden (Germany), in 1887. However, as Georg Toepfer shows (2011, p. 391), this term was previously used by the physiologist William Preyer.

The purpose of the work is to present the contributions provided by Preyer for the conformation of Biomechanics as a discipline of the scientific field. To carry out this work, 30 scientific publications have been analyzed, including books and journals published between 1820 and 1912, mainly about Physiology, Anatomy and Human Morphology. The books and articles analyzed were written in German, English, French and/or Spanish languages. Among them there are nine written by W. Preyer and eight by M. Benedikt.

PHILOSOPHICAL THOUGHT OF WILLIAM PREYER

William Thierry Preyer (4 July 1841 – 15 July 1897), also called Wilhelm, was born in Rusholme, England. He studied in Germany, where later on developed his professional career as a Professor of Physiology at the University of Jena. His work in the fields of Child Psychology and Physiology were substantial and some of its contributions are related to human development based on empirical observation and experimentation (Preyer, 1866; 1882; 1885). Philosophically, Preyer is considered a monist who held the idea of “eternal life”, a conception of the existence of the organic life in the Universe as eternal (Haeckel, 1909, pp. 106-107). In other words,

he considered that life has always existed throughout the Universe, as can be read in the following Spanish translation of his *Hypothesen über den Ursprung des Lebens* (1875) [Hypotheses concerning the origin of life]:

La que sí merece prelación sobre todas las otras teorías, es la que hemos expuesto de la eternidad del movimiento vital, que crece y decrece con el calor del cuerpo movido, y del comienzo temporal de lo inorgánico como producto de anteriores procesos de metamorfosis material de los cuerpos cósmicos (Preyer, 1876b, p. 251)². [The one that deserves precedence over all other theories is the one that we have exposed of the eternity of vital movement, which grows and decreases with the heat of the moved body, and the temporary beginning of the inorganic as a product of previous processes of material metamorphosis of cosmic bodies] (Preyer, 1876b).

Years later, the Russian Biochemist Alexandr Ivánovich Oparin, opposing the claim that “All organisms invariably originate from other living organisms” (Oparin, 1952, p. 34), will affirm that:

(...) the adherents of the theory of the eternity of life assume that at all times some principle existed eternally, which passed on from organism to organism, and without which the origin of living things would be impossible. Following this path of reasoning, we invariably fall into the pit of vitalistic conceptions (Oparin, 1952, p. 33).

While the vitalists believe in the existence of a vital force, the mechanists consider that such a vital force does not exist. Moreover, the later consider inanimate and living organisms regulated by the same physico-chemical physiology. In the midst of this dispute and controversies between vitalists, mechanists and monists, the term that we know as “Biomechanics” would have been coined in Germany.

BIOMECHANIK: THE INTRODUCTION OF A NEW TERM

The terms “Biostatik”³ and “Biodynamik” were already used in the field of Physiology in 1866, as can be seen in Ernst Heinrich Haeckel’s diagram (Fig. 1). There is also evidence from previous authors such as Kraus (1820); Duglison (1848) and Walser (1850), from whose work we have extracted the following quote:

Nach dem Vorhergehenden müsste es nun nächste Aufgabe der Biostatik sein, die allgemeinen Gesetze der Mechanik auf die Lebenserscheinungen anzuwenden und deren Gesetze etwa nach dem D’Alembert’schen Principe zu formuliren. (Walser, 1850, p. 229). [After the foregoing, the next task of Biostatistics should now be to apply the general laws of Mechanics to the phenomena

of life and to formulate their laws, for example according to the Principle of D'Alembert] (Walser, 1850).

These types of words that contain the prefix "Bio" were already used in the first half of the 19th century to relate Biology to Physics. However, as far as we have been able to verify, the term "Biomechanik" appears for the first time in *Über die Erforschung des Lebens*, a publication written by William Preyer and "Ausgegeben Anfang Januar 1873" [Published early January 1873] (Fig. 2).

After the preface (Vorwort), towards the end of the fourth page, we can find only one mention of the term 'Biomechanics' that appears in this book, where it can be read in German language that:

Die Biomechanik unternimmt es aber keineswegs alle Mysterien des Lebens zu entschleiern. Das kann sie nicht, und sowie sie es versucht, verliert sie an Ansehen (Preyer, 1873, p. 4). [Biomechanics, however, does not claim to reveal all mysteries of life. It cannot, and as soon as it tries, it loses reputation]⁴ (Fig. 3).

This sentence, surrounded by mystery, surely expresses the author's conception that life has existed eternally (Preyer, 1875, p. 75; 1876a, p. 350; 1876b, p. 251), as he summed up in the well-known aphorism "Omne vivum e vivo" [All life comes from life] (Preyer, 1883, p. 92)⁵. In simple words, according to his strong conviction, life cannot be explained by Mechanics exclusively, neither without it.⁶

Ten years after the first published mention, Preyer locates the term Biomechanics in the introduction (Einleitung) of *Elemente der Allgemeinen Physiologie* (1883), when he refers to the application of physical principles to the phenomena of life, relating the concepts Biokinetik, Biostatik and Biodynamik:

z. B. *Biomechanik*, d.i. allgemeine Bewegungslehre der Organismen (*Biokinetik*), mit den beiden Unterabteilungen *Biostatik* oder Lehre vom Gleichgewicht der Organismen, und *Biodynamik* [*Zoodynamik* und *Phytodynamik*] oder Lehre von den Bewegungen der Organismen, im engeren Sinne *Phoronomie* (Preyer, 1883, p. 4).

Just a year later, in the French translation with the title of *Éléments de Physiologie Générale* (1884), similar words can be read:

telle est, par exemple, la *biomécanique*, c'est-à-dire la science générale du mouvement des organismes (*biocinétique*), avec les deux subdivisions, *biostatique*, ou science de l'équilibre des organismes, et *biodynamique* (*zoodynamique* et *phytodynamique*), ou science des mouvements des organismes, dans le sens propre de *phoronomie*" (Preyer, 1884, p. 5). [such as, for example, biomechanics, that is to say, the general science of the movement of organisms (biokinetics), with the two subdivisions, biostatics or science of the equilibrium of organisms, and biodynamics (zoodynamics and phytodynamics), or science of the movements of organisms, in the proper sense of phoronomics]⁷. (Preyer, 1884).

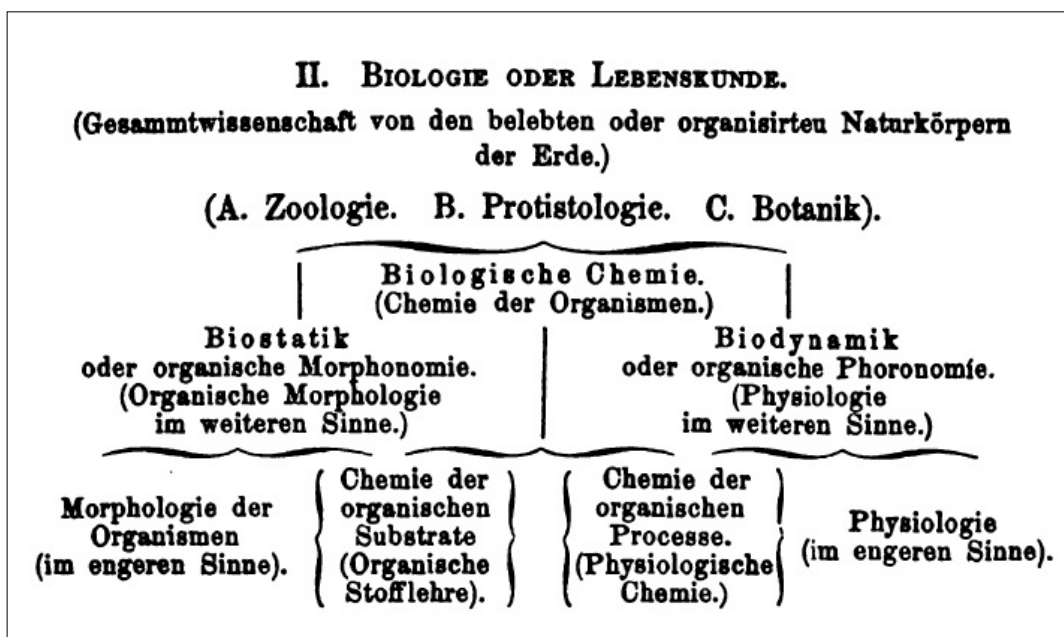


Figura 1: Generelle morphologie der organismen (Haeckel 1866, p. 21)

When looking at the first two mention of the word Biomechanics, we will notice quite an important change in the way the word limits its own scope and relates to other disciplines. While in the first mention, Preyer emphasize the limitation regarding the knowledge about natural phenomena, in the second, he gives it a special place next to other scientific disciplines.

Therefore, there is visible a transformation from a limited and isolated concept to a more articulated one.

It is interesting to note that at present time, Biostatics and Biodynamics are disciplinary fields subsumed to Biomechanics, just as Statics and Dynamics are branches of Mechanics, exactly as it was for W. Preyer in the late 1800. However, currently Statics is a particular field of Dynamics and they are subordinated in different hierarchical level. However, special attention needs to be considered in the interpretation of the concept “Biomechanics” as we understand it today. First, Preyer considers Biomechanics with Biokinetics alike, with not much distinction within each other, and secondly, it is important to discriminate that the concept of “movement” did not have exactly the same meaning in the Physiology at that time, than in current Biomechanics.

Although the term was first used by Dr. Preyer (1873), referring to the general “science” of movement (1883), it will have to wait until Dr. Moriz Benedikt (1887) begins to assign the value to express a new science in an epistemologically broad sense. It is due to employment and resignification were given by Benedikt that the term “Biomechanik” spreads, expands and begins to have the importance that we assign to it today (Muñoz, 2017, p. 58; 2019, p. 117).⁸

CONCLUSIONS

As a secondary result of our lengthy research, in 2016 we found that *Kraniometrie und Kephalmetrie* (1888) could be the first textbook that specifically addresses Biomechanics as a new object of knowledge. Although this text consists of a succession of lectures held by Benedikt at the Wiener Allgemeine Poliklinik, its final structure is not reduced to a simple accumulation of lectures, as his author expressly indicates:

Ich hoffe, diese Publication werde das Ende vom Anfänge einer klinischen und forensischen Kraniologie und einer präzisen Kraniometrie sein und der Beginn einer exacten morphologischen Wissenschaft. Es liegt hiermit ein hohes Ziel und ein reiches Programm vor; die geeigneten Forscher werden sich bald finden. (Benedikt, 1888, p. IV) [I hope this publication will be the end of the beginning of a clinical and forensic Craniology and a precise Craniometry, and the beginning of an exact morphological science. It is a lofty goal and a rich program; suitable researchers will soon be found] (Benedikt, 1888)

In his *Multilingual Database* (2008), Georg Toepfer publishes what would be, to date, the first mention of the term Biomechanik given by W. Preyer. However, the sentence containing this word appeared incomplete: “Die Biomechanik unternimmt es [...] keineswegs alle Mysterien des Lebens zu entschleiern” [Biomechanics [...] does not claim to reveal all mysteries of life]. Based on a bibliographic research, as a main result, we found an edition of *Über die Erforschung des Lebens* (1873) where this first quote can be read completely, and that we have already presented (Fig.3).

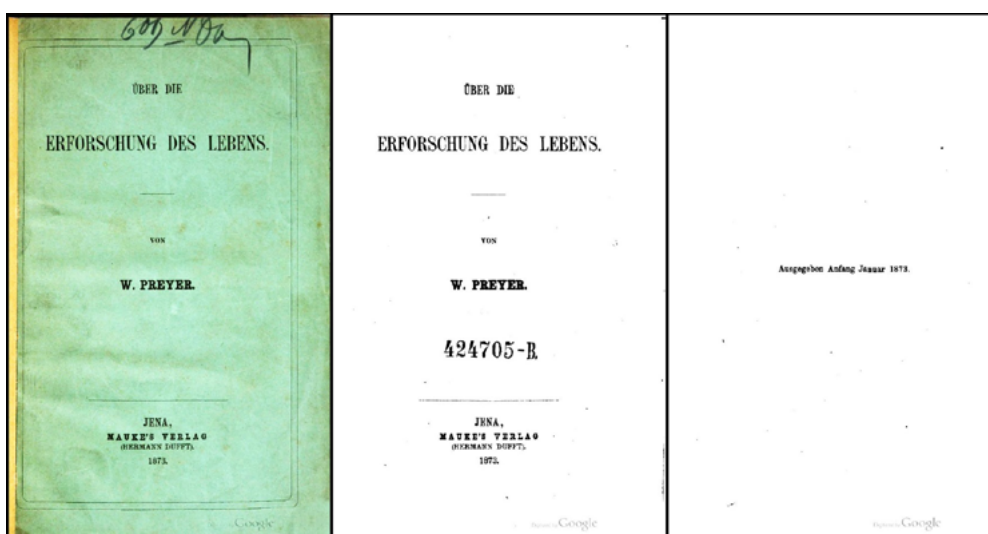


Figura 2: First pages of *Über die Erforschung des Lebens* (1873) in the edition of Mauke's Verlag

**Die Biomechanik unternimmt es aber keineswegs alle
Mysterien des Lebens zu entschleiern. Das kann sie nicht,
und sowie sie es versucht, verliert sie an Ansehen. Ge-**

Figura 3: The first mention of the term Biomechanics [Biomechanics, however, does not claim to reveal all mysteries of life. It cannot, and as soon as it tries, it loses reputation] (Preyer, 1873, p. 4)

We understand that this work will have a positive influence when presenting the History of Biomechanics in courses and university textbooks. As consequence, will result in a greater and more precise knowledge of the origins of this discipline by students, teachers and researchers.

In 1873, Preyer uses the term Biomechanik without any introduction, without giving it the proper status of a new concept, or an old one that he has renamed. Furthermore, as the author expresses in the Preface, dated October 28, 1872, he had presented the contents of the book at a conference a few months earlier:

Gedankengang und Inhalt dieser Schrift entstammen einem Vortrage, welchen ich, ehrenvoller Aufforderung entsprechend, in der ersten allgemeinen Sitzung der 45. Versammlung Deutscher Naturforscher und Aerzte am 12. August 1872 in Leipzig gehalten habe (Preyer 1873, p. IV). [The line of thought and the content of this script come from a lecture I delivered, by honorable invitation, at the first general meeting of the 45th Assembly of German Naturalists and Physicians on August 12, 1872, in Leipzig] (Preyer, 1873).

For these reasons, it seems clear that the term Biomechanics was written in 1872, and that this was probably not the first time that Preyer or other scientists have mentioned it. The search for the term in other documents is open to interested researchers.

Finally, it also remains to be clarified if Moriz Benedikt was truly unaware that the term Biomechanik had already been introduced by W. Preyer. In favor of this hypothesis, considering that Benedikt lived in Austria while Preyer lived in Germany, and although they shared a common language, the distances and communication channels that separated them were considerable for that time. To this is added that, until today, there are no known complaints or criticisms from Preyer or his peers in this regard. On the contrary, it could be argued that it is difficult to assume that Benedikt was unaware of Preyer's Physiology text, very relevant at the time, or that he had never heard about it from a colleague. Perhaps the Congress of 1872 can shed some light on these questions (Fig. 4).

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Figura 4: Announcement of publication of the conference given by Preyer in the *Schmidt's Jahrbücher der in- und ausländischen gesammten Medicin* (1872, p. 409).

NOTES

1. The discussion about the validity or not of the inclusion of these people, Meyerhold in particular, in the History of Biomechanics is outside the scope of this work. However, it is worth mentioning that Meyerhold developed Gástev's biomechanics (Wolfe, 2011), whose approach was aesthetic and practical, and aimed to improve "the workers' conditions: how best to avoid accidents, economise on labour and improve performance. Gástev attempted to reduce the presence of the emotions in the work process by inventing biomechanics, i.e. control of the body and economy of motion" (Anemone, 2011, p. 72). According to the students of Meyerhold (1922) some of the basic laws of Biomechanics were the following: (1) The body is a machine. (2) The worker is a machine operator. (3) The actor must discover his own center of gravity, his own equilibrium and stability (Anemone, 2011, p. 341).
2. The words "prelación" and "metamorfosis" of the quote are faithfully copied from the original in Spanish. According to current spelling rules, nowadays they should be written as prelación and metamorfosis respectively.
3. The term "Biostatik" (Biostatistics) was also used early in the first half of the 19th century, but mainly in the sense of a statistical theory of population, that is, Biostatistics (Toepfer, 2011, p. 628).

BIBLIOGRAPHY

- Abu-Faraj, Ziad Omar; Harris, Gerald F.; Smith, Peter A.; Hassani, Sahar (2015), "Human Gait and Clinical Movement Analysis". *Wiley Encyclopedia of Electrical and Electronics Engineering*, Second Edition, New York, John Wiley & Sons, pp. 1-34.
- Anemone, Anthony (2011), *Red Cavalry: Creation and Power in Soviet Russia between 1917 and 1945*, Madrid, ACTAR.
- Benedikt, Moriz (1887), *Über Mathematische Morphologie und Biomechanik*. Vortrag auf der Wiesbadener Naturforscher-Versammlung, Wiesbaden.
- Benedikt, Moriz (1888), *Kraniometrie und Kephalometrie*, Wien, Urban & Schwarzenberg.
- Dunglison, Robley (1848). *Medical lexicon: a Dictionary of Medical Science*, Philadelphia, Lea and Blanchard.
- Fraefel, Urban (1999), *Vom suggestiven wortfeld zur protodisziplin. Biomechanik 1880-1930*, Zurich, Historisches Seminar Zürich.
- Fung, Yuan-Cheng (1993), *Biomechanics: Mechanical Properties of Living Tissues*, Second Edition, New York, Springer.
- Gordon Biddle, Kimberly A.; Harven, Aletha M.; Hudley, Cinthia (2018), *Careers in Child and Adolescent Development*, New York, Taylor & Francis.
- Haeckel, Ernst (1866), *Generelle morphologie der organismen. Allgemeine grundzüge der organischen formen-wissenschaft, mechanisch begründet durch die von Charles Darwin reformirte descendenztheorie*, Berlin, Reimer.
- Haeckel, Ernst (1909), *Las maravillas de la vida: estudios de filosofía biológica para servir de complemento a los enigmas del universo*, Volumen 2, Valencia, Sempere y compañía.
- Kraus, Ludwig (1820), *Grundriß der allgemeinen Biodynamik*, Göttingen.
- Muñoz, Juan Carlos (2017), "El pensamiento biomecánico de Moriz Benedikt: aportes al desarrollo de la Biomecánica", *Anales de la Sociedad Científica Argentina* 259 (2), pp. 57-70, p. 58.
- Muñoz, Juan Carlos; Muñoz, Pablo Daniel; Holtz, Wanda (2019), "Didáctica de la Biomecánica: Cimientos para la construcción de una nueva Didáctica Específica". *Revista Argentina de Educación Superior* 11 (19), pp 108-122, p. 117.
- Oparin Alexandr (1952), *The origin of life*. Second edition. Translated by S. Morgulis. Dover.
- Preyer, William (1866), *De haemoglobino observationes et experimenta*. Diss. Inaug. University of Bonn. Max. Cohen.
- Preyer, William (1873), *Über die Erforschung des Lebens*, Jena, Mauke's Verlag.
- Preyer, William (1875), "Die Hypothesen über den Ursprung des Lebens", *Deutsche Rundschau* 3, pp. 58-77, p. 75.
- Preyer, William (1876a), "Las hipótesis sobre el origen de la vida", *Anfiteatro anatómico español y el Pabellón médico*, 4, pp. 348-350, p. 350.
- Preyer, William (1876b), "Las hipótesis sobre el origen de la vida", *Revista europea*. Eduardo de Medina (ed.). Vol. 7 (112), pp. 241-252, p. 251.
- Preyer, William (1882), *Die Seele des Kindes: Beobachtungen über die geistige Entwicklung des Menschen in den ersten Lebensjahren*, Leipzig, Grieben's Verlag.
- Preyer, William (1883), *Element der allgemeinen Physiologie. Kurz und leichtfasslich dargestellt*, Leipzig, Grieben's Verlag.
- Preyer, William (1884), *Éléments de Physiologie Générale*, Paris, Félix Alcan.

- Preyer, William (1885), *Specielle Physiologie des Embryo. Untersuchungen ueber die Lebenserscheinungen vor der Geburt*, Leipzig, Grieben's Verlag.
- Richter, Eberhard (ed.) (1872), *Schmidt's Jahrbücher der in- und ausländischen gesammten Medicin*, 156, Leipzig, Verlag Von Otto Wigand.
- Scouler, John (1830), "On the Production of Worms in the Human Body", *Glasgow Med J.* 3 (10), pp. 143–151, p. 148.
- Steinmetz, Michael P.; Benzel Edward (2016), *Benzel's Spine Surgery. Techniques, Complication Avoidance, and Management*. 4th ed., Saint Louis, Elsevier Health Sciences.
- Toepfer, Georg (2008), "BioConcepts. The Origin and Definition of Biological Concepts", *A Multilingual Database*, [on line], available in: <http://www.biological-concepts.com/views/search.php?me=biomechanik&ft=&q=Start>, [accessed 02/03/2021].
- Toepfer, Georg (2011). *Historisches Wörterbuch der Biologie. Band 2*, Stuttgart, J. B. Metzler.
- Walser (1850), "Biostatische Studien", *Jahreshefte des Vereins für vaterländische Naturkunde in Württemberg* 5, pp. 225-252, p. 229.
- Whiting, William (2018), *Dynamic Human Anatomy*. Second edition, Champaign, Human Kinetics.
- Winter, David (2009), *Biomechanics and Motor Control of Human Movement*, 4th. Ed., New Jersey, John Wiley & Sons.
- Wolfe, Ross (2011), "The ultra-Taylorist Soviet utopianism of Aleksei Gastev", *The Charnel-House blog*, 7, [on line], available in: <http://thecharnelhouse.org/2011/12/07/>, [accessed 02/03/2021].
- Wright, Wallace Thomas (1898), *Elements of Mechanics including Kinematics, Kinetics and Statics*. Second edition, D. Van Nostrand Company.