Torben Krarup – A Colleague

The internationally well-known statistician A. K. Erlang working with telephone communications had a (possibly not so known) working approach. When his colleagues asked for advice concerning a problem to be solved, Erlang did not give a "recipe" for a solution, but instead through a dialog helped with a clarification enabling the colleague to solve the particular problem. To end this story it should be added that Erlang's full name was Agnar Krarup Erlang, and Torben Krarup was a (probably rather distant) relative, and also that in my recollection, Torben Krarup often used the Erlang way, when he was asked for advice.

Krarup started at Geodetic Institute at a time, where the institute had existed for almost 25 years and worked for 35 years before retiring. The institute was established in 1928 as a fusion of "Den danske Gradmåling" (DDG) and "Generalstabens topografiske Afdeling" (GTA), which had the tasks of providing data for a meridian arc and providing topographic maps for the army, respectively. The structure was for the first 25 years hierarchical, with strong walls between the sections and strict vertical communication paths as the negative side. The positive side was that there was an abundance of resources of all kinds (staff, material, and tasks).

This situation changed drastically in the first decade after 1950. One of the key persons in this change was precisely Torben Krarup. The chief of Geodetic Division I, had the foresight and fantasy to (1) use EDP for solving a general transformation of some 30–40 000 sets of coordinates from a national system to UTM coordinates, (2) charging Torben Krarup and Bjarner Svejgaard the task, and (3) realizing that EDP in Geodesy was not a one-shot job, but had to be used for many other tasks than the simple transformation job.

The combination of Krarup and Svejgaard was a very fruitful one, because the two colleagues communicated extremely well and had complementary capacities enabling them to cover much wider areas than possible for two "identical" minds. The cooperation involved also an opening of EDP facilities to other members of the geodetic staff, and an "open shop" operation soon spread over the division. However, a more important feature soon emerged: The design and construction of a new computer was initiated with the preliminary name GIER (i.e. a Danish acronym of the Geodetic Institute's Electronic Computer).

GIER's logical structure was designed by Krarup and Svejgaard, sponsored by the Geodetic Institute, and produced by Regnecentralen (an institute established by the Academy of Technical Sciences). The GIER was the first Danish produced computer with semiconductors and with microprogramming of the instructions.

The GIER really changed the computing situation when it was put in service in 1961. A typical Krarup feature should be mentioned here. It was very desirable to have floating point arithmetic as hardware in order to support an ALGOL compiler. However, it turned out, that the floating point addition would be truncating, because there was not room enough in the microprogramming storage. Krarup then took the bold decision that floating point arithmetic was so essential for a good ALGOL compiler, that the small truncation error was an acceptable price. The GIER turned out to be the prototype of a series of more than 20 GIERs used widely for a whole decade. We consequently called "our GIER" GIER number zero.

The "open shop" way of running the computer was continued, so that GIER was for use by the institute in general and not a sacred thing served by sacred persons concealing it for the vulgar crowd. This is in a nutshell the Krarup-Svejgaard attitude.

Krarup's programming for GIER was "small and beautiful". If one studied his programmes it seemed that the instructions in the beginning made very little progress, but then suddenly, within a few instructions, the problem was solved because the "slow" beginning prepared for the quick and elegant solution.

When asked for this approach, Krarup did not mention coding details, but told a small anecdote. The emperor of China had in the old days also a cook preparing poultry. It turned that the knives used for cutting the poultry soon were scared and useless, with the result that the cook was beheaded—possibly with the useless knife. A rather long series of cooks had the same fate, but at last a cook managed to maintain his knives in good order. When asked for an explanation of how he managed he said: I am a

Taoist, so I cut the meat in accordance with the natural structure of the bird and avoid brute force. We immediately named Krarup's programming style Taoist programming.

Krarup hardly ever used an assembler for the programming, but put the instructions manually (in octal code) directly in the work storage. Most of his programmes contained less than 40–50 instructions—"small and beautiful".

A rapid and safe solution of the normal equations of the least-squares method is essential for geodetic data processing, but we soon realized that the trivial message "the matrix is singular" was not of much use when dealing with, say, 30 000 equations. Krarup's solution (requiring only 5 machine instructions) consisted in virtually removing the "sick" columns and rows by inserting very large diagonal elements, so the rest of the processing continues almost unaffected. The flags are then used for pinpointing the errors (mostly arising from lacking data).

Errors in the observation data may also make an adjustment "go into divergence". Krarup suggested a reduction of the weight of the suspect observation data and a fresh computation. Deviations of the observation data may be (1) real errors or (2) come from contaminations from other errors or (3) come from bad preliminary values. In practise several repetitions (say, 10 or even more) may be needed. The method is very crude compared with a more regular "data snooping", but has proved of practical value over a period of more than 40 years. Typically for Krarup he first asked for which weight reduction algorithm had been used, when his suggestion had been utilized in more than 15 years.

Krarup's collocation methods for handling gravity data was successfully implemented by C. C. Tscherning and others, giving geoid heights and deflections of the vertical enabling precise coordinate transformations between the more than 20 coordinate systems in use in Denmark, the Faeroe Islands, and Greenland. Geoid data was in this way no longer brought into use by approximate computations based upon a slide rule and mm-paper.

Error propagation in geodetic networks was studied by Kai Borre, and I feel convinced that a good dialog with Krarup has been a solid background for this work.

H. M. Dufour presented in 1967 a paper dealing with “the whole geodesy without an ellipsoid”. Krarup asked several colleagues what they thought of it. Krarup asked for suggestions of an “integrated geodesy” so that all geodetic data could be used in an integrated approach. Dufour’s suggestion was a fruitful one, but it had shortcomings in the use of gravity data and deflections of the vertical. Jørgen Eeg made a successful implementation with a rational use of geoid data, which easily could be incorporated in the general existing network adjustment software. The funny result was—as also remarked by Krarup—that an ellipsoid still was useful. Nevertheless, Dufour had started a fine approach.

Krarup was mostly very tolerant in general, but also with a distance to dilettantish ideas. I recall that at a symposium a (rather silly) resolution concerning rather poor solution of least-squares problems was put forward, neglecting Householder’s algorithm presented by one of the participants Krarup got on his feet and saw to that “Householder” was placed in a precise resolution.

Krarup’s almost 40 years of work had a very profound effect on the development and life of the Geodetic Institute. Krarup was at the same time an individualist and also had an open mind for his colleagues. He will always be remembered as one of the best of colleagues.

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