

R. de Boer

The Engineer and the Scandal

O*ne must
have hypotheses
and theories
in order
to organize
one's knowledge:
otherwise
everything remains
mere debris*

Georg Christoph
Lichtenberg
(1742-1799)
Physicist and witty satirist
in Göttingen

Reint de Boer

The Engineer and the Scandal

A Piece of Science History

With 103 Figures

 Springer

Professor Dr.-Ing. Reint de Boer
o. Professor em. für Mechanik
an der Universität Duisburg-Essen, Campus Essen
Institut für Mechanik
Fachbereich Bauwissenschaften
D-45117 Essen

<http://www.uni-essen.de/mechanik/Mitarb/deBoer.htm>
reint.deboer@uni-essen.de

ISBN 3-540-23111-0 **Springer Berlin Heidelberg New York**

Library of Congress Control Number: 2004116219

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilm or in other ways, and storage in data banks. Duplication of this publication or parts thereof is permitted only under the provisions of the German Copyright Law of September 9, 1965, in its current version, and permission for use must always be obtained from Springer-Verlag. Violations are liable to prosecution under German Copyright Law.

Springer is a part of Springer Science+Business Media

springeronline.com

© Springer-Verlag Berlin Heidelberg 2005
Printed in The Netherlands

The use of general descriptive names, registered names, trademarks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

Typesetting: Data conversion by the author.
Final processing by PTP-Berlin Protago-TeX-Production GmbH, Germany
Cover-Design: Erich Kirchner, Heidelberg
Printed on acid-free paper 62/3141/Yu - 5 4 3 2 1 0

*Dedicated to
my wife Vera*

Preface

When, in the early 1980s, investigations into the thermomechanical theory of heterogeneously composed bodies (theory of porous media) began on the part of the author and his co-workers at the University of Essen, it was soon recognized that it would be helpful for the creation of a consistent theory to follow the historical development of the theory of porous media, i.e, to collect all hitherto known results gained in the past. In this connection the author recalled some excellent papers on porous media theory published by Professor Heinrich (with Dozent Desoyer) from the Technische Hochschule in Vienna in the middle of the 1950s (Heinrich and Desoyer, 1955,1956, 1961)¹ and the beginning of the 1960s, which had been shown to the author during his sabbatical leave at the Technische Hochschule of Vienna at the beginning of the 1970s. (In addition, on this occasion the author was introduced to Professor Heinrich himself, who was at that time seventy years old). These papers have, unfortunately, not reached the international scientific community because they were written in German. Nevertheless, the papers had a high scientific standard and it was self-evident for the author to look for preceding papers of Professor Heinrich on porous media theory. However, the author's efforts remained unsuccessful for a considerable time. A lucky break brought the author, finally, on the right track. He found a small hint to a publication by Professor Heinrich (1938) in the book *Theoretical Soil Mechanics* by Professor von Terzaghi (1943), known as the father of modern soil mechanics.

In the publication, in a little known journal, Professor Heinrich thoroughly worked out the scientific fundamentals of the theory of the consolidation of clay layers. In a footnote he remarked that he intended to use the

¹ The bibliography, basis of this book, is listed at the end. Books and papers in journals, used in the description of the scandal and in the biographies are cited with the author's name and the year of publication. All other supporting documents, such a letters, notes, reports etc. are only listed at the end of the References. This is also valid for the evidence of the figures.

concept of a certain Professor Fillunger and referred to a pamphlet by Professor Fillunger (1936) *Erdbaumechanik?* (Earthwork mechanics?) edited by himself. The brochure *Erdbaumechanik?* opened the gate for unveiling one of the biggest and most dramatic scandals in science history, namely the bitter dispute between the excellent professors von Terzaghi and Fillunger from the Technische Hochschule of Vienna around the middle of the 1930s and its sad end. Furthermore, the intensive investigations have also revealed the story of the glittering life of von Terzaghi and a scientific masterpiece in the development of the theory of porous media by Fillunger, who is recognized as the founder of this theory today.

During the late 1980s and the 1990s the author investigated this piece of science history in several places in the world, namely in Austria, Norway and the United States of America. The investigations disclosed an amazing story which had been nearly completely forgotten in the world, even in Vienna, although all the newspapers in Vienna made reports about on the heavy dispute and its tragic end with large headlines in 1937.

The inquiries lasted a long time. Many files on the strange affair in the archives in Vienna and Oslo, a large number of notes and letters as well as related publications including the extended handwritten (with Latin and Gothic German letters) diaries of von Terzaghi had to be studied. Moreover, a great deal of interviews and correspondence had to be carried out. This could only be done with the financial support of several foundations, with the support of the archivists in Vienna and Oslo, colleagues and my co-workers (extending acknowledgements are listed at the end of the book).

Mrs. P. Lindner-Roullé and Mrs. G. Bujna, responsible for the word processing, have brought the manuscript to its present form and Mrs. V. Jorisch has taken care of the large number of the historical photographs. I would like to express my deep gratitude to them. This is also valid for the considerable work of Mr. J. R. Campbell, who corrected my English and brought it into the right form.

I record here also my heartfelt thanks to Springer-Verlag for the careful publishing and the pleasant cooperation.

Contents

| | |
|---|-----|
| Prologue | 1 |
| 1 Karl von Terzaghi’s Childhood, Youth and his Road to Practice and Theory | |
| 1.1 Childhood | 5 |
| 1.2 “Sturm und Drang” | 13 |
| 1.3 The Road to Practice and Adventure | 41 |
| 1.4 The Entrance to Science | 89 |
| 2 Prelude to the Scandal | |
| 2.1 Paul Fillunger – a Scientist and Critic | 153 |
| 2.2 Karl von Terzaghi’s Daily Life and Early Dispute with Paul Fillunger | 161 |
| 3 Intermezzo | |
| 3.1 Karl von Terzaghi’s Career Peaks | 173 |
| 3.2 The Founding of Modern Theory of Porous Media by Paul Fillunger | 190 |
| 4 The Scandal | |
| 4.1 The Run of Events | 195 |
| 4.2 The Aftermath | 231 |
| 5 The Further Development | |
| 5.1 Karl von Terzaghi’s Life and Work after the Sad Affair | 239 |
| 5.2 Some Developments in Soil Mechanics | 265 |
| 6 Epilogue | 273 |
| Acknowledgements | 277 |
| References | 279 |
| Author Index | 287 |
| Subject Index | 291 |

Prologue

This book gives one an indepth study into an important part of the development of the Theory of Porous Media as well as the amazing story of the glittering life of Professor Karl von Terzaghi and provides an outline of the bitter dispute between him and Professor Paul Fillunger, both working at the Technische Hochschule in Vienna in the fields of Soil Mechanics and Technical Mechanics, in the early to mid 1930s. The ugly confrontation with its tragic end was a scandal in many respects.

Karl von Terzaghi, considered in civil engineering circles as the father of modern soil mechanics, is still, nearly forty years after his death, a legend for many geotechnical engineers. Also in some geological circles he is known due to some contributions on problems in that field. This appreciation is surely not exclusively founded in his consulting activities, which he so successfully exercised all over the world. There have been other excellent engineers in the field of soil and structural mechanics who are widely unknown today. Rather it was his scientific achievements which made him famous. His disciple R. B. Peck stated in a speech delivered at the ASFE (The Association of Engineering Firms Practicing in the Geosciences) annual meeting, Boston, April 12, 1988: "Several milestones, perhaps three, mark the transition to what we now think of as modern soil mechanics in the United States.

The first of these was Terzaghi's establishment of the new sciences: the mathematical theory of consolidation and the accompanying recognition of effective stress, the deformation conditions controlling earth pressure, and the determination of numerical value for the pertinent physical properties of earth materials." The two other milestones were, in the opinion of Peck, Arthur Casagrande's (main disciple of von Terzaghi) installation of an effective teaching program at Harvard, and the International Conference on Soil Mechanics and Foundation Engineering held at Harvard in June, 1936.

Indeed, in particular, the description of the consolidation problem and the devolvement of the concept of effective stress have been closely associated with von Terzaghi's name up to the present day.

Karl von Terzaghi's biography is easy to follow. He left an extensive record of his life in diaries, manuscripts, books, pamphlets, statements, notes etc. In particular, his diaries contain a lot of facts about his life, individuals, who accompanied him, and his surroundings. However, von Terzaghi was a vain person and belonged to that group of people who work their whole lifetime on their own memorial. In his diaries he sometimes described important events in his life not on the day on which they occurred, but a long time later, and he glossed over many facts. Thus, one has to be careful in adopting his view on facts and his description of certain occurrences uncritically. There are several inconsistencies in his diaries, memoranda, notes, etc. In many cases his main statements have been cross-checked by the author in order to find the truth, and not only von Terzaghi's standpoint. This procedure was not always successful. However, the reader will surely be amused by many stories told by von Terzaghi, which sometimes remind one of colorful fairy tales.

Nevertheless, the biography will reveal a brilliant, fascinating man, a highly-gifted, independent engineer, an imaginative, enthusiastic researcher, a restless, fearless adventurer, a charming, humorless cosmopolitan – and sometimes a bragging showman with immense craving for recognition. Moreover, he was a very egocentric person, who mostly only accepted his own opinion (Thus, it is not surprising that he worked with only few people and not in a team). In other words, he obviously suffered from a special kind of “secondary narcissism” – well known in psychoanalysis; we will find numerous examples for this narcissistic disorder in his biography.

The opposite of von Terzaghi's dazzling personality was Paul Fillunger. It begins already with the fact that he left behind only little in written form. Thus, only a short biography can be presented, which shows a man who lived in a very small world of his own. He was, in a certain sense, arrogant, stern, and sometimes a know-it-all. However, Fillunger was an excellent scientist who investigated new scientific fields.

It is well-known in science history that new scientific findings are, in general, not accepted without struggle. Ideas and personalities clash, mostly not in a rational manner, but rather in an emotional and polemic one. Examples are the great feud between Newton and Leibniz on the invention of differential calculus, Maupertuis and König on the principle of least action and Boltzmann and Zermelo on problems of thermodynamics. The bitter dispute between von Terzaghi and Fillunger arose at the beginning and in the middle of the 1930s over certain physical problems in porous bodies. The Fillunger-von-Terzaghi occurrence, with its sad end, presents a microcosm of the unrest and upheaval in Middle Europe during this period. The whole affair and its tragic results were a big scandal at the Technische Hochschule of Vienna and had far-reaching consequences in engineering science. There are a lot of documents covering the whole strange affair from the very beginning until the end and through the aftermath. However, there are still some open points which have not been able to be clarified up to now. However, the research so

far has given a clear view of the whole scandal, which seems to be unique in European scientific history.

During his studies at the Technische Hochschule in Graz, Karl von Terzaghi was an active member of the duelling fraternity *Vandalia* – a particularly wild society according to its name. Karl's sometimes strange behavior in the fraternity or in meetings with his fraternity friends may cause offence for some people who were closely related to him or are admirers of his outstanding achievements. For those people a brief overview of the significance and the development of fraternities in the German-speaking countries may be helpful in order to show that Karl's sometimes wild and improper manners as well as his exuberance in his youth were not a personal weakness of character, but rather corresponds to the tradition of the fraternities.

There are only few human societies which have existed continuously for nearly 200 years and have seemingly survived all economical and social fluctuations unchanged (see Krause, 1979). The fraternities have been persecuted and banned – and high-ranking people belonged and belong to them as members. Although they are considered as old-fashioned they still exist today. They use their own vocabulary and have strange habits, show enthusiasm for ideals already declared dead and attract seemingly quite reasonable men of different ages to their ranks.

There is not a single unique fraternity. There are educational and academic fraternities, duelling and non-duelling, those that wear colors and those that don't, confessional and confessionally unbound whose various tendencies are reflected in a manifold of terms, like Burschenschaft (students' associations), Corps, Landsmannschaft (organization of German expellees), Sängerschaft (choral society), Turnerschaft (gymnasts) and Verbindung (fraternity).

A fraternity consists of the acting students and the so-called Alten Herren (alumni). Both groups have their own as well as common meetings.

At the end of the 18th Century student organizations of German expellees and orders had been formed and had reached great importance. A decisive change occurred when, on this basis, corps and student associations developed. The modern fraternities were created through both these types of incorporation.

The spirit of a fraternity is surely determined by three things: The voluntary binding of oneself to given principles, the inner democracy, characterized by the word *Convent*, and the custom described by the expression *Comment*. Four principles are common in all fraternities, namely friendship for life, fulfillment of the duties of study, the demand for an honest way of acting – and the encouragement of young men to sow their wild oats. Thus, in those days drinking, rioting and duelling were essential parts of fraternity life and “considered a legitimate and laudable manifestation of youthful exuberance, but it claimed many victims and its effects on the individuals engaged in

these manifestation was unpredictable.”² Some of them, taking full advantage of their academic liberties, “perished in the gutter, victims of alcoholism or venereal diseases.” However, most of the students “turned into painfully respectable citizens of the Main Street type” or became brilliant men in their profession.

This part of fraternity life was influenced and often supported by the alumni who paid for beer and brothel visits. However, they supported the students also in very positive respects, like spending money for the fraternity and giving aid for the young people to get good positions in the professional world.

Social life has always been the center in the life of students and the members of the fraternities – of course, connected with drinking a lot of alcohol, mostly in the form of beer, which sometimes ended in drinking bouts, whereby some students were so drunk that they completely passed out. Often the drinking bouts were connected with drinking games, like the *beer-state*, the *Doctor cerevisiae et vini*- and the *pope-game* which is also mentioned in Goethe’s *Faust*. Most famous was the so-called *Ledersprung* (leather jump) in Leoben, Austria (see Section 1.2).

It was quite natural for students to pass rioting and noisy through the streets after drinking bouts and sometimes sharp laws had to be introduced against disorderly conduct and disorder.

However, the students – at all times – liked also to sing in a style like *Carmina burana* – and they had their own songs, e.g. *Gaudeamus igitur* and the *Krambambuli* songs.

To the social meetings of the students belonged the *Kneipe*³ which they had to attend at least once a week. They spent the evening with discussions, playing some games – and drinking.

At the turn of the century, 1900, duelling was very popular in the fraternity. Karl von Terzaghi performed the duels with great enthusiasm, as we will see in Section 1.2.

² Text in quotation marks consists of statements by Karl von Terzaghi, if no other reference is made. Remarks in parantheses accompanied by “the author”, means the opinion of the author of this book.

³ Kneipe means bar, but may also refer to student’s drinking event

1. Karl von Terzaghi's Childhood, Youth and his Road to Practice and Theory

1.1 Childhood

Karl von Terzaghi was a descendant of a long line of Austrian professional men and army officers who lived in Lodi, Lombardy and Prague, Bohemia. His family tree can be traced back to 1762 when his great-grandfather Peter Terzaghi was born. He later became a lawyer and married Maria Leonardi. They named their son, born in 1806, Peter Anton (Pietro Antonio) (grandfather of Karl) who entered the Austrian army where he advanced to the rank of Oberleutnant later. In 1832 Peter Anton married Johanna Rischan from Prague. Peter Anton was awarded by Kaiser Franz Josef I with the title *Edler von Pontenuovo* in 1854, for “having attained the rank of Major, with more than 31 years of continuous military service and decorations for valor” (Goodman, 1999). Karl von Terzaghi's father, Antonius de Padua Petrus Aloisius Franciscus Johannes Nepomucy Edler von Pontenuovo (1839 – 1890), was stationed as a commander of an infantry battalion in Prague, and became later a Colonel (Oberstleutnant). In 1882, he married Amalie Phillipine Eberle (1853 – 1942) in Graz, the daughter of Karl Andreas Eberle (1823 – 1916) and Amalia Gettinger (1826 – 1904). Karl Andreas Eberle served in the Austrian Tobacco-Administration after he had finished his studies in mechanical engineering in 1846. In the 1870s he organized, as a general manager of an international bank consortium under extreme difficulties, the production of tobacco in Romania. He earned a lot of money and became a wealthy man.

On October 2, 1883, Karl Anton Terzaghi, Edler von Pontenuovo, was born in Prague (in the following paragraphs we refer to him simply as Karl von Terzaghi⁴).

He was born within the great Austro-Hungarian Empire, the Danube monarchy, at that time relatively quiet with only few conflicts so that he was able to spend his childhood and youth in an intact world. This is also true for his family life. His wealthy family presented him the right surroundings for his carefree development.

⁴ Karl von Terzaghi used several versions of his name in the literature: Karl von Terzaghi, Karl v. Terzaghi, Karl Terzaghi, and Charles v. Terzaghi.



The Austro-Hungarian monarchy at the time of Terzaghi's birth and youth.



Karl's birthplace in Prague



Grandfather Karl Eberle's house in Graz.

Nearly one and a half years later, on February 21, 1885, Amalie gave birth to Karl's sister, Gabriele Anna Johanna Nep. Terzaghi Edle von Pontenuovo, known later as Ella.

The von Terzaghis lived in an "old house on Thungasse, from which, over the tiled rooftops, one glimpses a high wooded hillside with only a church and a tower to mar the natural landscape rising above the city" (Goodman, 1999). Von Terzaghi's home town, Prague, is also called the *Golden Town* and was at that time the capital of the Austrian Province of Bohemia. It belongs to the loveliest cities in Europe and is known as the town of Gothic and Baroque. The city is divided by the legendary river Moldau. To the left of the Moldau the Hradschin, now seat of the Czech president, the castle Belvedere, and the municipal district Kleinsseite where its old narrow lanes and baroque palaces, are located. The old Karlsbrücke, beautified with many statues, leads to the right Moldau bank with its old town, university, and Jewish quarter. At that time the cultural and social life in Prague was influenced by German culture to a great extent and the Deutsche Technische Hochschule had educated many excellent engineers in Bohemia and also in the German-speaking countries.

Little is known about the childhood of Karl von Terzaghi in Prague. Only a few anecdotes are reported. In a letter to the author the late Ruth von Terzaghi (Karl von Terzaghi's second wife) pointed out: "I do not recall that Karl ever expressed any recollections of his parents from his childhood, although he did recall with apparent pleasure an orderly of his father ... The orderly (I suppose a sergeant or the equivalent) apparently enjoyed little Karl's company and made for him a toy barn complete with animals. To get a better view of the interior, Karl stuck his head into the barn and was unable to withdraw it. The orderly of course came promptly to the rescue." The siblings (Karl and Ella) stayed only for a few years in Prague. Their father retired in 1887 and the family moved to Graz, in the Austrian state of Styria, next to Meran the preferred place of residence for retired officers. Grandfather Eberle had bought a comfortable three-story house in the Rechbauerstr. 10, which was built in 1876. The von Terzaghis lived on the first floor. The large block was located directly across from the Technische Hochschule and only a short distance from the opera house and city park.

Unfortunately, Karl's father was not able to enjoy his retirement for a long time as he died shortly thereafter in 1890. Karl and Ella von Terzaghi's maternal grandfather, Karl Eberle, seems to have been happy to act in loco parentis. He exercised great influence on Karl's development. As he himself later remarked: "His strong, distinct personality and his honorable, masculine character influenced my development" and Ruth von Terzaghi continued in her letter: "Karl had many fond memories of him. One of these centered on the freshly roasted chestnuts which Grandfather regularly bought from street vendors and brought home to his grandchildren. Later, he seems to have played, or at least tried to play, a considerable part in the choice of careers."



Karl's father:
Antonio von Terzaghi



Karl's mother:
Amalie Phillipine von Terzaghi



Karl as a toddler, around 1886

Ruth von Terzaghi further wrote about Karl: "As a child, he might perhaps have been described as either *mischievous* or *troublesome*. (In the US it is almost an article of faith that gifted children are troublesome). Karl recalled one occasion when he and his younger sister Ella (his only sibling) were walking along a riverbank with a nurse; noting the nurse's inattention, he hid Ella behind a tree, rolled a large stone into the water, and led the nurse to believe that Ella had fallen into the water."

It was quite natural that Karl would become a career officer following the tradition of his ancestors. In 1893 he became a pupil in the military Unterrealschule in nearby Güns (Köszeg, Hungary) with the intention of applying later for admission into the Kriegsmarine (navy). The teaching positions were exclusively filled up by officers who were able to rouse vivid interest for sciences. The spartan living and the education to bear physical hardship laid an excellent basis for the practice of Karl's later profession as a journeyman in civil engineering.

However, already in the second year at the military Unterrealschule he had a hunch that he would not adjust to the military profession. But in the time to follow he concentrated his whole interest on geography, in particular on the polar regions. He shared his interests with his lively friend Hans Kalbacher, a very talented boy who became Karl von Terzaghi's life-time friend. They ordered books, catalogues, drew maps and worked on different technical problems. Moreover Karl became interested in astronomy. Despite a lack of mathematics and mechanics he worked half a year on the approximate calculation of the sunrise and sunset.

In his 15th year of age he entered the Military Oberrealschule in Mährisch-Weiskirchen (Hranice, Czech Republic). This year was of great influence for his further development. Geography as a mere description of countries was no longer of interest to him. This field was replaced with mathematics – algebra and geometry. In February 1898 he got sick for six months. During this time he was deeply involved in geometric problems and also philosophical questions gradually arose like the questions about the purpose of human existence and the birth of the universe. The unanswered questions bothered him and he turned to religious studies. The new interest for science and the antipathy towards the boring "soldier game" led him to resolve to leave the military school. However, the relatives in Graz did not agree, at first. Finally, after struggling he succeeded in being granted his wish.

During the summer of 1898 he prepared himself for the entrance examination to the Landes-Oberrealschule in Graz. He was not able to continue all his other studies with the exception of his reading in religion. Gradually, he came to doubt many statements in the Bible and he did not know what he should believe. Finally, he regarded religion as a superfluous tool which he abandoned out of his life.

Karl entered the 6th grade of the Landes-Oberrealschule. In a short time his interest in describing natural sciences was becoming his favorite field. He



Karl with mother, Ella and
grandparents about 1897



Karl at age 14



Karl's school report from the 6th class at the Landes-Oberrealschule in Graz.

studied intensively the books recommended by his teacher, in particular Darwin's *The origin of the species*. Ruth von Terzaghi recollected Karl's special interest at that time: "Much later, when he was enrolled in a high school run under (protestant) church auspices, he wrote a paper highly sympathetic to the Darwinian theory of evolution. As a result, he came close to being expelled."

His grades in different fields in the school year 1898/99 were not superb with the exception of natural sciences which he liked so much. Karl graduated at the age of seventeen (Matura). He passed the final examination, however, already with honors.

1.2 “Sturm und Drang”

With his graduation Karl's childhood had come to an end. A completely new decisive period in his life began, a period which was very important for his whole life, development, and career and which was marked by a search for his attitude to life accompanied by errors, confusion, and insights as well as the search for the right profession. This process of searching for his true self lasted several years. In this time most of his later characteristics became apparent and his view of life was formed (Sturm und Drang).

Most influential in his personal life during the next years was his grandfather, Karl Eberle. He took him on three major educational trips: to Switzerland, Germany, and Italy.

Karl's descriptions of the tours read, in the main parts, as a travelogue with a detailed listing of all objects of interest. Little was said about his personal life and about his relation to his grandfather during his travelling. However, in the description of landscapes, Karl's talent became apparent, namely that of laying down, in written form, his observations of the Earth's surfaces, which he did so masterfully later for geological problems.

At first, however, in July, 1900, Karl started alone for a small visit to Zell am See near the grandiose Hohe Tauern with several peaks more than 3000 meters high. After a very rainy ride he arrived at Zell am See on Tuesday, July 10, where he rented a room. His objective was to explore the beautiful landscape close to Zell am See, namely the magnificent surroundings of Kaprun and Krimml.

Two days later, he started for his first excursion; he left his room early in the morning. The path led him endlessly through a meadow which became very marshy close to the lake. On a hill he saw to the left side the remains of a castle, and to the right, slate-quarries. He passed the old castle Kaprun, and entered and hiked through the Kaprun valley. His first station was Kesselfalls Alpenhaus where he had breakfast. After a strenuous hike he arrived finally at Wasserfallboden. Here, in the valley, the timber-line was already reached. Thereafter he went to a glacier which was covered by new-fallen snow. In the late afternoon he returned to Kesselfall where a bus brought him back to Zell am See. On Friday, July 13, Karl rode under a cloudy sky from Zell am See to Krimml. During the ride with the local narrow-gauge railway he enjoyed the beautiful views into the cross-valleys of the Hohen Tauern, in particular, into the marvellous Habach valley and the Sulzbach valley with the three and a half thousand meter high Großvenediger. He arrived at Krimml after a comfortable three hour ride and went to the first two falls, where he was surprised by lightning. During the next day, he hiked on a steep and stony path to the waterfalls of Krimml. “The forest is wild-romantic, to the right and the left of the path, mighty, glaring yellow and red rocks, covered with braids. At times one branched off the pass to viewpoints.” After the third waterfall Karl entered the real Krimml valley. After a two and half hour hike

he arrived at the foot of the Tauern and he enjoyed the grand view of the high mountain Reichenspitze and after a while the view of a mighty ice-field. After climbing and hiking through a marvellous world of rock- and ice-fields Karl, finally, arrived after passing grain-fields and farms, at Kasern where he stayed over night. On Sunday, July 15, 1900, Karl was back in Graz.

It is amazing how precisely Karl von Terzaghi described, already at that early age, his observations in nature. Following every detail he designed an instructive overview of landmarks, prodigies of nature and of geological phenomena. This talent made it later easy for him to formulate real geological and engineering problems which he published in numerous journals. Today, it is still enjoyable for experts to read his publications.

Karl started the first educational tour together with his grandfather to Switzerland at the very beginning of August, 1900. They travelled by train via Innsbruck to Lindau. By ship they arrived at Bregenz and Konstanz on August 4 and August 5, 1900. In Konstanz Karl visited all important objects of interest. In particular, he was interested in the old Roman-Gothic cathedral. In the late afternoon Karl and his grandfather rode by train via Schaffhausen to Zurich. They enjoyed the picturesque landscape with the island Reichenau, vineyards and the famous cataract in Schaffhausen. After breakfast, on August 6, 1900, they took a walk along the banks of the Zurich lake and in the afternoon they entered the electrical rack-railway which brought them to the well-known Polytechnikum. Karl admired the splendid statues in the vestibule, the old reliefs and the busts of former professors in the aisles.

The next station was Luzern. During a walk they got to know the originality of this town. The two wooden bridges with roofs and with unusual presentations of motives from Luzern's history appeared very strange to Karl. He was impressed, however, only by the splendid banks of the Vierwaldstätter Lake. In the afternoon they made an excursion by boat to Küsnacht, well-known from Schiller's stage play *Wilhelm Tell*. On Friday, August 10, 1900, they left Luzern and hurried to Bern. On the way they admired Interlaken's beautiful wood carvings and the marvellous view on the Berner Alps with Jungfrau and Eiger. In Bern they rented a room in the *Löwen* and took a walk through the peculiar old town with cellars emerging to the streets. The dinner was superb and on the following walk they had the opportunity to have a look at the splendid lighting system. Both ended the evening with a beer in a small garden. The next day was again filled with sight-seeing. First, they visited the magnificent late-Gothic cathedral, a masterpiece of architecture. Karl entered the tower and enjoyed the nice view of the Platte, a square-bastion – like a spur – located in the inner part of a loop of the river Aare, 40 meters above the river with the parliament building, town hall, university, and museums.

After lunch they prepared for the departure to Geneva with the express-train which was so completely crowded that it was hard to get a seat. They did not see much of the landscape. However, the first look at the Geneva-Lake

and the Mont Blanc compensated for the stressful journey. In the evening they rented a private room and took a walk along the "Rue de Mont Blanc, the most beautiful street of Geneva" where they took their dinner in a restaurant.

On Monday August 13, 1900, they visited the Rhone banks, the Île de Rosseau and via the Pont de Monblanc the marvellous park on the right lake bank. While his grandfather was waiting in the park, Karl entered the tower of the old cathedral having a beautiful view. "The cathedral is with wood-carvings and monuments a building of interest of first rank." After lunch Karl visited the natural history museum, "for me one of the best objects of interest." Karl described exhaustively all the objects in the museum. After dinner Karl went with his grandfather to the Cafe *La Nord* in order to attend a string orchestra concert. On the next day, after breakfast they entered the steamer *Swiss* to go boating for 10 hours on the Geneva Lake. Having beautiful weather, Karl enjoyed the boat trip so much that he wrote an extra article on this boat outing with the title "La tour du Lac."

On Wednesday they left Geneva. After an interesting ride along the lake bank they arrived at Lausanne and further via Yverdon along the banks of the Neuchâtel-Lake to Neuchâtel and stayed there for one night. On the next day they rode by train to Biel. After having lunch they took a walk through the "town of the future", a really new town "because only a small kernel is old" and apart from that all was mostly new buildings.

After the sight-seeing tour they departed for Solothurn. Already at first sight the town made a favorable impression and they visited all the important objects of interest over the next two days. Then they rode to Aarau where they stayed only for one night because the town did not make a good impression on Karl and Karl's grandfather.

Via Zurich and Bülach they arrived at Schaffhausen on Saturday, August 18, 1900. They visited several points of interest on Saturday and Sunday and left Schaffhausen on the next day. Via Konstanz and St. Magarethen they entered Austria and rode to Landeck leaving Bregenz and Feldkirch behind them. In Landeck they stayed at the *Schwarze Adler*. After dinner Karl walked to the ruin Landeck and then through the Inn-Valley. On the way back he had a nice view of the Parseier-Peak. In the hotel he met his grandfather in company of an acquaintance from Graz to his great joy and surprise. On Wednesday, August 22, 1900, they left Landeck and rode back via Innsbruck to Graz.

The first major educational trip to Switzerland brought a lot of experience for Karl von Terzaghi, experience which was important for his further development. In particular, he saw many objects of interest, museums and the impressive Swiss landscape with the magnificent Alps. It is apparent that Karl was mostly interested in the description of the landscape, and not much in the history of Switzerland and its social and cultural life. He not only described the picturesque landscape in his diary, he also drew pencil drawings, some very nice and skillful, others, however, childish. He also tried to paint

water-colors. However, he had to state that he had no talent for this kind of art; thus he chose only pencil drawings as a hobby which he mainly carried on during his vacations.

His relationship to his grandfather seems to have been a little indifferent. In no place in his diary did he mention discussions with him or other events related to him.

In notes, written on Saturday, September 14, 1900, he drew a summary of his trip to Switzerland. "During the Switzerland-trip from August 2 to August 23 I enriched my geographical knowledge and knowledge of human nature in a very considerable manner."

In short trips at the end of August and the beginning of September, 1900, he became acquainted with the Dolomites. He rode to St. Lorenzen where he immediately took a walk along a small run. He enjoyed the marvellous view of the numerous wild romantic mountain peaks.

After his departure from St. Vigil Karl hiked through the bizarre Dolomites, through canyons, along abysses on rock- and ice-fields, and lime plateaus. He described the geological formations extensively on eight pages in his diary.

After several days of hiking and climbing it was time to end the tour. "Now I hiked on the road further to Welsberg (Monguelfo, Italy), with a heavy heart taking leave of the Dolomites and used the eight-hour-train for the ride back."

During this time Karl von Terzaghi not only discovered the Alps but also tried to adjust to himself and to his environment. "At this stage I have left a Realschule-education (Secondary school) of seven years behind me and I feel the drive to prove which changes in my personality have occurred partly by my own will, partly due to outside influence. Once I was weak. I was sinking in the morass of many vices and I have to repent numerous slips. However, the drive for discovery has lived in me forever; I have recognized that happiness, character and drive are embedded only in complete self-control, ...

I can state to my pride that I have tried to improve my scientific findings. This effort has led me to doubt religion and materialism; in contrast to this I have heard about spiritism."

Despite all his impressive travels his vacations won their greatest significance through the careful study of Darwin's theory and in particular, through the fact that he became acquainted with spiritual ideas. Through this contact an important change occurred in his philosophy of life. Materialism, which he had payed homage, was recognized as incomplete. Religion, which he was very superficially familiar with, and which he esteemed little, he now recognized as a philosophical truth. He desired to build further on this ethical basis.

In the fall of 1900 Karl enrolled at the Technische Hochschule in Graz, just next door to his home in the Rechbauerstraße. The Technische Hochschule Graz had emerged from the Joanneum founded by Erzherzog Johann in 1811. In 1865/66 the technical school was raised to the *Technische Hochschule*



Technische Hochschule in Graz



Technische Hochschule in Graz and grandfather's house

with few faculties: engineering, mechanical engineering, chemical technology, agriculture and forestry.

In 1878 the Staatsprüfungen (state examinations) were introduced and in 1901 the Technische Hochschule received the Promotionsrecht (right of graduation). It was the wish of his family that Karl should study mechanical engineering for the next four years. However, this special field did not appeal to him at all and he was only occasionally seen in the lecture halls of the University. In exchange, he enjoyed the academic liberties in a rather desolate manner. His life as a student was wild and turbulent; he joined the bellicose fraternity *Vandalia* and spent most of his time drinking, rioting and duelling.

At the beginning of August, 1901, Karl von Terzaghi started his second educational trip together with his grandfather Karl Eberle – this time to Germany in order to visit the culturally most important places in the neighbor-state of Austria. They left Graz on August 5 and arrived at Salzburg in the afternoon. It was not easy to get a hotel room because a music-festival had just begun. On the next day they rode to Munich. In the afternoon Karl took a walk through the center of Munich and was impressed by its many magnificent buildings. During the next morning he visited the *Alte Pinakothek*, in which many of Munich's marvellous art treasures are collected. Karl regretted that he could not appreciate the works of art in the right way due to his lack of education in art. Two landscape paintings attracted, of course, his greatest attention. By accident, he saw some Böcklin reproductions. His paintings had an irresistible fascination for Karl. They awoke different emotions in him which he could not explain and found rationally. He recognized that he had to fill this gap in his education. On the next day he went with his grandfather to the *Neue Pinakothek*. The impression was almost more lasting than that of the *Alte Pinakothek*. He again admired the landscape paintings.

He was a little disappointed by the *Ruhmeshalle* (Hall of Fame) with the *Bavaria*. On his last walk he saw the *Maximilianeum*. A broad and grand avenue led him to the object of interest, with its main memorials to great German scholars. He looked from the Isar-Bridge into the park adjoining the building, a real work of art. He took a seat on a bench for a while and admired the bushes, illuminated by the evening sun, with the red-lit Maximilianeum gleaming through.

At Maximiliansplatz they crossed the trolley lines. Karl was lost in thought, thinking of all the impressions he had gained. Suddenly, he heard a pitiful crying behind him. He looked back and was for the first moment paralyzed with terror. Karl saw his grandfather lying on the trolley lines, being dragged away by the trolley. This was a terrible moment. At last, the trolley stopped and to Karl's great surprise and joy his grandfather got up. Some passers-by led him into a house. Karl inspected his grandfather's injuries. However, fortunately, there were only some skin abrasions and swellings, which were quickly bandaged.



Karl as a young student, 1900.

The plan to leave Munich on the next day was of course in a sad manner cancelled. Karl and his grandfather spent the next day (August 9) involuntarily in Munich. The first trouble was soon overcome and in the afternoon Karl took a look around in the magnificent *Englischer Garten* (English Garden).

Karl and his grandfather continued their tour on August 10, to Nuremberg, the old town with battlements, turrets, and dark narrow lanes – recalling the Middle Ages. On the next day, Karl took a walk along the *Graben* and he really got the impression of an ancient castle. 34 years later Karl would return to Nuremberg on business.

Karl and his grandfather visited the next points of interest in Eisenach on August 12, 1901. Karl enjoyed the lovely Thuringia forest on the next day. Already at four o'clock a.m. he started his trip through the forest solitude; he admired the Warthburg on his hike and he recalled the place of this landmark in German history, in particular, its importance for the fraternities. In his thoughts he called on the students to keep the joy of songs and weapons and to conduct the bright *Schläger* (rapier) with honor.

In the evening they rode to Leipzig. However, Karl did not like this town; he felt it was too plain. Therefore, Karl and his grandfather headed on further to Berlin in the evening. The next morning he started his walk through Berlin in the famous street *Unter den Linden*. His expectations were not let down. The broad street was encircled by splendid buildings, royal castles and lovely parks. On one dignified end was the *Brandenburger Tor* and on the other

side the Schloßbrücke. Beyond the bridge he saw the highlight, namely the *Lustgarten*. Moreover, he admired the cathedral and the museums on the museum island. Furthermore, in the afternoon he visited the zoo, and in the evening, the observatory.

On August 16, 1901, in the afternoon, Karl and his grandfather made a trip to Potsdam in order to view the castle Sanssouci. Although he was not in the right mood, he enjoyed the stylish beauty of this castle located in an expanded, marvellous park decorated with statues, temples and fountains.

Two days later, Karl and his grandfather made their way to Hamburg. They stayed there in a splendid hotel which was located at the Alster. In the afternoon they took a walk through the city. Karl was very pleased with this interesting and original town: "a German Venice." On the next day they boarded a boat and visited the harbor, one of the most famous harbors in the world.

On August 21, Karl did his private correspondence and after he had completed this he went with his grandfather to the railway station and rode to Bremen, to the other main harbor on the North-Sea. The ride was a comfortable one, partly through forests and partly over waste heath-land. "The most interesting place in Bremen is without doubt the market. Encircled by splendid old houses, patrician and guild houses, the stock exchange, and, in particular, the city hall. In front of the old landmark of jurisdiction, the mysterious Roland. The Gustav Adolf and the Wilhelm monuments are located here. The interior of the city hall is in accordance with the outward appearance, splendid and antique. On the ceiling hang some small sailing-boats, the walls are covered with carvings and frescos. Also the cellar, a real drinking hole, is quite historic. Huge barrels are set up on the walls for thirsty souls." In the evening Karl proposed to already travel to Cologne on the next day. Karl's grandfather agreed immediately, as they had seen all points of interest. The ride to Cologne took seven hours. In Wanne (Herne) they entered the Ruhr area with all its heavy industry, plants and coal mines and the "nice small houses of workers." In Cologne they crossed the mighty river Rhine and arrived at Cologne's main railway station. Soon they found a room in the *Ewige Lampe*.

On the next morning, August 23, 1901, they visited, first, the Cologne Cathedral. "In front of our eyes the mighty Cologne Cathedral, a colossus, rises; the dimensions are beyond any imagination. We entered the interior through a memorable large portal and were astonished at the simple greatness, at the modest harmony of this house of God. To the right and to the left the columns, mighty, like the trunks of a very old forest, strive upwards, so that one can hardly follow them and end up there in mighty vaults. The faces of the apostles and martyrs looked seriously from the huge glass windows ...; each of the monumental sections breathes the idea of God and the withdrawal from the bustle of the world. One could not erect a more dignified monument for the God of the Christian world."

The trolley took them through the city. Karl's interest in the buildings was not great; his thoughts were still with the splendid Cologne Cathedral. In the afternoon he went again to the Cathedral. A doorman led him via a winding stair to a gallery where he stood in the middle of the architectural sections admiring all the details of the construction.

In the tower he met a young man from Berlin. He enjoyed the time with him and was glad to exchange his ideas with a person who felt like he did.

On August 24, Karl and his grandfather made their way to Mainz via the river Rhine on the steam boat *Auguste Victoria*. This trip is some of the most beautiful boating in the picturesque landscape of Middle Germany. Soon they left the flat land. To the left they saw the Siebengebirge with the castle *Drachenfels*; moreover on the peaks of the mountain the first castles, silent witnesses of the long German history looked down upon the Rhine. In Koblenz the boat brought them into the real Rhine Valley with the most spectacular views of the river banks, mountains with wine, castles and a mysterious charm. Karl von Terzaghi described the boat trip on the Rhine with at times florid language "One is not forced to think of a wild, romantic canyon. No. However, the woody heights, picturesque interrupted by vineyards and rocks. In the basins the most lovely towns thinkable, are still in their Middle Age garb ... That all combined with the venerable wreath of legends, which are tied up at every corner and every place of this marvellous region has, with the great historical past, an indescribable magic for every receptive heart." At the Loreley and the Rhine Rock these feelings reached their climax. "The prosaic spectator would say a slate-rock which projects into the Rhine. I say it again: The marvellous surroundings, the green stream, in the distance, the lovely St. Goar, and the old castles, in front of me the water rushing down grey rock is rising sphinx-like, the silent witness of the past of this place. I was on the verge of tears. All the feelings, which many inspired hearts of poets were able to feel in this place, passed my spiritual eye; I felt the whole solemn mood. My thoughts roamed the past to that man, on whose side I spent the most beautiful hours and whose memory I will also always keep in such moments" (Probably the man he met in Cologne is meant, the author). "The Loreley has passed out of our sight and here the incomparable Rhine Rock emerges on the deep bank from the green beech forest. The charm and the fascination of this region is simply indescribable. The idea, as to how one can imagine the castle in the old heroic legends, seems to come true. From the stream the hill emerges steeply surrounded by marvellous beeches. Rugged, adventurous ribs of rock and sharp points interrupt the green and here on the rugged tooth-like rock the castle rises as picturesque as possible; on the side a noble Gothic chapel. I will describe nothing in detail; it is impossible for me.

Now, we have left Bingen. I look back to the splendid *Niederwalddenkmal*⁵; the *Siegesstatue* contrasts with the red-hot sunset glow. In silent

⁵ Monument

majesty it makes known widely the glory and the greatness of the German nation; the monument is reflected in Germany's most famous stream. Not yet have we arrived in Mainz and already now the mountains contrast with the black of the night sky. The moon is reflected in the marvellous stream which seems as if covered with silver light. Meditating I am looking from the railing to the waves and letting pass before my eyes all impressions which I have felt on the unique Rhine today."

On Saturday, August 25, 1901, Karl and his grandfather spent the whole day in Frankfurt. Karl was not in a good mood. He did not like Frankfurt very much and also his relation to his grandfather was not the best in this moment. "My grandfather is a kind, good man, full of goodwill, but he is already old and I am still a young man. Both are not well matched. He, already detached, sees the world with cold eyes, and I, still full of enthusiasm and fantasy; it becomes unbearable, to see always a person around me who does not share my feelings. It seems to me that I cannot bear this state any longer. Wild indignation varies with complete indifference; I have felt this state often already, now it is most vehement. Oh, how I shall breathe again, on the mountain, there is freedom! What valuable enjoyment this trip through the German provinces would have at the side of a young man, full of enthusiasm and emotion, like me. Of course, at the beginning nothing would please me and as before mentioned today the feeling of constraint, of discontent, was stronger than ever. At last gradually the shadows vanish and I unwind slowly."

A highlight of Karl's Germany trip was Heidelberg. "Marvellous Heidelberg. There is hardly a second place on earth to be found which can be compared with the beauty, with the poetry of the Heidelberg castle. Here nature and the work of man are combined in a perfect harmony, which defies every description. At this place nature seems to have spent all its charming attractions. The reality exceeds the fantasies of a romantic, splendid castle. I am sitting here in the deep moat, all round rise very old ivy clad beeches and linden trees and only some lonely sunrays get lost in the shady ground. A mysterious rush goes through the forest ceiling, on the ground a source ripples talkatively. While I am writing in the moat, I notice a broken winding staircase, uncovered tunnels and vaults. All things carry the traces of time; climbing plants cover the sad remains."

Then, Karl left the moat and walked to a marvellous forest, to the large terraces where he viewed the old, red castle, and Heidelberg town divided by the river Neckar. After visiting other points of interest in the castle he said good-bye to this splendid place. In the morning of August 28, Karl and his grandfather left Heidelberg and headed for Ulm. However, the weather was so bad that they decided, after a short stay, to ride on further to Munich and to Salzburg, where they had lunch. Karl was very happy when they came to the Alps. "... I must state that our fatherland, the Alps, are beautiful, too. So beautiful, so marvellous also the nature; there is only one thing missing: