



CHAPTER I

[SUPPL Chapter 1 # 2]

In Perspective: the question of intuition in problem solving

Let me start by saying that discussing intuition versus the rational is not the typical supplementary material readers of TAPSOC will find in this web page. Rather, issues around chemical background related to mechanistic problems will be the central vein.

You will probably agree that intuition, nevertheless, deserves a word or two since intuition constantly presses its way up in almost every task we embark on, including the creative work so typical of problem solving in any field. If the subject does not interest you (it should) just drop it at this point. However, intuition is a lively part of everyone's life and a cultural blank in this area is never welcome.

Intuition: is it for real in the hard sciences?

Dealing with such a complex issue as intuition and its merits or failures in scientific endeavor and problem solving is likely to drive people to tempered debate.

Intuition, a complex word inscribing related terms like hunch, inkling, sense, inspiration, acumen, sixth sense and others, has a common ground: scarcity of tangible evidence at the time of getting the picture. This does not mean that intuition is to be taken lightly if we first recognize that it works hundreds of times faster than pure rational thought and allows us to survive the thousand and one perils we face every day.

Outstanding scientists like Albert Einstein valued greatly the powers of hunches: “The intuitive mind is a sacred gift and the rational mind is a faithful servant” he was once quoted as saying. If this was not enough praise, he charged: “We have created a society that honors the servant and has forgotten the gift”. Was Einstein referring to the social modelers of recent times who brought about our new slavery to the reason boss? Oh, not at all.

The real culprits of this societal model are not just around the corner of recent history but the Greek philosophers of the classical period: Socrates, Plato, Aristotle, and later on Plotinus in Roman times, in company with the great mathematicians of antiquity, Thales, Pythagoras, Euclid, Archimedes, and their mates.

This people came to the conclusion that it was the intellect, at the center of the human mind, and not the heart at the center of the chest, the one possessing the power to discover Nature’s and man’s secrets. Induction, deduction, and mathematical models to uncover the Natural Laws were the fundamental tools, they said. The humongous edifice of the current knowledge of the Universe and technological developments are nothing but a ‘footnote’ of this primordial way of thinking, according to some authoritative opinions.

The European civilization adopted this manner of deliberation to drive its progress hand in hand and frequently in conflict with the spiritual and moral concepts of Judeo-Christianity. Today’s scientists everywhere are heirs of this structured form of thinking, no matter if believers, skeptics, agnostics, or atheists, or research field.

Irrespective of their religious stand, the most accomplished scientists are also acutely intuitive people. There is no scarcity of examples beginning with the following fact of life most of us have come across: most physicians produce a first diagnosis of their patients *intuitively*. They simply ‘know’ based on their clinical eye [1,2]; that is, acuity and rapidness in pattern recognition of primary symptoms (here, transfer ‘symptoms’ to clues in a chemical reaction of which you want to unveil its mechanism).

Then, doctors may (or may not) recommend a series of tests to support their first hand judgment, produce an official report and write down a responsible recipe that can be defended in a court of justice (in Western societies, intuition alone would put this physician in jail head first). In your particular case as TAPSOC reader, you would embark on jotting down a mechanism supported on good chemistry and experimental data.

In emergency rooms, though, intuition will be all a physician can rely upon to quickly deal with the troubled individual before he/she gets worse. Likewise, homeopaths, herb healers, shamans, holistic and Chinese ‘doctors’ all over the world diagnose millions of diseased people using their intuitive clinical eye without resorting to TACs, imaging NMR or even blood/urine tests. Consider that all these professionals operate still within the realm of science, but perhaps not far from the borderline with the territories of faith. At any rate, their impact on improving people’s health is enormous and effective.

But, what about intuition in the core sciences?

In the hard sciences like physics, chemistry and biology, intuition also contributes significantly to solve some inextricable riddles in the initial stages, but not always. I shall not bother you with Kekulé’s daydreaming by his fireplace to concoct benzene’s structure since far more interesting stories behind brilliant discoveries are there for us to enjoy.

To mention just one particularly meaningful example familiar to everybody (but not in its intuitive details), Isaac Newton’s apple was not his first realization that heavy objects fell to the ground, to be sure. All souls of his time could have told him long stories about this obvious fact of life, known to man before cavern times.

However, the fruit falling from the tree on a hapless passerby's head may well have been the stimulus to awaken the intuitive channels of his mind to develop the theory of gravity expressed in this famous equation: $F = G (m_1 m_2) / r^2$.

Newton deduced intuitively that the force of attraction (F) between bodies of masses m_1 and m_2 should be proportional to these masses (product) whereas distance r would decrease this force as the inverse square, as light intensity does. With the technological constraints of the XVII century, master Isaac was unable to measure F experimentally, but intuition and earlier experience with other mathematical models suggested him to throw in a proportionality constant (G) so units of mass and distance would express units of force in grams or kilos.

Despite this brilliant deduction, Newton played with the occult concepts of 'action at a distance' between bodies, a bizarre phenomenon well within the arcane, and thus away from scientific reasoning, to justify somehow this gravitational attraction. Bodies had this strange property of attracting each other, but the reason was an unsolvable question. Therefore, he relied on the occult as much as Aristotle left the bucket in Zeus hands to explain the origin of rain, having run out of other rationales.

Regardless of the qualitative condition of F (Newton could not estimate G) and its causes, this exceptional man put all of his brain's rational capacity to demonstrate Johannes Kepler planetary model, put it in quite precise math terms using this equation, and thrust the final death stab to the Church's stand about Earth as the center of the universe that almost sent Galileo a few years earlier to the stake. To his and our good fortunes, by living in London, master Isaac was out of reach of the Catholic Inquisition.

Eventually, it was Henry Cavendish who, over a century later (1798), applied his gifted mathematical and experimental talents to calculate G at $6.674 \times 10^{-11} \text{ m}^3 \text{ kg}^{-1} \text{ s}^{-2}$, a very small quantity indeed, based on careful measurements of metal ball attraction employing his accurate torsion balance. Rational intellect at its best, this famous experiment closed a fantastic chapter of discovery of a Natural Law that started with a

spark of intuition, the falling apple, from which a remarkable and elegant edifice of rational intellect reaching as far as the planets was constructed.

Another example of intuition, now in our current times, is the discovery of the prion, the smallest molecular unit capable of controlling its reproduction and killing a host as big as a full grown cow. It all flowed from Stanley B. Prusiner's intuitive idea that there might be something smaller than a virus capable of causing and transmitting the mad cow disease like a medieval pest. Accused of inconsistency and flagrant malpractice, the scientific community turned against him cruelly. Eventually, Prusiner was able to show through hefty evidence that the prion was real, a twisted natural protein with a peculiar and almost indestructible three dimensional structure, and won the Nobel Prize of Physiology and Medicine in 1997 for it.

Rarely, though, do today's organic chemistry scientists dare to describe in writing their intuitive quests in solving a difficult synthesis design or mechanism conjectures. A conference podium or interview plateau is a more appropriate scenario for such confessions, usually recounted in passing as humorous inside stories. That this is, no doubt, dangerous terrain to tread, is the fact that intuition and rationalization move, not infrequently, in opposite directions [3].

In the end, intuition is a valuable tool if supplemented with a large dosage of rational thought to bring primary interpretation of phenomena closer to the real thing. Why? Because intuition is unsteady, capricious, even erratic with the pass of time, and subject to changing environmental influences besides the amount of caffeine in your cup [4].

REFERENCES

[1] The clinical eye for decision making is so valuable among the medical sciences that the convenience of specific courses to develop this ‘art’ is currently being debated. See, for example: Shapiro J, Rucker L, Beck J. *Med. Educ.* 2006;40:263-268.

[2] A few books on intuition in the medical sciences are available. For example: “Medical Intuition, Intuitive Diagnosis, MIDI-Medical-Intuitive-Diagnostic-Imaging: How to See Inside a Body to Diagnose Current Disorders and Future Health Issues”, by Brent Atwater, Just Plain Love Books, 2nd printing 2012: *Become a Medical Intuitive: The Complete Developmental Course*”, by Tina M. Zion. AuthorHouse, Bloomington, 2012.

[3] For instance, see: Solis M. “Rational thought can override a generous intuition”. *Scientific American*, March 31 issue, 2013.

[4] For an intriguing study about how the subconscious perception of instability in information recollection or source dependability can modify your intuitive discernment, see: Wright J. *Phylos. Psychol.* 2013;26:485-501.

