# Knowledge, Truth and Technological Change

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## Theories of Knowledge

## Theories of Truth

## Growth of Science and Technological Change

# Knowledge as relation

between its *subject* (aka epistemic agent) and its *object*.

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- mutual knowledge : shared by all members of the given epistemic community ; ex. : "Everyone knows John".
- common knowledge : mutual k. upgraded with mutual attributions of knowledge by individual agents to each other (at all levels) ; ex. : "Sara knows that Mary knows that Sara knows John", etc.

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- procedural knowledge aka knowledge-how ; exs. : knowing how to ride a bicycle ; knowing how to reason logically (Ryle 1945).

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2. $S$ **believes** that $p$
3. $S$ is **justified** in believing that $p$.

# JTB : Feature 1

JTB essentially involves the concept of *truth*. More specifically, it assumes that the truth-value of a given proposition is determined wholly independently of one's knowledge of this proposition. Such an account of truth has a long tradition in logic and has been strongly defended, among other people, by Gottlob Frege. We shall see shortly why this conception of truth is not commonly accepted.

# JTB : Feature 2

According to JTB, a true belief, i.e., one's belief in certain true proposition, by itself does not constitute knowledge. A missing element is justification.

Assuming that a mathematical proof is a special form of justification, for a motivating example think of Bob who is able to state the Pythagorean theorem (provided he understands its meaning and believes it is true) and Alice who is also able to prove it. In terms of JTB theory Alice *knows* the theorem but Bob does not. What is at stake here is not the linguistic meaning of "know" but the difference between the two sorts of epistemic states, viz. knowledge and (true) belief (or however one may prefer to call them).

# Gettier Problem (after Edmund G.1963)

$$\frac{16}{64} = \frac{1\cancel{6}}{\cancel{6}4} = \frac{1}{4}$$

$$\frac{26}{65} = \frac{2\cancel{6}}{\cancel{6}5} = \frac{2}{5}$$

My take on Gettier : the lack of satisfactory theory of justification (in particular, of mathematical proof) in today's Logic (but see Artemov&Fitting 2019).

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- Intellectualism : Knowledge-How reduces to Knowledge-That.
- Anti-Intellectualism : Knowledge-How is irreducible and consists in abilities, skills, or dispositions.
- My view : The assumption according to which Knowledge-How has an essentially tacit character and doesn't allow for a formal representation is erroneous.

# (Irreducible) Knowledge-How without Anti-Intellectualism

*[T]he intelligent reasoner is knowing rules of inference whenever he reasons intelligently'. Yes, of course he is, but knowing such a rule is not a case of knowing an extra fact or truth ; it is knowing how to move from acknowledging some facts to acknowledging others. Knowing a rule of inference is not possessing a bit of extra information but being able to perform an intelligent operation. Knowing a rule is knowing how. (Ryle :1945).*

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- K-How and K-That work together! Cf. Euclid's theory of elementary geometry (to be distinguished from the Euclidean geometry in its modern presentation)

# Correspondence theory : Deflationary aka Disquotational accounts of Truth

Proposition "Snow is White" is true iff Snow is White (Convention $T$ after Tarski 1930ies)

The truth-value of a given proposition is determined wholly independently of one's knowledge of this proposition.

# Constructive Truth

Truth as the existence of truth-maker aka witness aka evidence aka proof. This conception of truth unlike the Classical conception is epistemically-laden. JTB $\neq$ Truth $+$ Belief $+$ Justification. No justification for L.E.M.

# How conceptions of Truth matter. Is the following proof valid ?

**Theorem :** There exist irrational numbers $a, b$ such that $c = a^b$ is rational.

**Proof :** Take $a = b = \sqrt{2}$ and consider the two cases (which presumably exhausts all possibilities) :

Case 1 : $c = \sqrt{2}^{\sqrt{2}}$ is rational ; since $\sqrt{2}$ is irrational we are done ;

Case 2 : $c = \sqrt{2}^{\sqrt{2}}$ is irrational. Then $c^{\sqrt{2}} = \sqrt{2}^{\sqrt{2}\times\sqrt{2}} = \sqrt{2}^2 = 2$ is rational and we are done.

No irrational $a, b$ such that $c = a^b$ is rational have been found !

# Science-laden Technology and Technology-laden Science (a big leap but . . . )

Modern Technology needs Science, modern Science needs Technology (ex. : LHC). In many cases Science goes ahead of Technology (discovering truths that wait for technological implementations), in many other cases Technology goes ahead of Science (developing technologies lacking a proper scientific basis).

Historical examples : Computing the size of the Globe (Eratosthenes, 276-194 bce), Steam Engine (circa 1700, theoretical brakethrough Carnot 1824), aviation, nuclear power, . . .

# Current case : Knowledge Representation (as key element of AI)

The existing KR technologies poorly support justificatory procedures (arguably, as a result of "neglect of epistemic considerations in Logic").

More needs to be done in order to formulate appropriate epistemological desiderata, develop theoretical prototypes and implement them properly (my jww Sergei Kovalyov).

# Current case : Knowledge Representation (as key element of AI)

Statistical methods (Machine Leaning, Deep Learning) as an alternative to logic-based KR prove extremely effective in spite of the missing theoretical understanding of their functioning. In this case Technology clearly goes ahead of Science — as it happened earlier so many times in history.

Unlike some other thinkers I believe that this situation constitutes a theoretical challenge that needs to be met. This is vital for the future development of KR and IT more generally.

# Conclusion

Scientific Growth and Technological Change are two sides of the same medal (the same *technoscience*). The loss of theoretical understanding and of effective control on a technology amounts, in a longer term, to the loss of this technology itself. However important can be economic, social and other immediate drivers of technological developments the *big picture(s)* should never completely move out of view.

Thank You !