

# Virtual Entities in Science: A Virtual Workshop

19<sup>th</sup> March 2021

**False Mathematical Entities and Aesthetic Economic Explanations  
as Virtual Matters**

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## Outline

- ❑ Objectives
  - ❑ A Peircean interpretation of the notion of “virtual”
  - ❑ A kind of mathematical problems from Old Babylon, solved from about 1800 B.C.
    - [i] Tablet VAT 8389 (problem #1) (Høyrup 2002: 77-82)
    - [ii] Problem translated anachronistically in terms of systems of linear equations
    - [iii] Problem solved by the postulation of virtual entities
  - ❑ A problem in the field of Economics
    - [i] Adam Smith’s Invisible Hand explanations
    - [ii] Metaphorical constructions as virtual schemes
- ❑ Conclusions



# Objectives



- [1] To carry out a Peircean interpretation of the notion of “virtual”, based on James Mark Baldwin's *Dictionary of Philosophy and Psychology's* entry, in addition to other texts where Charles Sanders Peirce raises the question of the virtual, in relation to his pragmatic realistic position and his semiotic conception.
- [2] To propose two case studies, where we will apply this interpretation of the notion of virtual:
  - [2.i] a first case study, in the field of ancient mathematics, relative to the postulation of “false entities” in a specific kind of mathematical problem solving.
  - [2.ii] a second case study, now in the field of economics, concerning Adam Smith’s Invisible Hand metaphor.

# Peircean Interpretation of the virtual

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- ❑ The notion of VIRTUAL that we will adopt in this work is extracted from Peirce's texts.
- ❑ James Mark Baldwin's *Dictionary of Philosophy and Psychology*.
- ❑ Entry on the concept of virtuality:

“A virtual **X** (where **X** is a common noun) is something, not an **X**, which has the efficiency (*virtus*) of an **X**. This is the proper meaning of the word; but it has been seriously confounded with ‘potential’, which is almost its contrary. For the potential **X** is of the nature of **X** but is without actual efficiency. A virtual velocity is something not a velocity, but a displacement; but equivalent to a velocity in the formula, ‘what is gained in velocity is lost in power’.” (Peirce, 1902, CP 6.372)



# The virtual

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- ❑ Thus, the meaning of the virtual ultimately lies **in certain habits of conduct it could produce**.
- ❑ On this account, what matters is not what the object of an idea is like, but **what effects it is capable of producing**.
- ❑ The meaning of a VIRTUAL OBJECT is something that may be connected with it by subsequent thoughts: **all the conceivable or imaginable thoughts**.

# The virtual

- ❑ In his paper *Some Consequences of Four Incapacities* (1868), Peirce writes about the idea of virtuality, antecedent to the version that he will write in 1902, only that he here uses the term “potential” instead of “virtual”:

“[A]s what anything really is, is what it may finally come to be known to be in the ideal state of complete information, so that reality depends on the ultimate decision of the community; so thought is what it is, only by virtue of its addressing a future thought which is in its value as thought identical with it, though more developed. In this way, the existence of thought now depends on what is to be hereafter; so that it has only a **potential** existence, dependent on the future thought of the community.”

- ❑ We will see, below, that **POTENTIAL is NOT the same as VIRTUAL** in a 1902 more mature Peirce with respect to this notion from 1868.



# The virtual

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- However, to fully understand the scope of what Peirce proposed as a definition of the virtual, it is necessary to go back to other central and implicit aspects of Peirce's work. These are:

**[1] VIRTUAL VERSUS POTENTIAL**

**[2] VIRTUAL VERSUS REAL**

**[3] VIRTUAL AS A SIGN (OF AN INTERPRETANT OR A COMMUNITY)**

# Characterization of the virtual

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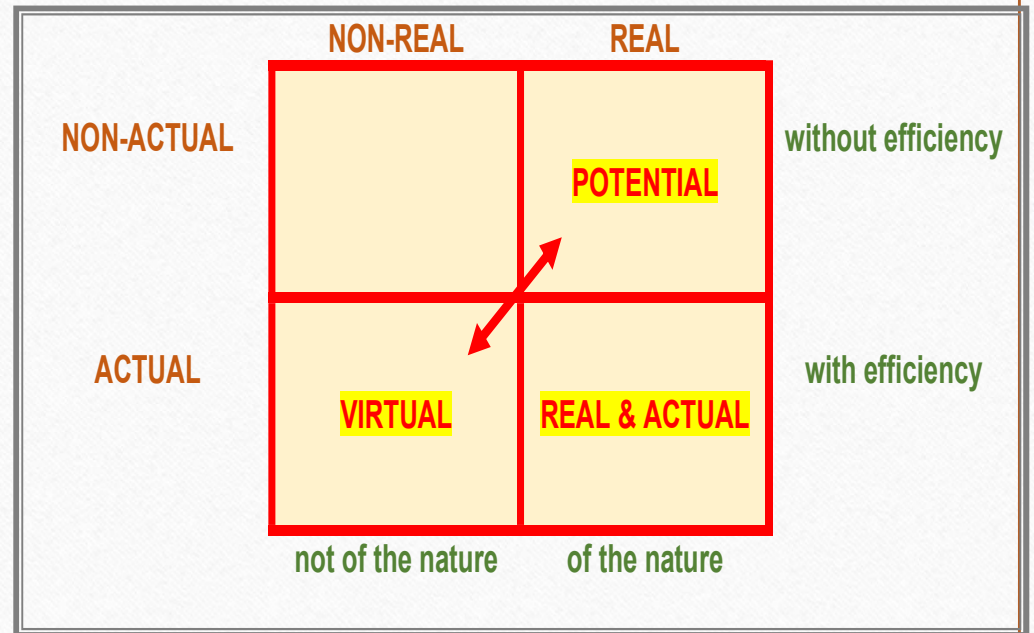
## [1] VIRTUAL VERSUS POTENTIAL

- ❑ The Peircean distinction between the potential and the virtual is already raised in the 1902 definition of virtual, also giving an idea of how to understand the real.
- ❑ Here Peirce is against the tendency to conflate the virtual and the possible.
- ❑ According to Peirce, being virtual is being ACTUAL without necessarily being REAL. An idea of an actual object may be grasped only as connected to the totality of effects which an interpretation of it may bring about.



This can be clarified in the following diagram:

- ❑ As Peirce indicates in his 1902 definition, the virtual and the potential are opposed.
- ❑ While the potential is real and not actual, **the virtual is not real and actual.**
- ❑ The virtual is completed reduced to the real when it is reified; instead, the potential is extended when it is actualized.
- ❑ actuality= potentiality + efficiency
- ❑ reality= virtuality + of the nature



## [2] VIRTUAL VERSUS REAL

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- The Peircean notion of virtual entity is not reduced to the virtual as an imitation of reality.
- Rather, the virtual manifests a type of reality that shares its effectiveness with the real.
- The virtual is opposed not to the real but to the actual: its existence belongs to **the level of the conceivable, of the imaginable, of constituting a result of a mental experiment and not necessarily an experiment that is actually carried out or has already been carried out.**



## [2] VIRTUAL VERSUS REAL

- ❑ Peirce captures this idea of the conceivable or imaginable through the postulation of what was called his “pragmatic maxim”, which characterizes the style of pragmatism promoted by Peirce, called by him *Pragmatism*, to differentiate it from that of William James:
- ❑ “Consider what effects, which might conceivably have practical bearings, we conceive the object of our conception to have. Then, **OUR CONCEPTION OF THESE EFFECTS** is the whole of our conception of the object.” (Peirce, 1878, CP 5.402)
- ❑ “In order to ascertain the meaning of an intellectual conception one should consider **WHAT PRACTICAL CONSEQUENCES MIGHT CONCEIVABLY RESULT** by necessity from the truth of that conception; and **the sum of these consequences will constitute the entire meaning of the conception.**” (Peirce, 1903, CP 5.9)

## [2] VIRTUAL VERSUS REAL

- ❑ In this aspect, we can see the characteristic of “conception” of the virtual, not necessarily empirical and actual, but which, nevertheless, gives it some kind of existence or reality.
- ❑ Note that, in this context, the virtual provides the necessary conditions under which real experience can be actualized.
- ❑ The latter is what the pragmatic maxim says.
- ❑ What makes a conception REAL is a set of conceivable effects of our past, present and future experiments with it.
- ❑ Therefore, virtuality is an open and dynamically creative definition.



### [3] VIRTUAL AS A SIGN (OF AN INTERPRETANT OR A COMMUNITY)

- ❑ The idea of the virtual was made by Peirce within the framework of his theory of signs.
- ❑ Virtual entities are expressed and represented in terms of semiotic supports.
- ❑ In the Peircean context there is a semiotic conception of knowledge elaborated by him, which understands that there is no thought or knowledge that is not mediated by signs.
- ❑ Since any kind of being is always defined as being a sign, VIRTUALITY is also a characteristic of signs.
- ❑ By "a sign", Peirce means something capable of standing for something else in some respect to something or someone which or who can interpret it.

### [3] VIRTUAL AS A SIGN (OF AN INTERPRETANT OR A COMMUNITY)

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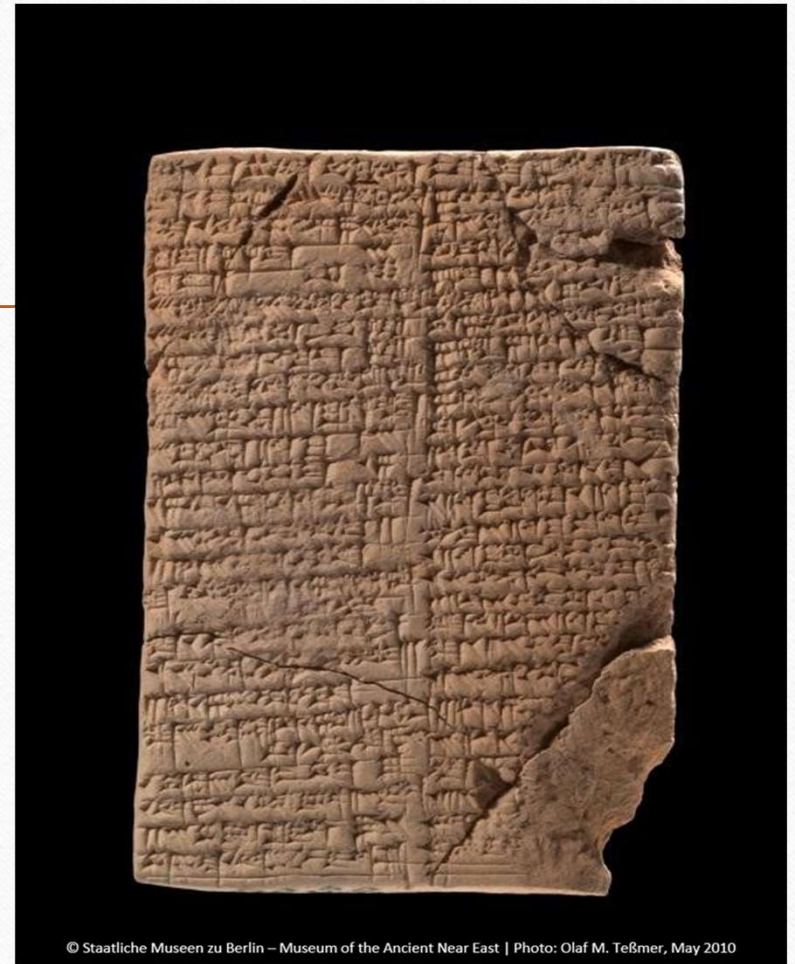
- The virtual is present in effects of its acting, on behalf of something else, the real object it stands for.
- In the sense that it reproduces the efficiency (*virtus*) of the real object it represents, in certain respect to an interpreting community.
- Instead of that the basis of the virtual is the real**, Peirce would say that the real has a capability of taking on virtual properties.
- That is why **the virtual** (in semiotic format about the conceivable) **PRECEDES the real**, as was outlined in the diagram *ut supra*.



# Case study 1: Babylonian mathematics

## Tablet VAT 8389- Problem #1

(Vorderasiatische Abteilung,  
Tontafeln Collection of the  
Staatliche Museum in Berlin)



## Transliteration

- I-1 i-na bùr 4 še.gur am-ku-us
- I-2 i-na bùr ša-ni-im 3 še.gur am-ku-us
- I-3 še-um ugu še-in 8,20 i-ter
- I-4 garim ġar.ġar-ma 30
- I-5 garim en.nam
- I-6 30 bu-ra-am ġar.ra 20 še-am ša im-ku-sú ġar.ra
- I-7 30 bu-ra-am ša-ni-am ġar.ra
- I-8 15 še-am ša im-ku-sú
- I-9 8,20 ša še-um ugu še-im i-te-ru ġar.ra
- I-10 ù 30 ku-mur-ri a.šà garim.mes ġar.ra-ma
- I-11 30 ku-mur-ri a.šà garim.meš
- I-12 a-na ši-na ħe-pé-ma 15
- I-13 15 ù 15 a-di si-ni-šu ġar.ra-ma
- I-14 igi 30 bu-ri-im pu-tur-ma 2
- I-15 2 a-na 20 še ša im-ku-su
- I-16 il 40 še-um lul a-na 15 ša a-di ši-ni-šu
- I-16a ta-aš-ku-nu
- I-17 il 10 re-eš-ka li-ki-il
- I-18 igi 30 bu-ri-im ša-ni-im pu-tur-ma 2
- I-19 2 a-na 15 še-im ša im-ku-sú
- I-20 il 30 š-um lul a-na 15 ša a-di ši-ni-šu
- I-20a ta-aš-ku-nu il 7,30
- I-21 10 ša re-eš-ka ú-ka-lu
- I-22 ugu 7,30 mi-nam i-ter 2,30 i-ter
- I-23 2,30 ša i-te-ru i-na 8,20
- I-24 ša še-um ugu še-im i-te-ru

- II-1 ú-sú-uḫ-ma 5,50 te-zi-ib
- II-2 5,50 ša te-zi-bu
- II-3 re-eš-ka li-ki-il
- II-4 40 ta-ki-ir-tam ù 30 ta-ki-ir-tam
- II-5 ġar.ġar-ma 1,10 i-gi-a-am ú-ul i-de
- II-6 mi-nam a-na 1,10 lu-uš-ku-un
- II-7 ša 5,50 ša re-eš-ka ú-ka-lu i-na-di-nam
- II-8 5 ġar.ra 5 a-na 1,10 il
- II-9 5,50 it-ta-di-kum
- II-10 5 ša ta-aš-ku-nu i-na 15 ša a-di ši-ni-šu
- II-11 ta-aš-ku-nu i-na iš-te-en ú-sú-uḫ
- II-12 a-na iš-te-en sí-im-ma
- II-13 iš-te-en 20 ša-nu-um 10
- II-14 20 a.šà garim iš-te-at 10 a.šà garim ša-ni-tim
- II-15 šum-ma 20 a.šà garim iš-te-at
- II-16 10 a.šà garim ša-ni-tim še-ú-ši-na en.nam
- II-17 igi 30 bu-ri-im pu-tur-ma 2
- II-18 2 a-na 20 še-im ša im-ku-sú
- II-19 il 40 a-na 20 a.šà garim iš-te-at
- II-20 il 13,20 še-um ša 20 a.šà garim
- II-21 igi 30 bu-ri-im ša-ni-im pu-ṭur-ma 2
- II-22 2 a-na 15 še-im ša im-ku-sú il 30
- II-23 30 a-na 10 a.šà garim ša-ni-tim
- II-24 il 5 še-um ša 10 a.šà garim ša-ni-tim
- II-25 13,20 še-um a.šà garim iš-te-at
- II-26 ugu 5 še-im a.šà garim ša-ni-tim
- II-27 mi-nam i-ter 8,20 i-ter



## Translation

- I-1 From 1 bur 4 gur of grain I have collected,
- I-2 from 1 seco[nd] bur 3 gur of grain I have col[lected].
- I-3 grain over grain, 8'20 it went beyond
- I-4 My plots I have accumulated: 30'.
- I-5 My plots what?
- I-6 30', the bur, posit. 20', the grain which he has collected, posit.
- I-7 30', the second bu[r], posit.
- I-8 [1]5', the gr[ain wh]ich he has collected,
- I-9 [8']20 [wh]ich the grain over the grain went beyond,
- I-10 and 30' the accumulation of the surfaces of the plots posit:
- I-11 30' the accumulation of the surfaces of the plots
- I-12 to two break: 15'.
- I-13 15' and 15' until twice posit:
- I-14 lgi 30' of the bu[r, d]etach: 2''.
- I-15 2'' to 20', the gra[in wh]ich he has collected,
- I-16 raise, 40' the fa[lse] grain; to 15' [wh]ich unt[i] twice
- I-16a you have posited,
- I-17 raise, 10' [ma]y your head hold!
- I-18 lgi 30, of the seco[nd] bur, detach 2''.
- I-19 2'' to 15', the grain which he has collected,
- I-20 raise, 30' the false grain; to 15 which until twice
- I-20a you have posited, raise 7'30.
- I-21 10' which your head holds
- I-22 over 7'30 what goes beyond? 2'30 it goes beyond.
- I-23 2'30 which it goes beyond, from 8'20
- I-24 which the grain over the grain goes beyond,

- II-1 tear out: 5'50 you leave.
- II-2 5'50 which you have left
- II-3 may your head hold!
- II-4 40', the ch[ange], and 30', [the change,
- II-5 accumulate: 1°10'. The igi [I do not know].
- II-6 What to 1°10' may I posi[t]
- II-7 which 5' 50 which you head holds gives me?
- II-8 5' posit. 5' to 1°10 raise.
- II-9 5'50[ i]t gives to [y]ou.
- II-10 5' which [you have p]osited, from 15' which until twice
- II-11 you have posited, from [o]ne tear out,
- II-12 to one append:
- II-13 The first is 20', the second is 10'.
- II-14 20' (is) the surface of the first plot, 10' (is) the surface of the second plot
- II-15 If 20' is the surface of the first plot,
- II-16 10' the surface of the second plot, thei[r] grains what?
- II-17 lgi 30', of the bur, detach 2''.
- II-18 2'' to 20', the grain which he has collecte[d],
- II-19 raise 40'. To 20'. The surface of the f[irst] plot,
- II-20 raise, 13'20. The grain of 20', [the surface of the meadow].
- II-21 lgi 30', of the seco[nd] bur,[ detach:] 2''.
- II-22 2'' to 15' the gr[ain which he has collect, ra]ise, 30'.
- II-23 30' to 10', the s[urface of the second plot]
- II-24 raise, 5 the gra[i]n [of the surface of the second plot].
- II-25 13'20 [the grain of the surface of the first plot]
- II-26 over [5] the gr[ain of the surface of the second plot]
- II-27 what goes beyond? [8'20 it goes beyond].

## Tablet VAT 8389- Problem #1

- ❑ To facilitate the explanation of the case, we proceed by solving the original problem transforming the base-60 numerals in base-10 numerals.
- ❑ We can simplify the old Babylonian cuneiform writing in current terms, as follows:
- ❑ One of two fields yields  $\frac{2}{3}$  *sila* per *sar*. The second yields  $\frac{1}{2}$  *sila* per *sar*. The yield of the first was 500 *sila* more than that of the second. The areas of the two fields were together 1800 *sar*. How large is each field?
- ❑ Both reductions lead anachronically to a system of two linear equations in two variables:

$$x + y = 1800$$

$$\frac{2}{3} \cdot x - \frac{1}{2} \cdot y = 500$$

- ❑ The goal is to find the areas  $x$  and  $y$ .
- ❑ Today we would solve the system by manipulating the symbols from symbolic algebra, instead of using the Babylonian method of “false position”.
- ❑ Let’s see how the Babylonians worked the problem.



## Tablet VAT 8389- Problem #1

- ❑ The first step begins giving x and y, *equal* initial **VIRTUAL** values, offering a solution only to the first equation.
- ❑ The text literally says that we start “breaking” the total area (1800) and “positing” each half (900) on its own (Høyrup, 2002: 83).
- ❑ **This is precisely the instance of creation of the VIRTUAL ENTITIES.**
- ❑ Actually, we don't know if the two x and y values are equal. But this virtual assumption leads us to start solving the problem by using the linear proportional methodology.
- ❑ If this assumption leads to a solution of the second equation, then we have solved the problem. Otherwise, the virtual values we assigned are false values, or “false positions”. And we need to proceed in another strategic way.

## Tablet VAT 8389- Problem #1

- ❑ Assuming that both areas are equal to 900 *sar*, the yield of the first field is  $\frac{2}{3} \times 900 = 600$  *sila*, and the yield of the second field is  $\frac{1}{2} \times 900 = 450$  *sila*. Hence, the yield of first field is 150 *sila* more than that of the second.
- ❑ However, the problem states that the yield of the first field was 500 *sila* more than that of the second, which is 350 more than 150.
- ❑ The proportional strategy leads to increase the value of  $x$  in the same quantity we decrease the value of  $y$ , giving an increase in the value of  $(\frac{2}{3})x - (\frac{1}{2})y$  of  $\frac{2}{3} + \frac{1}{2} = \frac{7}{6}$ .
- ❑ The scribe now needed only to solve the equation  $(\frac{7}{6})z = 350$  to get the necessary increase  $z = 300$ . Adding 300 to 900,  $x$  would be 1200, while subtracting gave  $y$  equal to 600, the solutions of the problem.



## Tablet VAT 8389- Problem #1

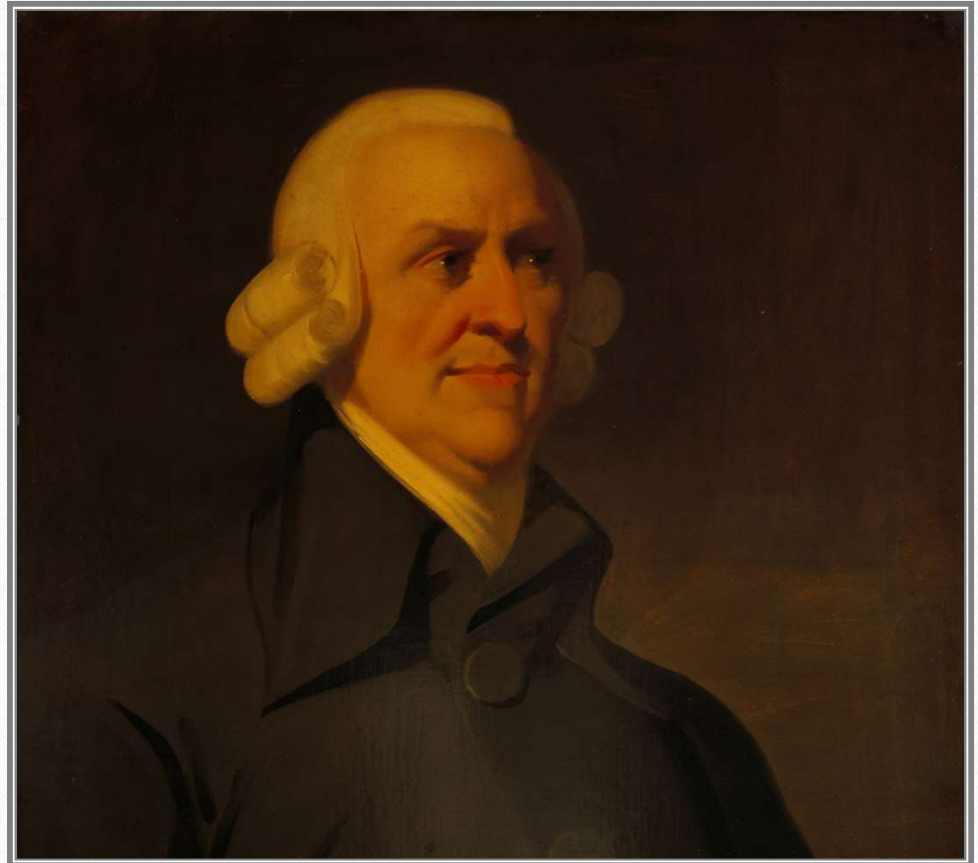
- We try to answer now to the obvious question: **Why the values x and y represent virtual entities?**
- x and y are not the real solutions of the problem.** They could eventually be real solutions, but in that case, a reifying transformation from the virtual to the real had happened. But, in general, x and y preserve its virtual character, because they effectively fulfil the role of supposed areas that are operationally the same type as the real solutions.
- Therefore, **x and y represent actual but not real entities**; **they are efficient** throughout the resolution process that uses them.
- And **their lack of reality** is reflected in that they end up being false proposals, even when operationally they work well.
- Such virtual entities would offer ontological and explanatory starting points that, otherwise, would have been impossible or difficult to reach.

**Case Study 2: A problem  
in the field of Economics**

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**Adam Smith's  
INVISIBLE HAND  
metaphor**

Adam Smith (1723-1790)





## Adam Smith's INVISIBLE HAND metaphor

- In this case study on the economic conception of Adam Smith, this author seeks to solve **the problem** that is generated when **seeking to achieve a better distribution of the wealth of a Society**.
- We could pose the problem as follows: which system solves it best?
- On the one hand, an extreme liberal or, on the other hand, a strongly intervening mercantilist State.
- Neither one nor the other.
- By our interpretation, Smith would take a moderate liberal stance. His solution leads to an explanation based on a **VIRTUAL ENTITY**: the postulation of an **"Invisible Hand"**. We will see how this happens.

## The VIRTUAL Invisible Hand

- ❑ What would assume the role of **THE REAL** is the real historical existence of a rationalist, mercantilist system that advocates a strongly intervening State in the economy.
- ❑ Here there would be a **VISIBLE HAND** of an intervening State, an allegedly omniscient government that decides what each one should do.



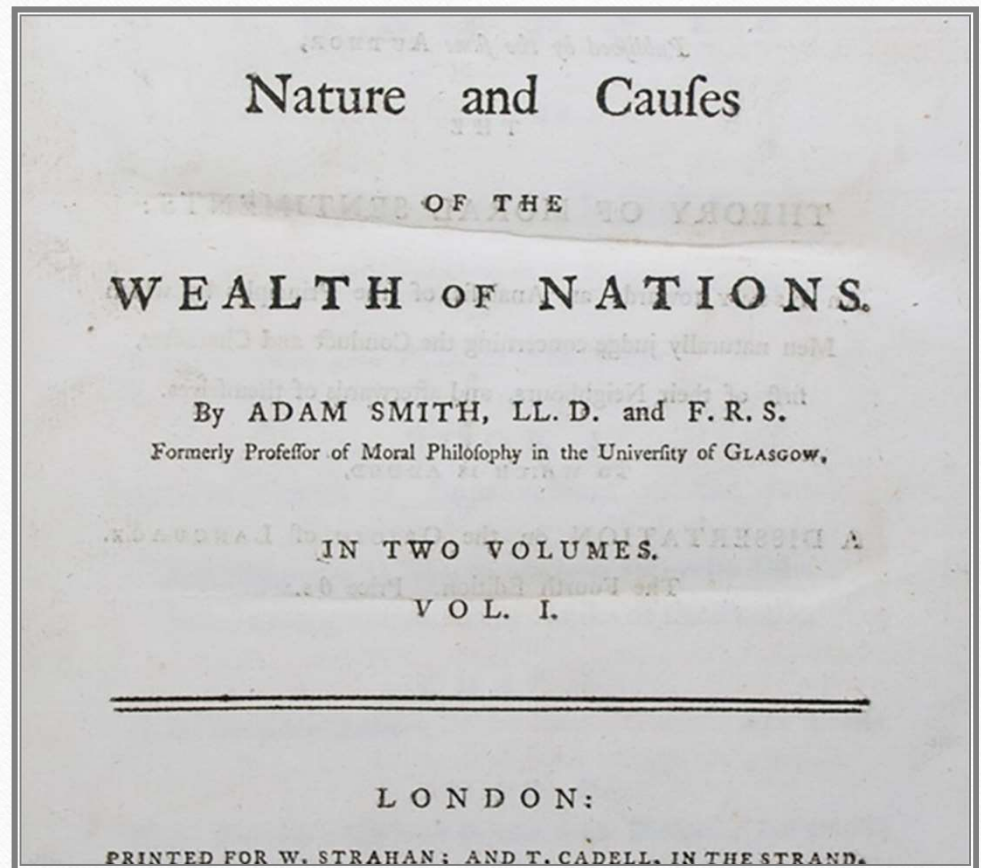
## The VIRTUAL Invisible Hand

- ❑ In exchange for this, Smith defends a more liberal socio-economic system than this mercantilist Society and proposes **the existence of a VIRTUAL entity: the INVISIBLE HAND** (of a superior being).
- ❑ The **virtuality** of an explanation of an extra natural type directing the economic process arises given that there is an **EFFICIENCY in the actions of individual beings** that, due to their own anthropological constitution, guided by passions and interests, are achieving that better distribution. And **it is VIRTUAL; for such distribution is unintended**.
- ❑ There is the virtual phenomenon of the INVISIBLE HAND because individuals work in unintended cooperation, but they are, nevertheless, paradoxically EFFICIENT.
- ❑ There is no REAL *ex profeso* caused overall efficiency: this efficiency is unintended.
- ❑ No government has the cognitive and practical capacity to generate a system that tells how each human being should act at all times and in all places to achieve an optimal distribution of wealth.

One of the main objectives of **Adam Smith's *Wealth of Nations*** is to show the superiority of what he calls the "obvious and simple system of natural liberty" over the mercantilist system.

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In this context, the famous metaphor of the Invisible Hand is used to understand the paradoxical situation according to which individual, free and self-interested actions, in their cooperation, achieve economic results superior to those generated by an order strictly designed by the State, and that, precisely because of this greater economic efficiency, it resembles a deliberate and purposeful action, but of a higher order.





## The VIRTUAL Invisible Hand

- ❑ When considering the metaphor within the Smithian gnosological-epistemological scheme, it can be affirmed that, thanks to its translational property derived from the capture of similarities or analogies through the imagination, this trope plays a key role in the cognitive process.
- ❑ This, without neglecting its aesthetic function of ornamentation of language, but precisely thanks to it.
- ❑ On the one hand, taking into account that (common and scientific) knowledge is basically constituted by connections of ideas built by the imagination, metaphorical representation would help to generate and expand these relationships by exchanging the meanings of diverse ideas, but somehow way, related.
- ❑ Adam Smith uses the metaphor of the Invisible Hand three times: in the *History of Astronomy* (“the invisible hand of Jupiter”), in the *Theory of Moral Sentiments* and in the *Wealth of Nations*. We will refer to the last two.

In the *Theory of Moral Sentiments* he says:

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“The rich only select from the heap what is most precious and agreeable. They consume little more than the poor, and in spite of their natural selfishness and rapacity, though they mean only their own conveniency, though the sole end which they propose from the labours of all the thousands whom they employ, be the gratification of their own vain and insatiable desires, they divide with the poor the produce of all their improvements. **They are led by an invisible hand to make nearly the same distribution of the necessaries of life, which would have been made, had the earth been divided into equal portions among all its inhabitants, and thus without intending it, without knowing it, advance the interest of the society, and afford means to the multiplication of the species. When Providence divided the earth among a few lordly masters, it neither forgot nor abandoned those who seemed to have been left out in the partition. These last too enjoy their share of all that it produces. In what constitutes the real happiness of human life, they are in no respect inferior to those who would seem so much above them.** In ease of body and peace of mind, all the different ranks of life are nearly upon a level, and the beggar, who suns himself by the side of the highway, possesses that security which kings are fighting for.” (Smith, 1759, *TMS* IV.1.10)



## The VIRTUAL Invisible Hand

- ❑ The invisible, providential hand acts for the welfare of society through the consumption of the rich.
- ❑ There is a natural limit for each individual as to what he can consume. Therefore, the goods of the rich that are not consumed, which are surplus, function as an engine for the development of economic circulation.
- ❑ The distribution of the product achieved is so close to maximum equity that it does not appear to be accidental. The similarity of such an effect to a volitional-rational decision suggests that **an invisible VIRTUAL divine hand has acted in some way** with the intention of reaching it.
- ❑ The distribution of wealth results as an unintended consequence on the part of individuals, since they only pursue the satisfaction of their own desires.
- ❑ Individuals are naturally unable to achieve an equitable distribution on purpose, for such a thing would require knowledge and a capacity for action far beyond their powers.

## In *Wealth of Nations* he says:

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“As every individual, therefore, endeavours as much as he can both to employ his capital in the support of domestick industry, and so to direct that industry that its produce may be of the greatest value; **every individual necessarily labours to render the annual revenue of the society as great as he can. He generally, indeed, neither intends to promote the publick interest, nor knows how much he is promoting it.** By preferring the support of domestick to that of foreign industry, he intends only his own security; and by directing that industry in such a manner as its produce may be of the greatest value, he intends only his own gain, and he is in this, as in many other cases, **led by an invisible hand to promote an end which was no part of his Intention.** Nor is it always the worse for the society that it was no part of it. By pursuing his own interest he frequently promotes that of the society more effectually than when he really intends to promote it. I have never known much good done by those who affected to trade for the publick good.” (Smith, 1776, *WN* IV.ii.9)



## The VIRTUAL Invisible Hand

- ❑ In this way, the efficiency of individual actions from the consideration of their results at the aggregate level appeals to the virtual efficiency of an Invisible Hand: the reality of a superior being is not postulated that mechanically leads to the achievement of the best possible economic result, but that the virtuality of the Invisible Hand allows a better understanding of the phenomenon of the socially desirable results of the unintended cooperation of actions of real individuals under certain institutional conditions (a moral background).
- ❑ The system of natural liberty and the operation of the Invisible Hand emerge as a paradoxical response to the rationalistic claims of mercantilism. Paradoxical because although the system proposed by Smith is described as “obvious and simple”, he would nevertheless respect the complexity of intersubjective and intergroup human relationships. On the other hand, the mercantilist system sins as reductionist, by oversimplifying the understanding of human action, eliminating its essential element of indeterminacy, given human cognitive capacities.
- ❑ The notion of harmonization of interests implicit in the metaphor of the Invisible Hand must be characterized by its flexibility and gradualness, which allows us to understand the pragmatic emphasis of the Smithian proposals in their discussions about the State-market relationship.

# Conclusions

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- ❑ In this paper we seek to describe the distinction between the virtual and the potential, the real, and the actual, embodied in **two case studies**: one in the history of mathematics of the Ancient Near East, in Mesopotamia, and another in the history of economics as interpreted by Adam Smith.
  
- ❑ In these cases, the virtual is applied:
  - [1]** to fill explanatory gaps in problems, such that they are not possible to be evacuated through the traditional ways of justification in their respective domains of expertise. And
  - [2]** to allow to obtain consistency in a theory that has unspecified cases, whose incompleteness causes inconsistencies.



# Conclusions

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- ❑ In both situations, we have applied Peirce's 1902 definition of “virtual”.
- ❑ Based on our interpretation of this text and others by said philosopher, it turns out that **there is something more to the real than the merely actual: the virtual.**
- ❑ Therefore, **the virtual extends the scope of the actual to other more general levels of reality, and not necessarily the empirically real ones.**
- ❑ And this facilitates working with ideal, abstract, fictitious, imaginary entities and many others, which escape the experimental analysis of standard empiricist scientific practice.
- ❑ This is the pragmatist legacy that we have inherited from Peirce.

# Conclusions

- ❑ On the other hand, Peirce did an interesting job, **distinguishing the virtual from the possible or the potential**, a subject that is generally controversial.
- ❑ Having characterized the potential as the real but not actualized, it turned out that the virtual responded to something contrary to this: **the virtual is the actual or the effective, although not necessarily real**.
- ❑ This Peircean interpretation of the virtual allows us to remove the idea that its existence is in doubt or that it is of a lower level than the real: **what eventually differs from the real object it represents, is its physical conformation or its inherent or essential properties, but not its efficiency**.



# Conclusions

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- ❑ This allows us to simulate reality without having to be there.
- ❑ We would like to use **a metaphor** that Sigmund Freud once raised when analysing works of art.
- ❑ The **relationship between the possible (or potential) and the actual** would be compared to the role that Freud assigns, in a theatre play, to the relationship between the actor-character and a spectator of the play: the spectator enjoys the staging scene without having to live the actions that are manifested there; without having to be the one who suffers the practical consequences (physical or mental damage, for example).
- ❑ That is the difference between a spectator and a leading actor, as we analogically believe there is the relationship between the potential and the actual.
- ❑ On the other hand, to make **the relationship between the virtual and the real** explicit, a situation like that of the two examples that we propose in this work is needed, where the virtual suffers all the consequences of what defines the real, and yet does not it is; it is of another nature.

# Conclusions

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- ❑ Finally, and what is more interesting, it consists of the virtual extension of any given reality, which allows **changing the sense of the conformation of the real from the possible, and now analysing the constitution of the real as a particular case of the generation of the virtual**,
- ❑ since **ALL REIFICATION OR HYPOSTATISATION MOVES FROM THE VIRTUAL TO THE REAL, AND NOT IN THE OPPOSITE DIRECTION**. All reification is conditioned by the virtual.
- ❑ In short, Peircean realist pragmatism captures **the virtual as an extension of reality** that explains the real as a reduced instance of the wide spectrum of existence alternatives that the virtual covers.
- ❑ And this has special relevance in scientific research, when it is sometimes impossible to physically and experimentally access layers of reality that deserve to be studied through techniques that capture the virtual.



**THANK YOU!!!!!!**

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**False Mathematical Entities and Aesthetic Economic  
Explanations as Virtual Matters**

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