

Founding of the Julius Wolff Institut Charité – Universitätsmedizin Berlin

Editorial Comment

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Abstract This Editorial on Julius Wolff corresponds to a translation of the historic text, *Zur Lehre von der Fracturenheilung*, available at DOI [10.1007/s11999-010-1240-9](https://doi.org/10.1007/s11999-010-1240-9); and a translation and abridgement of the historic text, *Ueber die Innere Architectur der Knochen und ihre Bedeutung für die Frage vom Knochenwachstum*, available at DOI [10.1007/s11999-010-1239-2](https://doi.org/10.1007/s11999-010-1239-2). (Supplemental materials are available with the online version of CORR.) An accompanying biographical sketch is available at DOI [10.1007/s11999-010-1258-z](https://doi.org/10.1007/s11999-010-1258-z).

Julius Wolff can certainly be historically considered one of the most outstanding scientists in the field of orthopaedics. He not only linked biological adaptation to mechanical rules but also always had a clear focus from a clinical point of view on anatomical structures. Wolff was born in 1836 in the eastern part of Prussia. He graduated from medical school in 1860 and in the same year received his doctorate in surgery from the Charité in Berlin. By 1861 he began his career as a general practitioner and qualified as a professor (“Habilitation”) at the Charité in 1868. Prof. Dr. Wolff was the founder of the orthopaedic clinic which he brought into the university clinic Charité in 1890. Throughout his career, he held a personal interest in research in the field of

surgery on the structure and the structural adaptation processes of bone.

His classic work entitled “*The Law of Transformation of Bone*” (“*Das Gesetz der Transformation der Knochen*”) and published in 1892 described a relationship between the form and function of bone: “As a consequence of primary shape variations and continuous loading, or even loading alone, bone changes its inner architecture according to mathematical rules and, as a secondary effect governed by the same mathematical rules, also changes its shape”. The nature of the structure and shape of bone to continually adapt to the loading conditions has widely become accepted as “Wolff’s law of bone adaptation”. Wolff regarded this law as a “brick to complete the building of Charles Darwin” (1809–1882). We assume the formulations used by Wolff were influenced by the dominant personality of the medical faculty, Rudolf Virchow (1821–1902), the pathologist and politician. At the time Wolff’s work was published, German was one of the primary languages of science, thus his work was widely accessible and his ideas quickly spread. His thinking, largely illustrated by this still classic work, played a critical role in establishing orthopaedics as an independent discipline in Germany. His scientific analyses and close interactions with colleagues paved the way for the foundation of the German Society of Orthopedics, which he strove to establish. Regrettably, shortly before the actual foundation act took place in 1902, he died after suffering a stroke.

The Law of Transformation of Bone was the culmination of decades of thought. The initial ideas arose from a brief paper published by Hermann Meyer from Zurich in 1870 noting the regularity of trabecular architecture in a given bone from individual to individual. (Readers should note these observations were made in the preradiographic days and would have required uniform sections of whole bone.)

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Wolff took this observation and introduced important ideas about bone adaptation in a seminal paper he published in 1870, “Ueber die innere Architectur der Knochen und ihre Bedeutung für die Frage vom Knochenwachstum” (“On the Inner Architecture of Bones and its Importance for Bone Growth”). A second brief communication, “Zur Lehre von der Fracturheilung” (“On the Theory of Fracture Healing”) was published in 1873 following a brief paper from Prof. König of Rostock, who disagreed with Wolff’s interpretations. Few in the scientific community are likely aware of these earlier papers owing to the powerful influence of Wolff’s opus magnum. However, due to the importance of these original works, our goal of translating these texts into English is to provide the modern scientific community an insight to the understanding of fracture healing in the late 19th century. These specific texts have been chosen as they clearly demonstrate Wolff’s opinions regarding the processes that drive fracture healing and the associated bone adaptation. The friendly manner in which Prof. Wolff discusses the issues—despite a clear difference of opinion with Prof. König of Rostock—demonstrates his warm and open nature. Indeed, contemporary witnesses characterized Julius Wolff as an enthusiastic and inspiring teacher. Orthopaedic surgeons and scientists traveled far and wide to hear his lectures. Such attributes are a keystone of modern teaching, something that has inspired not only the development of research within the Charité, but also the founding of the institute in his name.

The “Julius Wolff Institut”, devoted to the research of musculoskeletal regeneration, was recently founded as the research institute of the orthopaedic and trauma departments at the Charité—Universitätsmedizin Berlin, Germany. The Institut provides a common foundation for the Research Laboratory of the Center for Musculoskeletal Surgery in the trauma surgery department and the Biomechanics Laboratory in the Orthopaedic Department. It associates Wolff’s name with current scientific research in his hometown where he performed his early work. The focus of the institute is to perform patient-oriented and basic research in the fields of trauma surgery and orthopaedics. While the texts demonstrate the understanding of fracture healing and statics—the ability of a structure to carry load—in the late 19th century, we believe it important for the new Julius Wolff Institut to push the frontiers of science in the modern world.

Due to the strong focus of the research on clinical applications, a very close cooperation exists with the

Center of Musculoskeletal Surgery and other clinical institutions both within and outside of the Charité. Directed by Prof. Dr.-Ing. Georg Duda and vice director Prof. Dr.-Ing. Georg Bergmann, the Julius Wolff Institut focuses on understanding the loading conditions at various joints and within the long bones of the musculoskeletal system. Its research teams try to understand by what means mechanical rules influence tissue adaptation and analyze the natural pathways of musculoskeletal regeneration and healing. Biologically active implants as well as optimized surgical procedures are explored by the research of this institute. Solutions developed and evaluated by the institute have found their way into daily clinical routines. The institute plays a prominent role in the foundation and organization of several national and international research activities, including the Centre of Excellence on the “Biomechanics and Biology of Bone Healing” (SFB 760) funded by the German Research Foundation (DFG), the excellence cluster “Berlin-Brandenburg Center for Regenerative Therapies” (BCRT) funded by the German Federal Ministry of Education and Research, and the PhD and MD/PhD Graduate School “Berlin-Brandenburg School of Regenerative Therapies” (BSRT) funded by the German Research Foundation.

The institute has been named after Julius Wolff to remember the outstanding historical contribution he brought to the field of musculoskeletal research. The present developments in the field of musculoskeletal research, specifically those with a strong focus on mechanobiological and mechanotransduction aspects in basic and applied research, attest to the fact that Julius Wolff was not only correct to speculate about such rules but way ahead of his time. Today we begin to understand by what means physical measures influence biological processes and signaling, and consequently the structures formed and adapted throughout human life.

We will further explore current research with an international symposium held on November 19–20, 2009 in Berlin on the topic of “Biomechanics and Biology of Bone Regeneration” (www.bonehealing.de). During the meeting we will continue the discussion that originated from Julius Wolff’s contributions to our scientific community. All members of the institute and the partnering clinical department look forward to a future that we hope will be rich in inspiration, international partnerships, collaboration, and progress in musculoskeletal research.