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A Daughter's Reflections upon her Father's Creativity

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I don't suppose there was anyone who listened so much to father as I did.
Ever since my earliest years I came to be the one for whom he "thought aloud". Whatever he began with, he always ended on the subject of his research and work, on his "ponderings", to use his own vocabulary.

In almost any situation, while handling his ever-present pipe, he would begin to reflect on virtually any subject, fix on some thread and begin to unwind.

Very soon he completely lost track of both time and space, and for long hours by day and night he would elaborate his ideas widely, associate freely, create thought patterns and make those phenomenal cross-bridgings that were so typical for him.

Nothing was too great and nothing too small to consider - totally unconstrainedly he would move from the trivial to the extraordinary, and from the deeply complicated to the simple, in the way that is possible only for the truly penetrating mind. He would always point out something unexpected, and to me, even as an adult, he was the great storyteller.

But the contents of the stories were not the usual ones. Here there existed neither good nor bad, no winners or losers. His stories also lacked both a beginning and end, for the content was about the processes that govern nature. What he narrated was the saga of reality.

The fact that I so often understood him was certainly due to his exceptional ability to simplify. A few matches, a packet of throat pastilles and a few sketches on a piece of paper sufficed to create the most fascinating puzzle - but a puzzle in which the most important parts were always absent figures.

But then, with a light gesture, all of a sudden he would sweep away all the hypotheses as if they were merely pieces on a gaming table and say laughingly "Or might it be the other way around, let's start all over again in a new direction!"

The way he spoke had the same simplicity. With the compressed pictorial language of a kind of poetry, he was able to shed light on matters from completely new angles and bring underlying structures, hitherto hidden, to the surface.

That which is sometimes called the twilight zone between the knowledge of today and that of tomorrow, or the unfilled patches on the map of knowledge, were by no

means colourless areas to him; on the contrary, here the colours gleamed brightest. To these areas his mind was drawn. That which was already established easily made him feel confined, and he would ascribe it to a weakness of character that he became bored when things proved too easy - or when the equation was finally solved.

Father was born in 1905 and he left us the summer before last, 87 years old. His long life-span coincided with an era of change in cultural and social life and in technology, that had never previously, in such a short time, been so dramatic. The situation in his childhood and adolescence seems much more remote than only one generation away.

At school, Swedish and history were among his favourite subjects. Even at an advanced age he could still refer to particular teachers and lessons. Perhaps his interest in the arts, formed at this early stage, contributed in developing his very special ability to regard circumstances in a broad context.

Not least did this apply to his relationship to his own tradition. Taught by strong personalities, father and his generation were quite aware, perhaps differently from the way we are today, that not only the entire mass of knowledge about which we think, and the entire reference system (we may well call it a world view) against which we measure our observations, are created and furnished by an infinite series of predecessors and teachers. Thus, even from his student days, it was clear to him that tradition, as well as being a natural and necessary area of growth, is a man-made creation, imposed by all the magnitudes and limitations of man. Such distancing from one's own tradition is certainly a prerequisite for profound thinkers.

Father was always cautious about equating the concepts of fact and truth, as we often do today. His life-long studies of the rise and fall of great cultures made it natural for him to be well aware that the degree of truth in the "facts" of today will come to be revised tomorrow, if it hasn't altogether lost its validity.

For certain scientists the mathematical talent is connected to a musical one. In father's case his logical discrimination was linked to another sensory faculty - he was a visualist, he comprehended, he thought and formulated in images. Like the sculptor, who in a simultaneously methodical and playful way, by the interplay between light and shade, might reveal constantly new aspects of an object, father played with the searchlight over known and unknown problem complexes within his tradition.

But even if his ways of visualisation in many respects resembled those of the sculptor, his visions were never represented in so few dimensions as three. Nature is dynamic, not static, so the fourth dimension of time was always conceived.

I also believe that he would have approved of likening the whole of human knowledge to a growing, constantly self-changing sculptural organism which, when supplied with new knowledge, is shifted to earlier centres of gravity and balances,

and whose consequently new perspectives will expose new dimensions, forces and functions in itself.

I once visited one of father's younger colleagues in India. Well acquainted with father's work he was an admirer, yet he was also critical. In his opinion father had spread himself over too many areas and, especially, had not, in accordance with the Einsteinian ideal, summarized his deep insights (particularly in the field of bioelectricity) in one single equation.

Father himself considered this criticism justified, but if one tries to look upon it from a reverse perspective, the way he always did himself, perhaps the criticism also emphasizes one of his truly great features as a person and thinker, namely his inability to believe in *one*, and *only one* truth and his unwillingness to lock himself up into one single position.

He always distrusted that which was too orthodox, and for him it was almost instinctive always to leave space for the unknown. He, who was a gentle person and very tolerant of others, became noticeably irritated when he met those who were convinced that they had found their own way to salvation.

When, in the autumn, we relatives went through father's possessions, I found one of his old slide-rules in a drawer, and for a long time I sat in meditation about this simple but ingenious little object, which was one of the most important mathematical tools of his generation. The speed with which information is obtained today, and the tremendous possibilities of memory storage which have been brought about by transistors and silicon chips, were something father had access to only during the last part of his working life - and always enthusiastic about new opportunities, he was one of the first to take advantage of them.

But we who remember father's working environments from earlier times, from the fifties, also know what the so-called electrical analogue machines of that time looked like - they occupied not only cubby-holes but entire rooms, which seemed impenetrable, veritable snakes' nests of cables and plugs. Inconceivable as it might seem, these gigantic machines - constantly under reconstruction and readjustment - were conceived by father as a physiological reality.

Preceding and parallel to this electronic period was the slide-rule. Still with father's in my hand, I wondered whether the computer revolution will bring about essential differences in man's thinking and comprehension. This question, which is certainly one of the most important of our time, I of course cannot answer. But I can illustrate some further features that were typical of father's conceptions and formulated during the pre computer age.

My father and his generation had to do their calculating manually, and it took weeks or even months. What went on in the heads of these persons during their endless calculations? Was it just a loss of time which even though necessary retarded the free play of their intellect?

Creativity implies the achievement of something. Thus, inbuilt into this concept is a time-consuming quality which may be termed maturation. Perhaps the prolonged work of calculation also provided an opportunity for subconscious or marginally conscious analysis of the problems, a possibility of distancing and sorting them, that came to have an impact on the end result?

I know that at least as an artist, the very mechanical work of producing the artistic product, which sometimes can be a rather dull process between the initial intention and the completed work, often includes a process during which previously undiscovered knots in the sketch are identified and resolved, bringing more clarity to the final work. This maturation, the process of merging pieces into a structured whole, does not take place on a purely conscious level, but is a kind of subconscious crystallisation resulting from long preparatory work and needs time to be achieved.

Not only was seemingly endless time spent on calculating, but father and his generation weighed and measured too, and this again was done manually and with mechanical tools. Could this have contributed to father's concept of nature and its categories as a physically tangible reality? It was the presence of their concrete character which he saw and encountered all around him, under the microscope or during a walk in the forest, in mathematics, in saline solutions and in ion transport; or when patting one of the animals of which he was so fond - it was this experienced reality that inspired him and aroused his curiosity. It is not the inexperienced that fuels our involvement; only the stimuli of perception make us capable of concentration and drive us further and into greater depth.

Here, it seems to me, lies one of the most important differences between human and artificial intelligence - in involvement. However theoretical father became during his life, his intellect developed in relation to his perceptual capacity, and this relationship was never lost.

It is also my belief that this broad perceptual spectrum influenced and refined his imagination and intuition and that the observations deriving from this perceptual ability differ qualitatively from those made solely by mental activity.

The demand of nature to be investigated, together with the subtle instruments of fantasy and intuition that make this call comprehensible, also form part of the thirst for knowledge which, at least hitherto, is reserved for the human mind. Here again there are differences between human and artificial intelligence. Sometimes I wonder how the human mind of tomorrow will be influenced by the fact that so much of reality is now mediated only indirectly in a non-sensory and already pre-treated way via screens.

Father's own imagination was such a completely spontaneous asset to him that I believe it belonged to one of the few phenomena of nature upon which he never reflected. If a path led to a blind end, his answer would be: "Well, then we will have to find a new one, won't we?". He never doubted the possibility of tracing the

mysteries of living nature. There is a great joy and optimism in trusting that new figurations will constantly appear, and these features were also a special part of his creativity.

The fact that during the course of his work he increasingly came to leave the love of his youth, pure chemistry, to focus more on chemical and physical functions related to living material, was, I believe, more than a chance occurrence. It was characteristic that he should transcend the subjects themselves and instead concentrate on their interactions in attempts to understand the processes of life.

Father's scientific devotion was in itself a way of living and I do not think I have ever met anyone so impossible to divide into a professional and a private person.

He was a philosopher who, with a sort of humanistic Linnéan tradition, put questions to nature about its construction and processes. He always tried to pose and analyse the most valid and important questions, always attempting to reformulate and focus them more sharply, never to get bogged down by details but always to seek the whole. Humbly and with endless patience he would test, and test again, to see whether his hypotheses would explain the response of nature, well aware that every response could be a chimera, and that all human awareness is, and will remain, an island in a sea of ignorance. On those occasions when nature did confirm his ideas, he looked upon this not so much as an achievement but as new footprints guiding him into the unknown.

Just a few years ago he made this remark about his own contributions: "Certainly I felt a tremendous joy on the few occasions when I succeeded in opening slightly the door to Our Lord's creation, discerning something about its principles". And then he added: "Nowadays it seems to me that people are more interested in how the hinges are constructed!". These very quick and often deeply humorous switches of perspective were typical.

During his long lifetime father, too, came to be exposed to the hardness that is an intrinsic part of life. Perhaps his long study of nature's work on building up and breaking down, its endlessly oscillating transformations, helped to pave the way for the attitude he developed towards the way life strikes, a sort of stoical submission, whose dark undertones, however, never undermined the deep respect for life itself. This conception of life, as the very opposite to stagnation, got a particularly poignant formulation in a remark he once made to me concerning depression: "Never forget that depression is the art of seeing things from one point of view alone, from a fixed standpoint, and that such goes against life's principles of perpetual motion.

There is much of course that I don't known about my father, and perhaps it is in these unknown parts of a person, in the hidden recesses, that the true source of creativity lies, in the ultimate solitude when faced with all the questions encountered between birth and death. Perhaps from these forever secret and intangible zones stem in common our great scientific, artistic and religious traditions.

In his last weeks father's constantly alert mind accelerated almost feverishly, and untiringly he continued to communicate his experiences. He was steering towards a "spiral of stars", a galaxy, but was anxious about not being able to keep course, and in the inimitable way of the old mathematician he calculated and recalculated the manoeuvres. "I have to change stations, you see", he explained.

He described the clock that had to be set at zero, but first, time had to begin to float backwards.

Increasingly often he would also return to the mountain of coral that he had to climb, and which at the end was so close that he could see the carved-out ledges intended for his staircase.

Right up to his last hours he created extraordinary visions and metaphors, this time for the breakdown phase of the natural processes, whose total extent, from micro to macro, from beginning to end, we know so little about.