

## **Prof. G. Gudehus, Karlsruhe/D**

Professor Kovari's review of Kolymbas' book "Geotechnik – Tunnelbau und Tunnelmechanik", published in TUNNEL 4/2001, is subjective and polemic to an extent which I have not met in geotechnics in 35 years. It is exceeded only by the famous dispute among Terzaghi and Fillunger. The present dispute will not develop as far as the past one, but I have adapted the title of this little treatise to the one of Terzaghi's refutation. I will first outline the background and then deal with Kovari's text.

Criticism of NATM and its principles is not new and quite natural as this method is widely empirical and more intuitively than rationally justified. The existence of NATM is incontestable, it is not worth the effort to dispute the name, the practical success is also indisputable. The attempt towards a rational scientific justification is in the vital interest of all those who are responsible in tunnelling. Thirty years ago the euphoric idea came up that all geomechanical processes, including those during tunnelling, could be predicted with the then new finite element method. This was sharply rejected by practitioners, which is fully right. (This illusion has contributed to the wider use of Functional Bid, the failure of which has led to a lot of trouble in tunnelling.)

In 1993 Kovari made a violent attack against the NATM in Salzburg by trying to show that its principles were absurd. This was doubtlessly a derision of the mental fathers of NATM, and the first reaction of their followers was not quite adequate. As Kovari could not make better proposals the Community left his attack aside soon. The Heathrow collapse caused a revival of the NATM debate, but Kovari's arguments did not play a role therein. He now uses the review of a textbook published 1998 by Kolymbas to reprimand the NATM in his personal manner.

In the beginning Kovari writes "that (book) of Kolymbas is a fruit of the NATM ideology". As there is not the slightest ideology in the attacked book, in particular not in favour of NATM, the Reviewer exposes himself already with this phrase. The subsequent statement "Kolymbas' main aim on the other hand is, in his own words, to provide the missing 'theoretical foundation of NATM' "goes beyond the first one and shows that Kovari distorted the text.

He then spreads his malice upon the reviewed author: "Due to the pseudo-scientific nature of NATM neither practical experience in tunnelling nor recourse to one's own research work is necessary." Should the Reviewer have overlooked a paper by Kolymbas published in a journal edited by Kovari with the title "Vereinfachte statische Berechnung der Firste eines Tunnels in massigem Fels?". This was decisive nearly twenty years ago when considering Mr. Kolymbas for an associate professorship at the TH Darmstadt. His textbook on pile foundations, which was worked out alongside with the major scientific achievement of Hypoplasticity, was welcomed by the Community, and certainly played a role when selecting him for the full professorship in Innsbruck seven years ago. In this way and now again with his two textbooks on geotechnics Prof. Kolymbas has done what can be expected from a university teacher: to penetrate methods scientifically, to order, upgrade and improve them, and to outline them clearly and distinctly.

Kovari means that "his approximate formulas, which are intended to 'explain the principles of NATM', are based on unrealistic assumptions only resulting into inappropriate and unacceptable mathematical formalisation of tunnelling". Kolymbas actually writes that his approximate formulas can explain some NATM principles – again distortion of text. He outlines his

assumptions clearly and tractable and shows that his conclusions are not disproved by observations. Kovari instead evidently rejects a “mathematical formulisation of tunnelling”. He thus leaves the realm of science which is precisely described by Karl Popper in his book “Logic of Scientific Discovery”. Kovari then blames Kolymbas for not having considered the influence of deformation when determining the required lining resistance and adds “In this way he not only causes embarrassment to the proponents of NATM but also contradicts himself”. Kolymbas, however, speaks of mobilised strength in his book and thus points to associated deformations. Did the Reviewer overlook this adjective?

We now come to the characteristic lines of tunnel lining and ground, which is the crucial point of the NATM-principles and the debate. I tend to follow the corresponding text of Kolymbas and would like to add the following. Because of the history dependence of the ground, it has strictly speaking, not only one characteristic line, and also the lining resistance can have several characteristic lines. By doing so I do not join Kolymbas making “the protagonists of NATM ... guilty of scientific fraud”, as Kovari states. The great achievement of the NATM-founders is just that this successful method is justified by use of characteristic lines which therefore can be considered as useful hypothesis. With modern constitutive laws (developed by no one else more than by Kolymbas) and by good numerics one will more and more be able to check and delimit these NATM-hypotheses. We thus do not “relegate NATM to the realm of fantasy” as Kovari writes.

Kovari is left with his secret of concluding from an evident printing error that Kolymbas has ignored the cost of making bore holes and placing anchors. He also does not prove his statement that Figures 10.3 and 11.1 are “basically incorrect”. These and further figures are certainly very simplified and not apt as building instruction, they serve only for a rapid overview.

The last Kovari-phrase on the Kolymbas book should be slowly digested: “We consider his newly created term ‘tunnel mechanic’ to be superfluous, for after all, applied mechanics has been associated with tunnelling for all of 200 years.” This is nothing but a stage-effect. Soil and rock mechanics are in general not associated with Applied Mechanics, otherwise both would not exist as disciplines of own right. This is particularly true for tunnelling and the associated ‘Gebirgsmechanik’ (to use a term of Leopold Müller’s). The notion “tunnel mechanics” is justified therefore and should be kept alive as provocation until the ‘Gebirgsmechanik’ has been fully developed also for tunnelling.

Professor Kovari has moved further offside with his attempt to push there a younger colleague by distortions and invectives. O si tacuisses, philosophus mansisses – but now he deserves an appropriate response. I also recommend reading Karl Popper’s “The Magic of Platon – The Open Society and its Enemies”.

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