whole number or a ratio of whole numbers. There are now many proofs of this, but here is a beautifu

then by well-ordering there is a least member of that set: call it k. So $k\sqrt{2}$ is a natural number an

$$m\sqrt{2} = (k\sqrt{2} - k)\sqrt{2} = 2k - k\sqrt{2}.$$

$$0 < \sqrt{2} - 1 < 1$$

oduce an infinitely descending set of natural numbers, which is impossible.

an interpretation of this proof in the geometry of triangles, but the proof itself is free of any geome

but no matter—they had some other that proved the same fact: $\sqrt{2}$ cannot be either a whole numb

d again, we cannot be sure what proof was used). By the time of Euclid this discovery was well-devel

$$\sqrt{\sqrt{a} \pm \sqrt{b}}.$$

sical terms, what can $\sqrt{2}$ be, and what can it not be?

minalising strategy that might look promising for the natural numbers or the rationals will work for

t number.

ht-angled isosceles (RAI) triangle is not intrinsically any number at all, rational or irrational. Thus i

natural units—one goat, one sheep, one neutron, *etc.*—this cannot be carried across to geometrical r

nnot *both* be whole numbers or ratios of whole numbers: one must fail, but it is an arbitrary choic

not work either for $\sqrt{2}$. This is because there is *no numerical* expression—I must emphasise '*nur*

des) were *arrheton* (unspeakable or unsayable).[7]

word in Euclid that we translate as 'irrational' was *aloga* which can have as many meanings as th

he expression 'the square root of two' is obviously such an expression. The point is that there is no

approximation method known as *anthyphyrasis*, which was known in Plato's time. And this in itself

cimal representation of $\sqrt{2}$ would be an infinite, non-recurring string of numerals. Cutting it off aft

was still very much a live issue in the 19th Century. It is a familiar point that 'number' for the Greel

ne good argument for thinking of these unsayable entities as numbers in a new sense: the square ro

ept of number to including these new entities, at *Epinomis* 990d, for example.[9]

ans that not every real number *can* receive a name of any kind. Thus even if we allow ourselves to

How would Plato (or any mathematician before the 19th Century) go about adding $\sqrt{2}$ and π? Ca

$$\sqrt{a}.\sqrt{b} = \sqrt{ab}.$$

ust the manipulation of symbols according to set rules—has to confront the fact that here we have

a that congruence can be a nominalist substitute for the role that the metric structure plays! Sinc
ace. Suppose that there were two four-dimensional manifolds, one with its metrical structure determ
formulation thesis in favour of segment-congruences. But this presents him with a dilemma: either th
g useful numerical words! We could run this same argument with a comparison of $\mathbb{R}^4$ with Minkow
antum mechanics. If we consider the Hilbert space as a space of the possible states of a system the
simply nothing available at all. The problems are then only compounded from this point on. Once w
pted.[23]
exing" the physical facts. The term 'indexing' comes from Melia (2000) and is meant to cover the us

. The constant has the (or one) meaning:

$$\alpha = \frac{1}{4\pi e_0} \frac{e^2}{\hbar c}.$$

s improving, but it does not seem to be related to any known mathematical constants, and note tha
v is that numbers don't exist, and thus that α does not exist either. But if that is the case then, ne
othing exists.[26]
it is one that is equally as hard for any form of nominalism that is currently espoused.[27]
s the ability to perform the act or complete the task depends upon must likewise be determinate. Bu
being merely approximate.[28] The doubling of the cube requires finding $\sqrt[3]{2}$ which is irrational (the
squaring the circle as the example, where the impossibility depends upon the transcendental charact
Earth where the wind does not blow. It is impossible to partition explanation into the physical versus

s, via incommensurable magnitudes and irrational numbers. Then in a second step we were led to t
front the problem of the dimensionless constants. This latter problem defeats even a putative struct

t platonism manifests itself in its most irresistible form as geometry. In support we may quote Shi

guage of geometry. Indeed, it is reasonable to consider geometric objects as part of nature. Practic

relationship between algebra and geometry? If geometry may be likened to the face, then algebra is

asily deal with the integers—I believe that even here it must fail. But in mathematical terms the int
s what I mean by saying that these 'almost geometrical structures' are the primary basis for mather
his: the *only* plausible explanation for physics continually using the seemingly abstract mathematica

osophical foundations of technology, and its purpose is to critically discuss these foundations in orde

Science (Polak and Trombik, 2022).
nental philosophical assumptions, the philosophical concepts involved, the axiology of decisions); (b)
technical perspective to philosophical analysis.
not be possible without a change in both parties' mutual attitudes, so it is also necessary to look fo

rily to analyze the relationship between philosophy and physics. This concept has since proven to be
out what methods should philosophy in technology apply? We have already mentioned that a discus

esence and roles of the great classical philosophical questions in technology, such as the nature of fre
of technology is to our comprehension of reality is an important task for philosophers, but it is on
not possible to apply classical concepts directly, because they were forged for different purposes an
nteresting issue here is the task of **formalizing classical concepts,** so they can be made as spec
concepts in technology and engineering (e.g., Smith, 2019), and clarifies the unclear use of concepts
l consequences of their actions.[10] On the other hand, even when they are aware of the philosophical s
ing the consequences and possible postulates for any changes in the philosophical foundations (e.g.

mpact of technology on religion and theology (e.g., Rodzeń, 2016).
1) or the theological aspects of human-like robots (Balle, 2022). The classical religions of today also

l concepts unclear and incomprehensible to modern people, because these concepts were created with
encyclical *Aeterni Patris* (1879), but these were doomed to failure as evidenced by the problems w
me easier to understand how we can incorporate it into theology or religious practices. With a prope
ys built its message on the existing philosophy through which a given culture expresses itself.
actical life of people, albeit from the perspective of faith rather than technical action. However, the
the concepts and elements of the current worldview that are needed to modernize the theological vi
f technology, which go far beyond purely technical applications, will become clearer. In other word

de (Heller, 1987).

ssing the notion of information beyond the concept of a numerical value. In fact, the ToC does not d
nformation, just as the definition of a kilogram does not define what mass is. The entropy of infor
f the ToC this way is less prone to misinterpretations and may be closer to Shannon's original inte

f information beyond the concept of a number" would certainly count as one. Most studies of inform
ore bluntly, misinterpretations of the original idea and purpose. Shannon developed his ToC as a th
e generally get lost in explanations, or mathematics.[10]
either of these. According to Heller, the structures only encode or express information. Information
nformation in the physical world is just form or form behind form, with meaning as in knowledge
s a ring of truth to it, but this does not go down well with hardline physicalists. Nevertheless, the

a unified whole that reflects the unity of the world. This triadic structure is rooted in the long-stan
d levels of mentality. Finally, the World of Structures comprises various kinds of ideal structures. T
ot make the theory itself any less comprehensive or wrong; philosophy is not a beauty contest, even i
he authors view, we do not have anything better than the GTI theory, at least for now.

nation cannot be identical to, or identified with, the external form or shape of an object, structure a
n itself. To address this insight, Heller proposed that information is "an abstract form" or "somethi
The concept of information as the potential of nature to create low-entropy (thermodynamic entrop
roperty of nature is observable in everything from snowflake structures to organic life and the cosm
7) or Austin and Marmodoro (2017).)

ntuitions belong to studies into the deep foundations of reality and border (for some) on metaphysic

cost of introducing metaphysical ambiguities. We may argue that Heller did not clarify his ideas
eaves the reader feeling somewhat uneasy. Yet the concepts Heller was grappling with are not well u
aims might have implied.
that Heller's ideas on information fits well into a larger comprehensive theory), but it also legitimiz
s the case with Heller's ideas,[18] but rather through the deep conceptual analysis.

ter functions in empirical sciences. In the system in question, the information from the object of the
lable (for example in the form of a visualization). A computer with appropriate software can also
e quantitative changes to experimental work, or if we are also dealing here with qualitative changes.
cal methods introduce a different type of justification of scientific hypotheses—namely a numerical
its representatives, and thus no answers were given to them. In the following paragraph, I will also
d to reformulate a number of theses advanced by the supporters of the existing version of the new

t of the realities of experimental practice in the analyses of the philosophy and history of science. A
eating, producing, refining and stabilizing phenomena.
xisting phenomena and to create new ones (Hacking, 1996). Today, this type of equipment is aided
as it only spreads over a single paragraph of the cited article. Hacking claims in it that thanks to fa

pirical research only to fast computer calculations (in the previous paragraph I listed nine other fun

y a much greater role than, for example, in chemistry (Zeidler and Sobczyńska, 1995). In modern p
o-called Higgs field by finding a particle mediating interactions with this field, i.e. the so-called Higg

, the unification of the electromagnetic and nuclear weak interactions would be impossible. The theo
tives of this accelerator was to indirectly confirm the electroweak theory by discovering new partic
reators of this philosophy of experiment, however, fail to observe this fact, and—what is worth point
g (the existence of the CERN laboratory).
g weak interactions (the Super Proton Synchrotron accelerator which was transformed into a proto
umerous examples related to high energy physics, thus he for sure must have been familiar with t
d by Hacking himself (Hacking, 1984, p.164)), thus—and it is worth emphasizing—without the comp
ng was the computer, although the author ignores this fact. Thus, based on the analysis of the wo
ntal research is a serious oversight of the representatives of the new experimentalism. Hacking post
h systems. Due to this significant omission, the new experimentalism it its initial phase was not a
tal sets as those described in the previous paragraph. It will at least partially justify the need to
mental apparatus without the tested object. According to the new experimentalists, there is no need
d to commonly used computer-aided experimental sets.
ith the help of a microscope, but mainly with the help of computer systems. Therefore, one should

which the computer is a part of the experimental set. This would refer to the process of obtaining

d relations.[7]

s for this emphasis on “content”—rather than on “parsimony of ISOs” in the broader sense. The first
ate on the parsimony of ISOs. In other words, there may *in principle* be other parsimonies involved

r [14] or [15] by itself.

nd A_2 are further specified, A_1 is fulfilled if and only if

O_1 (see also [13]), no matter which primitive.

ds, [55–56] are consistent with [1–3], thus ensuring the plurality of the methodological approaches s

1596 ERC—PolyphonicPhilosophy).

Neither the European Union nor the granting authority can be held responsible for them.

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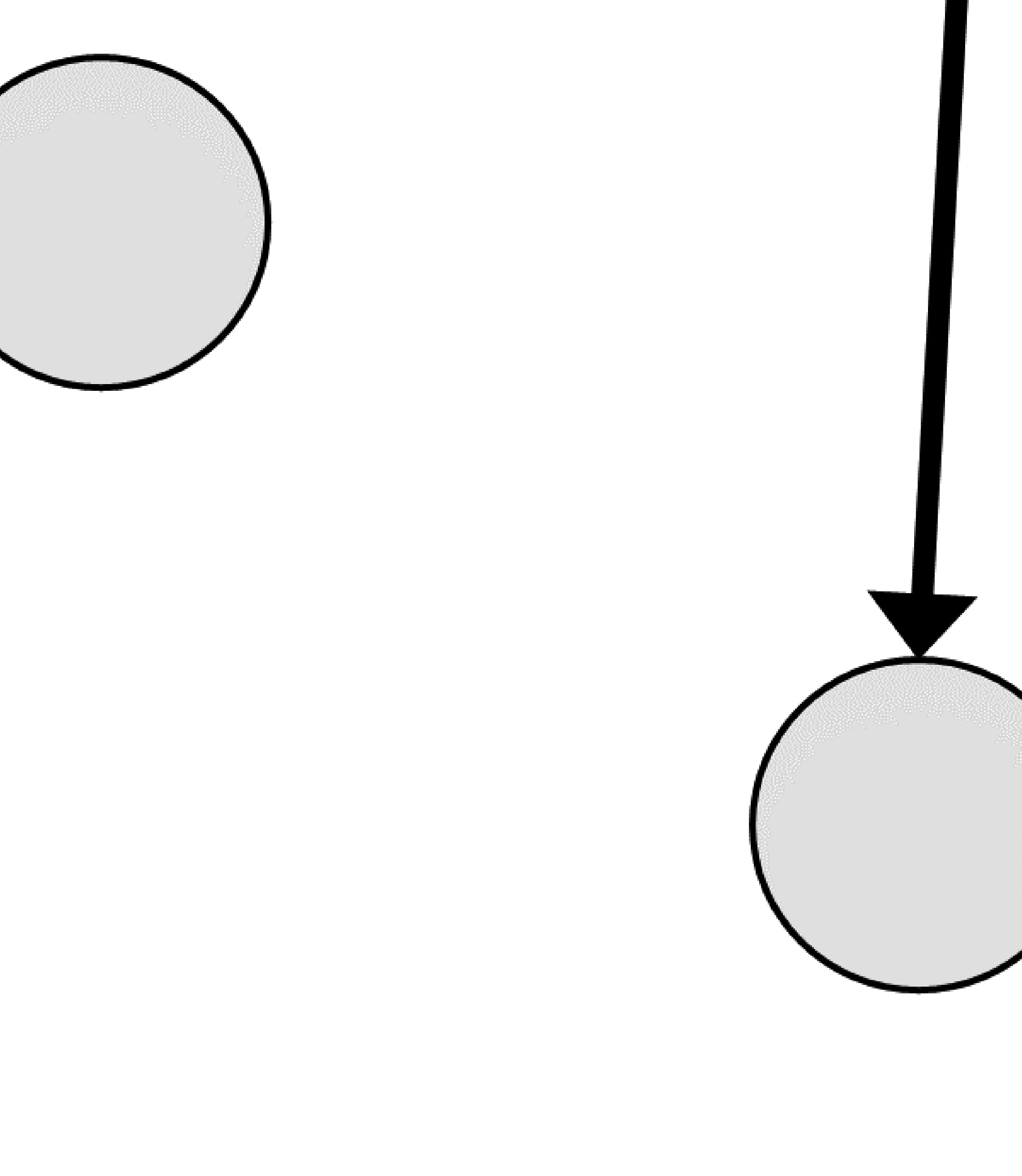
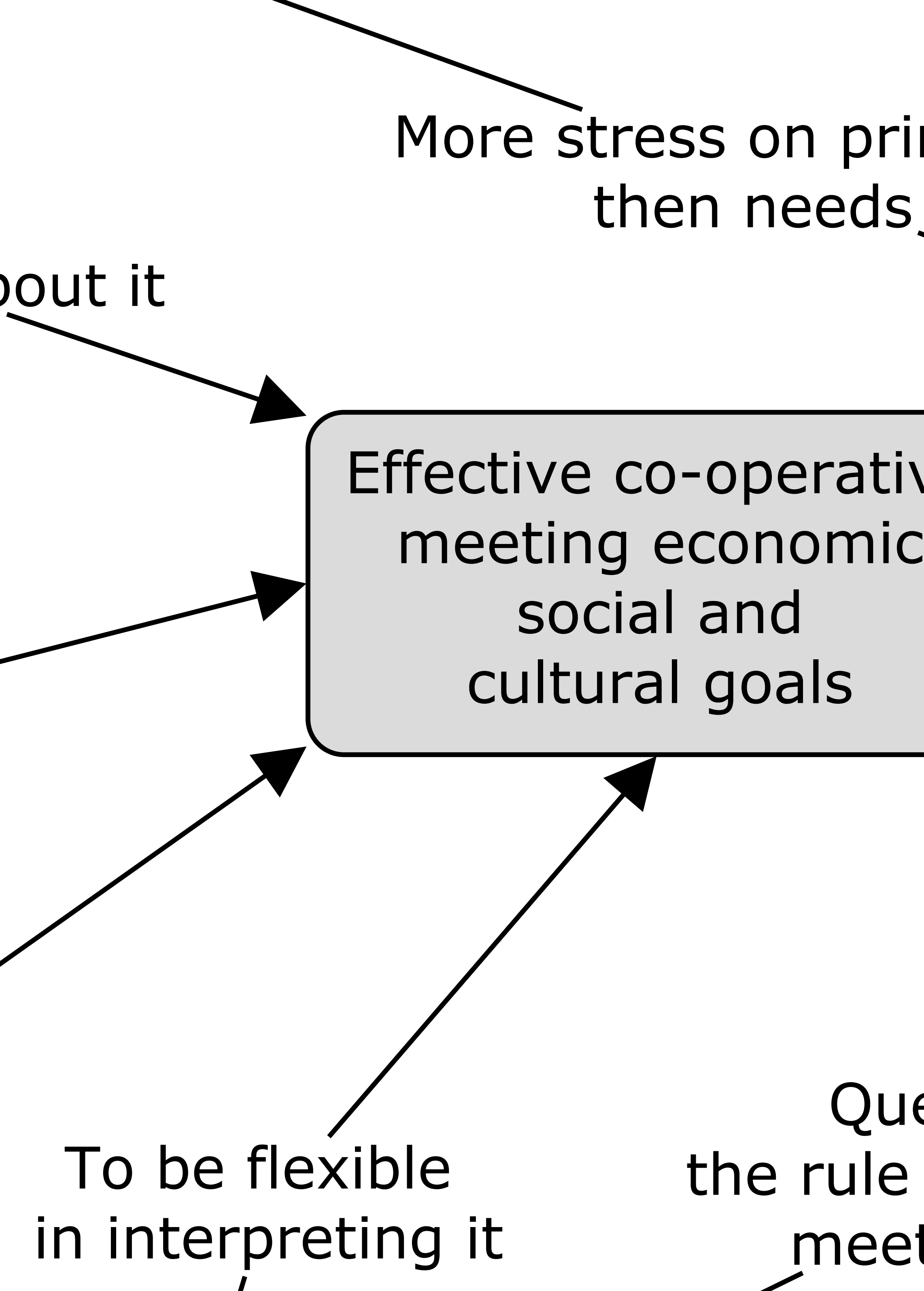


(b) The ball with the cent


More stress on prir
then needs
bout it
Effective co-operativ
meeting economic
social and
cultural goals
To be flexible
in interpreting it
Que
the rule
meet

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of the mathematics of transformations.

don't determine them uniquely and other factors need to be taken into account in their derivation.
matrix relating mass and flavor states (e.g., Banerjee et al., 2015; Bilenky, 2016). A form of this m
properties of the neutrino by indicating particular form of the time evolution and its symmetry (e.
esented above show that the situation is more complex and a more nuanced approach needs to be ac
y of analogy, a particular instance of rationality such as those indicated by Życiński can be linked w
tructures proper to a given point. As a result, a symmetry group will turn up in the physical theory
y. Unfortunately, at this stage of analysis it is not possible to explain why this cross section contai

f rationality. It turns out that one can think of these potentialities in two different ways based on ho
is not hard too see that the proposed placing of the abstract groups such as SU(2) and SU(1,1) in
regarded as potencies that become actualized in the form of the properties of fields and particles w
stract groups. In contradistinction to SU(2), the SU(1,1) has several physically meaningful represe
ems. Also, this kind of potency accounts for the physical character of the unbroken symmetries.
opinion that symmetry is a key element of the design of the Universe has been expressed by Americ
om. While in a messy room one can quite easily shift items around without upsetting its invariant s
ing of symmetry suggesting that producing a design connotes rather having intentional control over

athematics duality is known to be a broad concept and its precise definition is given when duality
angeability of these concepts with special emphasis on their *reciprocality*. In particular, they refer to
etry breaking, leads to the emergence of more complex structures resulting in the growth of comp
aving the greatest number of invariants and the smallest symmetry group, through affine geometry w
would mean changing topology and breaking the structure's symmetry.
ers an example the formation of a crystal which leads to the lowering of the symmetry: "the general
which symmetry might be broken: *explicit* and *spontaneous* (e.g., Castellani, 2003). The mechanism
citation of a vacuum could with some reservations reflect the mechanism of the spontaneous symm
ease of temperature).
his field. Since following the explanation provided in a previous section symmetries relate to the co
suggesting that Życiński's postulate of the "radical separation" between the abstract and concrete
eir physical existence as accessible for the scrutiny of the scientific method.
neral physical laws that govern their dynamics (e.g., the Kepler laws). When symmetry is spontaneo
mmetry transformations and the whole set maintains the symmetry of of a given theory and its la
h more detailed analysis that remains beyond the confines of this study.
a path that hypothetically leads back to a structure that has the potency of producing every possi

y breakings (the separation of each of the four interactions) gave rise to increasing diversity. The c

n the model of science proposed by Larry Laudan.[9] His approach situates itself in the mainstream c
ocesses in the field of research and the assumptions concerning the methods that should be applied i

uccessful ones are those that leads to solving more different problems, and which imply fewer anomal

$$\text{Research Tradition} \rightarrow (I; O; R; M; \{T\}; \{p\})$$

ect which constitute the domain of any given science" (Laudan, 1977, p.15, Laudan's italics); and c
. of theology of science can be shortly narrate as a specific theological research tradition operating

) if theology of science is a branch of theology, then all criteria of its evaluation are that of theology

eological and scientific reflection?[10] It seems that at least two reasons in favor of Heller's theology of

l, and today these are deeply shaped by science. The only question is whether they will do this criti
lly important resource. Just as Aristotelian philosophy, trough the ministry of such great scholars as

co, 2021, p.61). Of course, one cannot forget, that beauty is not a scientific category. Nevertheless, t
r's theological syntheses offered in his treatise on theological aesthetics (Balthasar, 2009).
n from error and superstition; religion can purify science from idolatry and false absolutes. Each can
ogy of science. It has different object, vocabulary, philosophical roots – shortly, it is a pretty differen

his thinking, and his thinking becomes manifest in his faith" (Jagiełło, 2020, p.221). The religious t
ou), an objective dimension (we think about it)" (Jagiełło, 2020, p.224). Roughly speaking these dime
ełło, 2020, p.165). Religious thinking in its objective dimension turns to the stage of human drama

me, bread and God, and where he finds a graveyard. The stage is at man's *feet*. [...] Man experienc

paradigm. He also expresses hope "that the understanding of the unity of the world and the unity o
ences.[8] The concept of "philosophy in science" also sought to counteract this discrepancy: Heller ar
ki, various areas of misunderstanding exist between the humanities and science, and one of the key o
suspicion, but how does Fuliński himself respond to this type of allegations?
7). Nevertheless, according to Fuliński, the proposed concept of reductionism is significantly differer
rder of things and phenomena" (Fuliński, 1990b, p.36). Nevertheless, the reductionism of physics, a

pitfalls today lie in the fact that the tendency to think in simple models is strongly established am
ng the world, taming it, and even worse, repairing all its sins and imperfections (Fuliński, 1989, p.2

em fluently. Drawing attention to the benefits of using reductionist procedures in science, he emphas
ble to model the entirety of reality according to one pattern and based on one language.
f a transcending world of freedom, the products of which are not fully determined by the laws of na
ssue of values, and so on. This approach to the problem was not so distant from the methodologica
thematical?" was one of the most important and frequently discussed issues by Heller and Życiński. I
m clearly not taking sides in the philosophical dispute.
described mathematically does not mean that reality is mathematical in the ontological sense (Fulińs

blem was apparent and that the two claims should not be considered to be contradictory. A scien

y. Like a work of art, like an artistic creation, theoretical physics is both a reconstruction (in a diffe

he did not question this possibility, he demanded greater caution when examining this dispute, pointi
of the world and the ontological status of theoretical physics" (Fuliński, 1988a, p.65; see also Fuli
e.g., Życiński, 1988, pp.217–218). On analyzing the works of other representatives of the Krakow in
eu, such as Ł. Lamża and M. Hohol.

in the dialogue between science and philosophy and participated in various interdisciplinary proje
lined by Heller (1986; English translation: 2019). In his programmatic paper, Heller indicated that
the three areas of "philosophy in science", e.g.:

ilosophy, devoted, for example, to the achievements of the "philosophical physicist" Marian Smoluc

ejected the radical isolationism of science and philosophy, and he was also very critical of systemic p