A personal recollection

by

Klaus-Peter Adlassnig

Selected biographical data

Born 1950: Zittau, German Democratic Republic (GDR; East Germany)
1970–1974: Computer Science Studies at the Technical University of Dresden/East Germany, MSc
1976–1992: Systems analyst and research associate at the Department of Medical Computer Sciences, University of Vienna/Austria
1977–1983: Computer Science Studies at the Vienna University of Technology/Austria, PhD
1981: Co-Organizer of the Central European Congress Medical Informatics '81, Vienna
1984–1986: Visiting Research Fellow at the Computer Science Division, Department of Electrical Engineering and Computer Science, University of California, Berkeley/U.S.A.
1987: Federal State Prize for Excellent Research in Rheumatology by the Austrian Federal Ministry for Health
1987–2015: Project leader, head of Laboratory and later Section (= Institute) on Medical Expert and Knowledge-Based Systems at the University of Vienna Medical School, from 2004 on at the Medical University of Vienna
1988: Associate Professor for Medical Informatics
1991: Secretary General of the Tenth International Congress of the European Federation for Medical Informatics (EFMI) MIE 1991, Vienna
1993: Visiting Professor at the Section on Medical Informatics, Stanford University, Stanford/U.S.A.
2000: Visiting Professor at the Computer Science Division, Department of Electrical Engineering and Computer Science, University of California, Berkeley/U.S.A.
2002–2005: Foundation and management of the Ludwig Boltzmann Institute for Expert Systems and Quality Management in Medicine, Vienna
2002–2016: Editor-in-Chief of the international journal Artificial Intelligence in Medicine, Elsevier B.V.
2002: Founding CEO and Scientific Head of Medexter Healthcare, Vienna (university spin-off), info at: www.medexter.com
2005: Visiting Professor at the Department of Computer Science, Meiji University, Kawasaki/Japan
2008: Visiting Professor at the Computer Science and Artificial Intelligence Laboratory, Massachusetts Institute of Technology, Cambridge/U.S.A.
2009: Scientific Program Committee Chair of the 22nd International Congress of the European Federation for Medical Informatics (EFMI) MIE 2009, Sarajevo/Bosnia & Herzegovina
2014: Fellow of the American College of Medical Informatics (FACMI)
2015: Retired from, but still active at the Medical University of Vienna, info at: www.meduniwien.ac.at/kpa
2018: Fellow of the International Academy of Health Sciences Informatics (FIAHSI)

My background

My father was Austrian, my mother German. I was born in Zittau, Germany, in 1950. At the time, Zittau was part of the German Democratic Republic (GDR; East Germany). From birth, I was an

Austrian in the GDR. I attended school in Zittau (ten-class general educational polytechnic secondary school, as it was called), completed high school (abitur) and a combined apprenticeship in electromechanics in Frankfurt an der Oder, and then started my studies in computer science at the Technical University of Dresden in 1970.

In those years, I began reading the scientific and technical literature. I found science fiction written, for instance, by the Polish author Stanisław Lem (1921–2006) extremely absorbing, creative, and inspiring. Not only was his technical fantasy based on scientific evidence, but also his illustration of utopian worlds influenced me very deeply. Quite a few years later, I also came to appreciate the descriptions of dystopian worlds by the U.S. science fiction writer Philip K. Dick (1928–82).

My studies in Dresden, East Germany

The computer did what you programmed it to do. I liked this, and consequently I was inspired by my computer science studies!

The year I began university studies, 1970, was the second year that courses in what was then called information processing were being taught at the Technical University of Dresden. We learned a lot about mathematics, statistics, physics, formal languages and automata, computer languages (machine code, ALGOL 60 and 68), operating systems, systems theory, and—last but not least—we had to study Russian and English. We also attended compulsory classes on Marxism and Leninism as well as lectures on political systems theory. Millennia-old philosophical questions such as “What came first—matter or mind?” or “Can the world—in principle—be understood?” were addressed in these classes. I found these interesting but was averse to the politics of the time and its lopsided and pseudo-scientific, often erroneous arguments.

During my first year of these studies, I also attended lectures on cybernetics. We were taught to apply systems analysis approaches from cybernetics not only to technical and biological but also to societal systems (such as socialism in the GDR). These attempts did not yield the desired political conclusions. As a result, cybernetics was deleted from the computer science curriculum. Nevertheless, I was already, say, infected by the ideas behind cybernetic feedback circuits and the possibilities of unintended network consequences.

At the same time, I came in contact with a research group focused on pattern recognition. We programmed what were known as adaptive threshold units, which are closely related to artificial neural networks. Programming was done in ALGOL 60. This group also collaborated with the Institute of Pathology, Medical Academy of Dresden (now a part of the Technical University of Dresden). At the end of the third year of study, a three-month practical training period was prescribed by the

curriculum. I completed this at the Institute of Pathology, focusing on a computational aspect of image processing: calculating the ratios between cell protoplasm and nuclei in microscopic images of mouse tissues.

One day in 1973, we had the opportunity to witness an interesting and rare event in the autopsy room. A dead orangutan from the zoo in Dresden was brought in. The autopsy was performed in order to identify the cause of death. It was difficult to stay in the autopsy room: the odor was almost unbearable, but made you aware of your senses. However, during the three months of my practical training, all elements of my subsequent professional life—namely computer science, research, and medicine—came together, forming my professional identity and paving the way for my future endeavors.

Unfortunately, despite my interest and enthusiasm, I was unable to continue working on such interdisciplinary research and medicine. As research, in the GDR, fell under increasingly stringent political controls, I was told I would be unable to pursue my research any longer. Being a citizen of Austria, I was not permitted to enter research institutions or even computer centers. Austria belonged to the Western hemisphere and the GDR to the socialist block. However, I was able to complete my studies and submit an MSc thesis in 1974 on a computer program for teaching Boolean logic.

In 1975, I finally decided to move to Vienna; which I was able to do legally.

At the Department of Medical Computer Sciences, University of Vienna Medical School, Austria

I arrived in Vienna and needed a job, ideally in research. I went to all of the universities, academies, and other research institutions in Vienna and its vicinity (there are many!) but did not find a suitable position. I then decided to join Siemens Austria as a programmer. We programmed in two-address machine code. This was a great job!

Later, in mid-1976, I received a phone call from Professor Georg Grabner (1923–2006), who remembered me from my interview when I first arrived in Vienna. He spoke to me about a job as a systems analyst at the Department of Medical Computer Sciences of the University of Vienna Medical School. Professor Grabner was not only the head of Medical Computer Sciences but also the head of the Second University Clinic for Gastroenterology and Hepatology. In essence, he was a clinician, but he was also a far-sighted, progressive, future-oriented individual who recognized the need for computer applications in clinical medicine.

I started to work on September 1, 1976, and was permitted not only to work as a systems analyst at the computer center of the Department of Medical Computer Sciences, but also to pursue research on this subject. My aim was to write a PhD thesis.

CADIAG—Computer-Assisted Diagnosis in Internal Medicine

The Department of Medical Computer Sciences, with its access to clinicians of the Second University Clinic of Gastroenterology and Hepatology, had started excellent work on computer-assisted diagnosis as early as 1968. Clinicians, together with mathematicians and statisticians, developed logical models for computer-assisted diagnosis in internal medicine, based on the seminal paper by Robert S. Ledley (1926–2012) and Lee B. Lusted (1922–94) on "Reasoning Foundations of Medical Diagnosis" published in *Science* in 1959.

On my first day at the new job, Professor Grabner handed me a pile of papers published in German medical journals on research topics related to medical computer methods. I immediately went to my desk and thought: I will never be able to add new, sensible ideas to what has already been developed at this place or elsewhere!

But, most of us learn from experience that by focusing on a specific topic and intensively reading and thinking about it, you become creative and get new ideas. Well, that is exactly what happened to me.

After contemplating the then predominant two-valued logical approaches to medical data and clinical knowledge models, I developed a three-valued logic system (symptoms and diagnoses are present, absent, or not tested/unknown) based on Kleene's ternary logic. I found later that the ubiquitous unsharpness in the "boundaries" of linguistic medical terms (denoting concepts such as fever, leukopenia, or hypoxemia) could best be formally defined by fuzzy sets. Fuzzy logic would then be able to propagate the calculated fuzzy logic values through a diagnostic inference network suggested and "established" by experts.

Together with clinicians from the Second University Clinic of Gastroenterology and Hepatology, but especially the rheumatology specialist Professor Gernot Kolarz, we started to develop medical knowledge bases for differential diagnosis in internal medicine: for clinical rheumatology with Professor Kolarz; hepatology with Professor Grabner; gall bladder and bile duct diseases, and pancreatic diseases with Professor Werner Scheithauer, and others. We collected an extensive body of data from actual patients, carried out accuracy studies, developed symptom and disease ontologies, programmed knowledge base consistency checking methods, and much more. These differential diagnostic consultation systems were named CADIAG. The process of development extended from 1976 to 2010. And maybe it has not ended yet!

As mentioned above, I was always interested in philosophical questions. When I looked at computer-assisted diagnosis (sometimes this subject was referred to as computer diagnosis), I needed to form an opinion as to what the computer can or cannot do in clinical medicine, that is, in patient care. Artificial intelligence (AI) researchers were—in a more general sense—also concerned with the question as to how far human beings themselves or their mental processes could be simulated or replaced by computer processing. Lacking an easy technical answer, these questions became philosophical ones. Can human clinicians be supported or even replaced by computers? Are there natural limits as to how far and how well a computer is able to simulate human mental processes? Well, I investigated AI texts but—actually more importantly for me—analyzed and studied what I call medical methodology. How does clinical medicine work? What are the subject-matter entities and the clinical work processes? This kind of study seemed a prerequisite for me to understand patient care. By doing so, I became a more informed communication partner with my collaborating clinicians and was able to at least envisage answers to the above-mentioned philosophical questions.

My exposure to fuzzy set theory and fuzzy logic

Immediately after I discovered fuzzy set theory and logic in 1977, I started to develop fuzzy models for representing medical data and clinical knowledge. I redesigned the three-valued logic CADIAG system and extended it using fuzzy logic methods. Fuzzy sets, and later fuzzy logic, were developed by Professor Lotfi A. Zadeh (1921–2017), from the Computer Science Division, Department of Electrical Engineering and Computer Science, University of California (UC), Berkeley, U.S.A. I read a number of technical reports and papers published by Professor Zadeh and became convinced (and still am!) that fuzzy set definitions of linguistic clinical terms are more intuitive—let's say even more correct—than definitions based on sharp binary yes/no boundaries. Fuzzy logic, on the other hand, is an infinite-valued logic, able to express medical relationships such as confirming, almost confirming, confirming to a certain degree, disconfirming to a certain degree, disconfirming (excluding) at different numerical levels of strength, or by linguistic hedges on degrees of belief about a diagnostic, prognostic, or treatment hypothesis. Set theory and logic are core disciplines in mathematics and formal systems, and so are fuzzy set theory and fuzzy logic. Research and applications of fuzzy set theory and fuzzy logic have been considerably extended over the years.

In 1982, I wrote: "Fuzzy set theory with its capability of defining inexact medical entities as fuzzy sets, with its linguistic approach providing an excellent approximation to medical texts as well as its power of approximate reasoning, seems to be perfectly appropriate for designing and developing computer-assisted diagnostic, prognostic, and treatment recommendation systems."

We tested the fuzzy-based CADIAG with hundreds of real patient cases including data from patient histories, physical examinations, laboratory test results, and findings from X-rays, biopsies, and others. Together with Professor Kolarz, we developed the largest computerized medical knowledge base for clinical rheumatology in the world. The smaller knowledge bases, e.g., for gall bladder, bile duct and pancreatic diseases, or parts of hepatology, were also tested. Methodological and clinical studies with patient data were performed.

I presented my PhD thesis in computer science at the Vienna University of Technology in 1983, titled "A computer-assisted diagnostic system using fuzzy subsets". Since my arrival in Vienna, I had established close relationships with the informatics departments of the Vienna University of Technology, especially Professor Manfred Brockhaus, with whom we also started teaching medical informatics in Vienna. He was my PhD supervisor.

Teaching Medical Informatics

Explaining and teaching has been something I always liked and did. At high school, university, and even before that at elementary school, there were courses for fellow students or others where I served as instructor. When I joined the Department of Medical Computer Sciences at the University of Vienna Medical School in 1976, I initiated regular research lectures. Every associate was supposed to speak about his or her research.

My colleagues prophesied that a regular course of this nature would last only a couple of months. I was told that everybody in the department had tried to initiate it, and all of them had failed. Well, Austrians are occasionally prone to pessimism and low self-esteem. Our large imperial and royal Austro-Hungarian dual monarchy collapsed in 1918, and we, unconsciously, may still be lamenting the loss. But don't worry, we compensate for it by transient phases of self-exaltation.

When I once visited the Vienna University of Technology to attend a class on database systems delivered by Professor Brockhaus, he invited me for a cup of coffee and proposed that we jointly develop a small curriculum for Applied Medical Informatics that would be available to his technical students. The aim was a collaborative project between the University of Vienna Medical School and the Vienna University of Technology. We included Professor Grabner and also Professor Trappl from the Department of Medical Cybernetics of the University of Vienna Medical School and then prepared a comprehensive program consisting of topics related to medicine and medical informatics for informatics students. This was the beginning of medical informatics studies not only in Vienna, but also in all of Austria!

Later we also established a medical informatics curriculum for medical students at the University of Vienna Medical School.

My post-doc at the Computer Science Division, Department of Electrical Engineering and Computer Science, University of California, Berkeley, U.S.A.

In the course of my work on CADIAG-2 (or FuzzyCADIAG), the differential diagnostic consultation system for internal medicine applying fuzzy sets and fuzzy logic, I started to exchange letters with Professor Lotfi A. Zadeh, asking for technical literature and advice. As a result of our correspondence, he invited me to visit the Computer Science Division, Department of Electrical Engineering and Computer Science, UC Berkeley, U.S.A., as a post-doc, deepen my knowledge of fuzzy methods, and share my research with them. I actually had to apply twice for a fellowship from the Max Kade Foundation in New York, NY, U.S.A., awarded by the Austrian Academy of Sciences, in order to finance the trip and period of residence, and to be able to take my wife Christine with me.

My post-doc time at UC Berkeley (including extensions) lasted from 1984 to 1986. From the very beginning, we enjoyed the warmth and friendliness of Lotfi and his wife Fay. They helped us to settle down, find furniture for our rented apartment, and get acquainted with people and the local environment.

I treasured the “think-freely and think-broadly” atmosphere in the entire campus of UC Berkeley. This was perceptible all over the campus, in every department, division, laboratory, and class, as well as in research and student lectures. In this regard, you may remember that the Free Speech Movement began at UC Berkeley in 1964.

I attended classes by Professor Zadeh on AI and discussed fuzzy set theory with fellow students and guest researchers. Every one or two weeks, there was a lecture by a visitor from Stanford University or San Francisco State University, or from one of the research institutions or companies from Silicon Valley, or others. After the lecture, we would meet at one of the Chinese restaurants in downtown Berkeley, introduce ourselves to the visitor, and enjoy an early dinner together. All of these events and encounters were very satisfying, both scientifically and emotionally; I recall them with great pleasure.

One of our favorite topics of discussion was whether the degrees of membership of the elements of a universe of discourse in a fuzzy set (for instance, the degrees of membership of “measured body temperatures” into the fuzzy set “fever”) are actually probabilities. However, in probability theory the included events—such as fever—need to be crisp and clearly defined; only the occurrence of such events is uncertain. In fuzzy set theory, the basic events are defined with fuzzy “boundaries”

taking their inherent linguistic unsharpness into account. Uncertainty with respect to the event's occurrence may arise on top of this (e.g., "fever" occurs "often"). We then speak about fuzzy events that occur with a fuzzy probability.

"If you have a hammer, everything looks like a nail," Lotfi said sometimes, emphasizing the bias in how our measurements depend on our instruments and techniques of measuring. People study probability theory at school as a measure on crisply, binary (yes/no) defined sets of events; so every uncertainty they encounter later on tends to be interpreted as a probability.

Shortly after my arrival in Berkeley, Professor Zadeh received a phone call from Professor Ted Shortliffe from the Medical Information Sciences Training Program of the Stanford University School of Medicine. He had heard of my work using fuzzy methods in medical expert systems. Professor Shortliffe was the creator of MYCIN, one of the first and world-known expert systems in the medical field. He wanted me to give a talk at Stanford and invited Lotfi and me to come over. Shortly thereafter, we drove to Stanford, and I spoke on the methodological and clinical foundation of FuzzyCADIAG at one of Shortliffe's medical informatics seminars. Everything went well. This was a great experience for me as a young post-doc!

I also experienced the following: about two (!) minutes after I started my presentation, I was interrupted and asked a question. The question came from Professor Gio Wiederhold from the Computer Science Department, Stanford University. He was interested in some technical detail, posed his question, which I answered, and then I continued. Culturally, this was different from Austria. There, one waited until the end of the lecture, which usually took 45 minutes, and finally told the lecturer that he or she had said something that was unclear, missing, or even utterly problematic. I found myself always preferring the immediate, direct way.

The lively discussions around AI at UC Berkeley at the time were highly interesting and rewarding for me. I deepened my knowledge not only by enjoying avidly-discussed lectures (for instance by Professor Robert Wilensky (1951–2013), Computer Science Division of the Department of Electrical Engineering and Computer Science, UC Berkeley), but also by attending a class held by Professor Stuart Dreyfus from the Industrial Engineering and Operations Research Department, UC Berkeley. The topic was "Mind over Machine: The Power of Human Intuition and Expertise in the Era of the Computer", a topic that was published later as a book co-authored by Hubert Dreyfus (1929–2017) from the Philosophy Department at UC Berkeley. Professor Hubert Dreyfus was already a well-known critic of AI. He published the book "What Computers Can't Do: The Limits of Artificial Intelligence" in 1972. There were others: Professor John Searle from the Philosophy Department (also well-known for his philosophical debates related to AI), Professor George Lakoff from the Linguistics Department (pioneer in the study of linguistics and metaphor and their influence on cognition and mathematics),

both at UC Berkeley, and many voices from the outside. These discussions were fascinating, but often too loose, too general for me. I was focused on AI in clinical medicine: AI for the real patient.

Medical expert systems, clinical decision support, and running my own institute

Upon my return from Berkeley in 1986, I began a long phase of developing medical expert and knowledge-based systems for internal medicine, laboratory test interpretation, intensive care, and infection control. I intensified my contact with clinicians and the hospital administration, delivered classes on medical expert systems and fuzzy set theory, and supervised many MSc and PhD students, both from the Vienna University of Technology and the University of Vienna Medical School.

At the time, we developed a number of medical expert and clinical decision support systems. To name a few: Hepaxpert for the automated textual interpretation of hepatitis serology test results (together with the hepatologist Professor Wolfgang Horak, then head of the Hepatitis Serology Laboratory of the University of Vienna Medical School); Toxopert, FuzzyToxopert, and Thyrexpert for toxoplasmosis and thyroid test interpretation, respectively; and Celipert for celiac disease test interpretation. Together with the intensive medicine specialist Professor Michael Hiesmayr, we created KBWean and FuzzyKBWean for supporting the weaning from artificial ventilation of intensive care patients. FuzzyKBWean was a fuzzy control application. We also developed FuzzyARDS, which made use of fuzzy automata for patient state representation in patients with adult respiratory distress syndrome. We continued to study and improve CADIAG, generalized it to MedFrame, and created RHEUMexpert, a small descendant of CADIAG/RHEUMA. And there were others.

For infection control and quality benchmarking, we developed Moni, a system for monitoring and surveillance of hospital-acquired infections (together with Professor Walter Koller and Dr. Alexander Blacky). This development was very successful. Moni was connected to the patient data management systems of the intensive care units (ICUs) and neonatal ICUs of the Vienna General Hospital.

Over the years, we developed or used various knowledge representation and processing methods to establish medical knowledge bases, as one of the core components of medical expert and decision support systems. During our studies, we encountered Arden Syntax, a specification developed for medical knowledge representation and processing. For many years, the Arden Syntax had been part of the international standards fostered by Health Level Seven (HL7) International. As it was fun for us (though we also considered it a necessity!), we fuzzified Arden Syntax, calling it Fuzzy Arden Syntax, and were successful in bringing it under the patronage of HL7. Now, Fuzzy Arden Syntax is Arden Syntax version 2.9. It was officially approved by HL7 International and the American National Standards Institute (ANSI) in 2013 and evolved to version 2.10 the next year.

In 2004, the government of Austria decided to separate the three Medical Schools in Vienna, Graz, and Innsbruck from their home universities and establish individual medical universities of their own. For us, at the University of Vienna Medical School, this was an unwelcome development. The University of Vienna was founded in 1365 and thus was the oldest in today's German-speaking regions and the third oldest in Central Europe. We now became one of the youngest. There were a number of pro and con arguments, but the pro arguments obviously prevailed.

At the time, I was already the head of a Section (Institute) on Medical Expert and Knowledge-Based Systems at the Center for Medical Statistics, Informatics and Intelligent Systems of the Medical University of Vienna. Stimulated by developments in the U.S.A., I renamed my own profession clinical informatics, and myself a clinical informatician. This was to emphasize the direct patient-care-oriented work of our medical informatics research and development.

Editor-in-Chief of Artificial Intelligence in Medicine

In 2000, I received a letter from Professor Kazem Sadegh-Zadeh, then professor of philosophy of medicine at the University of Münster, Germany, with an invitation to serve as Editor-in-Chief of the international journal Artificial Intelligence in Medicine. He, a visionary in our field, had founded this journal in 1989. A notable remark by him in discussions on AI in medicine was: "To remain naturally unintelligent or to become artificially intelligent? This is the question, and—*in dubio pro aegro*—, the answer." Not a bad answer!

I had known him earlier, as Associate Editor of Artificial Intelligence in Medicine and—more importantly—I taught his research results on formalizing the clinical diagnostic process in my classes.

My service as Editor-in-Chief extended from 2002 to the end of 2016: a period of 15 years. It was an extremely interesting but also time-consuming activity. We (the Editorial Office headed by Dipl.-Ing. Andrea Rappelsberger and myself) started with about 80 submissions per year in 2002. This number grew to approximately 350 by 2016. The essential topics of the journal may be summarized as follows:

Theory and practice of AI in medicine, human biology, and health care:

- theories of knowledge representation, automated reasoning, and intelligent communication, computational theories of learning, planning, perception, signal, image, speech and natural language understanding;

- theory, engineering, and practice of computational, knowledge-based, and agent-based intelligent systems in clinical medicine, biomedicine, and health care;
- software intelligence built into medical instruments, equipment, robotic and prosthetic devices; and
- methodological, philosophical, ethical, psychological, and social aspects of medical AI, including some aspects of general intelligence such as artificial consciousness and simulation of the brain.

At the start of 2017, Professor Carlo Combi from the Department of Computer Science of the University of Verona, Italy, took over the editorship.

CEO of Medexter Healthcare

To a large extent, computer science is an engineering science. It creates the foundations for developing software algorithms and building software systems; we may refer to these as software "machines". In clinical informatics, especially in clinical decision support, these "machines" are put into operation to help or secure patient care, trying to explicitly bring more precision and safety into the processes of care, and provide transparency for cost reduction, if reasonable and needed.

Medexter Healthcare was founded in 2002 with the above objectives in mind.

My fellow clinicians served as an additional driving force. Once we had concluded the development, testing, and publishing of one of our medical expert or clinical decision support systems, clinicians would frequently ask why one should not put the system into daily use—as a supportive tool for their work. After tedious internal discussions, discussions with the hospital administration and clinicians, and—most importantly—with the funding authorities of the hospital, it was decided that a university department cannot operate a routine software system for patient care. In order to continue our development and also put them into practical use, I decided—together with a colleague—to found Medexter Healthcare.

Medexter Healthcare is dedicated to the development and global marketing of innovative software systems for decision support with proven clinical usefulness. After its inception, Medexter has succeeded in establishing technical platforms and clinical decision support systems for a number of hospitals, commercial partners, and medical and teaching institutions.

Retirement and activities now

I retired from the Medical University of Vienna at the end of September 2015. However, I continued as Editor-in-Chief of the international journal Artificial Intelligence in Medicine until the end of 2016, still supervise MSc and PhD students, and now continue to work fulltime on software systems for clinical decision support with Medexter Healthcare. The main topics are still:

- Clinical decision support and medical expert systems for clinical medicine;
- Knowledge-based systems based on knowledge design with clinicians, also partly open to "machine-learned" knowledge; and
- Fuzzy methods in medical research and patient care.

Furthermore, I am very interested in the state and future impact of AI, especially in clinical medicine, in philosophical questions as to what computers can or cannot do usefully, safely, and ethically, and in processes of societal development in my immediate vicinity and also worldwide. I do hope these developments follow evolutionary paths towards humanistic, non-violent futures. Yes, several, possibly different ones! Why not?

Vienna, Austria, August 6, 2019