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Circle and sphere – geometrical speculations in philosophy

Abstract. The circle and the sphere, in philosophical speculations, exist as symbols of perfection, as metaphors of divinity, as models of eternity as well as approximations of essential properties of cognitive acts. Their geometry is also an excuse for visual speculations of an artistic nature. In this article, we discuss some chosen metaphors based on the circle and sphere which refer to both ontological and epistemological issues pertaining to various models of knowledge and the cognitive process.

1. Introduction [1]

The short essay by Jorge Luis Borges "The Fearful Sphere of Pascal" starts out with words which could stand in as the motto of this article: "It may be that universal history is the history of a handful of metaphors" (Borges, 1964, p. 168). Borges describes the metaphors based on a sphere which appear in history by referring to among others Empedocles', Giordano Bruno's or Pascal's speculations. This essay focuses around the famous metaphor quoted after Alain de Lille, in which "God

is an intelligible sphere whose centre is everywhere and whose circumference is nowhere" (Borges, 1964, p. 169)[2]. This article is also a review of other philosophical metaphors based on roundness pertaining not only to the sphere but also to the circle. In this instance we refer to the thoughts of Parmenides, Plato, Nicolas of Cusa, Quine, Heller and Twardowski. Metaphor is understood here broadly in the sense proposed by Lakoff and Johnson (1980) as a certain model representing chosen aspects of a given issue in terms characteristic for a different issue.

The circle and the sphere, in philosophical speculations, serve as symbols of perfection, as metaphors of divinity, as models of eternity as well as approximations of properties of cognitive acts. Their geometry may also be an excuse for artistic visual speculations. In our proposed approach, art, hand in hand with mathematics and philosophy becomes a cognitive tool – it constitutes not only an aesthetic complementation of scientific cognition, but it is its reinforcement, deepening and extension.

The article consists of two parts. In the first, we discuss metaphors which appear in ontological problems. Ontology is treated here as the most general science on what there is and what may be, and speaking in the language of traditional philosophy: as the science of existence or being. Within such a wide understanding of ontology we are allowed to also take up metaphysical issues which are related to real existence and not only possible existence[3]. In the second part of the article we discuss epistemological traits pertaining to various models of knowledge and cognitive process.

In this article we mainly focus on metaphors which are based on the analysis of the geometrical properties of the sphere and the circle and not only on the superficial properties of these figures visible to the naked eye. This harmonious fusion of geometrical analysis, philosophical speculation and artistic visualization offers an opportunity for wider comprehension and an intelligible approximation of the studied subject.

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2. Original: "Deus est spaera intelligibilis, cuius centrum ubique, circumferentia nusquam" (Alanus De Insulis, VII PL 210, 0627A).

3. On the relation between metaphysics and ontology see (Perzanowski, 1988, pp. 87–90).

2.   Circle and sphere in ontological metaphors

2.1.   Spherical vision of reality by Parmenides

Parmenides was supposedly the author of one treaty of which only a few fragments have been preserved[4]. However his thought has played an important part not only in Greek philosophy but also in later philosophies. In the Prologue to his poem Parmenides recalls the motif of a journey; a journey from the land of night to the land of day and light. That journey symbolizes cognition which starts with sensual experience but does not end with just that. As Parmenides wrote, the presumptions of mortals are based on senses, but the truth may not come from presumptions alone. Therefore, true cognition needs reason to act as a guide. A goddess welcoming travelers says (Kirk and Raven, 1957, p. 267):

> It is no ill chance, but right and justice, that has sent thee forth to travel on this way. Far indeed does it lie from the beaten track of men. Meet it is that thou shouldst learn all things, as well the unshaken heart of well-rounded truth, as the opinions of mortals in which is no true belief at all.

As early as in the prologue the motif of roundness appears. Reason leads to true cognition, to a Truth which is rounded and similar to a sphere.

Parmenides following the path of light and reason, described existence [Parmenides called it "true reality"] in many aspects. Most of all true reality is what is and not what may be. It has not been born and is indestructible, it has never been created and it cannot die. It is a wholeness which is filled, in every part, in the same way. It may not be more in one place and less in the other, there is the same amount of true reality in every place. True reality is continuous and undividable. It is also unimpressed and unchangeable. Such a characterization of true reality leads to regarding it as perfect. In the rationale of that perfection Parmenides writes: "But since there is a furthest limit, it is bounded on every side, like the bulk of a well-rounded sphere, from the centre equally balanced in every direction" (Kirk and Raven, 1957, p. 276). Therefore true reality resembles a sphere, it is sphere-like. The interpretation of that fragment is not a trouble-free task; it is especially hard to establish how Parmenides understood the limit. This fragment may be understood, for instance, that there is the furthest limit of true reality which is the sphere which surrounds it, while true reality is similar to an open ball i.e. the space inside a sphere (without the boundary points).

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4. More on the life and work of Parmenides may be found in (Kirk and Raven, 1957, pp. 263–285).

In the contemplations of Parmenides, although they are not unam-
biguous, the motif of roundness as one of the attributes of perfection has
come up. True reality is perfect; therefore it is similar to a sphere. What
testifies to that perfection? True reality is "(...) equal to itself on every
side, it rests uniformly within its limits" (Kirk and Raven, 1957, p. 276).

2.2. Plato's roundness of the world

The idea of perfection by Parmenides was taken up and developed
by Plato. In the dialog *Timajos* he describes the creation of the world.
The organizer of the world's creation, the world's craftsman is the pla-
tonic Demiurg (Greek: *demiurgos*). Demiurg using the eternal and perfect
models has created the world out of fire, air, water and earth. The world's
perfection which is the reflection of the form's perfection is demonstrated
in the spherical shape the world was given (Plato, 33 BC):

> Wherefore he made the world in the form of a globe, round as from
> a lathe, having its extremes in every direction equidistant from the
> centre, the most perfect and the most like itself of all figures; for
> he considered that the like is infinitely fairer than the unlike.

Amongst other properties, what proves the sphere's perfection is the
smoothness of its surface. That smoothness for Plato symbolized self-
sufficiency which was understood by him as the absence of any needs.
Although Plato understood the world as a living creature, he stated that
no limbs protrude from it (legs or arms) which might serve as means
to grasp onto subjects or to move. Beyond the world there was nothing
that could be held onto and nowhere it could move to. The spherical
shape of the world resulted in the fact that it did not need anything
else for its existence. Although Plato's idea of the world described here
may seem bizarre or even grotesque to a contemporary reader, it carries
an interesting ontological reference between the spherical shape and self-
sufficiency. If we interpret self-sufficiency as existential self-sufficiency, i.e.
that a given object exists independently of the existence of other objects,
then surprisingly a sphere would become a symbol of one of the most
vital characteristics in contemporary ontology [5].

The fact that according to Plato the universe is spherical, results in
the impossibility to distinguish between its "top" and "bottom" because
the surface of the world is the same everywhere. Perfection does not
differentiate into the right and left side, top and bottom side or front and
back side. Even if inside the world there was a solid, it could not be going
towards the circumference of the world towards the top or towards the

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5. See (Ingarden, 1960, p. 132).

bottom because each edge part of the world seen from the inside is the same and rounded the same way (Plato, 62 DE).

Plato's world was not motionless but it moved in a perfect way, i.e. uniformly along a circle. Plato also probably thought that the world revolved around its own axis. He also mentioned seven planets which move along circles around the earth. Along the circle closest to the earth the moon was moving, whereas the sun in Platonist cosmogony circled around the earth in the second cycle (Plato, 38 CD). The circling of the planets along circles created day and night, month and year – a temporal sequence. The creation of time was therefore determined by among others roundness and a circular movement.

While presenting the creation of the world Plato also described the creation of a human being. The most perfect part of the human body is the head because inside it – according to Plato – the mind is located. The head should therefore be of a perfect shape too. That is why the gods copied the perfect shape and gave the human head the shape of a sphere. The following parts of the human body were created in a way to fulfill the orders given by the most divine and round body part (Plato, XVI D). In the Platonist cosmogony, perfection (but also divinity) of the human mind and the perfection of the world, were met in the metaphor based on roundness.

2.3. Geometrical speculations by Nicolas of Cusa

For Nicolas of Cusa (also called Cusanus) the analysis of geometrical properties of infinite objects became the basis for speculations of a philosophical-theological nature. In the work *On Learned Ignorance* he discusses the relationship between the straight line and a curved line and notices that "(. . .) the circumference of the maximum circle, which cannot be greater, is minimally curved and therefore maximally straight" (Nicholas of Cusa, 1985, p. 21). Therefore the circumference of an indefinite circle must be the same as the straight line. What Cusanus could only have imagined, today we are easily able to present in the form of a moving picture. Figure 1 presents a shot from an animated loop showing growing circles, the arches of which constantly tend to a straight line.

The animation dependent on time may only present a potential identity of a circle and a straight line. Nicolas of Cusa however, when he wrote about the indefinite circle had actual identity in mind and that is the identity he uses to refer to God, whom he describes there as the Maximum. Out of the features of the Maximum, paying particular attention to his unity when he writes that "(. . .) for in the Maximum all difference is identity" (Nicholas of Cusa, 1985, p. 35). The unity is "(. . .)

exhibited by the infinite circle, which is eternal, without beginning and end, indivisibly the most one and the most encompassing" (Nicholas of Cusa, 1985, p. 35). The center of an infinite circle is the beginning of everything, the infinite circumference encapsulates everything, and the infinite diameter penetrates everything.

Figure 1. A shot from the animation *Limits of the Circle* (*Granice koła*, J. Jernajczyk, 2015).

Revolution of a circle around the diameter creates a sphere. It may be said that the sphere is potentially included in a circle, and using Nicolas of Cusa's terminology it is enfolded inside a circle. The finite circle is, of course, a sphere only in a potential sense – it has the ability to revolve. However an infinite circle is an actual sphere. That is why the spherical pertains here to the existence of the Maximum in the act. Just as the sphere is an actual line or a circle, in the same way the Maximum is supposed to be the actuality of all things (Nicholas of Cusa, 1985, p. 38).

The ontological metaphor of a sphere returns and is developed in one of the later works of Nicolas of Cusa – in the dialog *The Bowling-Game*. The description of a game popular in his times became a starting point for deliberations on the properties of the world and God.

Roundness leads to eternity. Both in a circle and in a sphere it is impossible to distinguish a point which may be the beginning or the end. Circles and spheres which have no beginning and no end become the model of eternity. Because the most perfect form of eternity in the Cusanus' understanding is God, the sphericity – like for Plato – is related to the divine. In the Nicolas of Cusa understanding the world is spherical,

therefore it is eternal (Nicholas of Cusa, 2000, p. 1189–90). It is not however a perfect sphere; it is created on the basis of a model of a perfect sphere.

The roundness of a perfect sphere is not visible (Nicholas of Cusa, 2000, p. 1185):

> For since the surface of a [true] sphere is everywhere equally distant from its center, the outer-extremity of what is [perfectly] round-given that it ends at an indivisible point-remains altogether invisible to our eyes. For we see only what is divisible and quantitative.

We may not see a single point and what is visible may not consist of points. So if the limits of a perfect roundness are set out by an indivisible point, according to Cusanus, it may not be visible. Although roundness as such may not be seen, that does not mean that a round thing cannot be seen. Indeed, we see what is material, whereas in the material only the image of roundness is realized and not the true roundness (Nicholas of Cusa, 2000, p. 1186).

Roundness in itself includes the ability to move. Round objects move more easily than non-round, angular objects. In order to move a real sphere needs a mover, someone who will provide its impetus. Whereas perfect roundness does not need an external mover, it is able to move on its own, it is both the moved one and the mover. What is interesting, for Nicolas of Cusa the soul also moves (the movement of soul is life) in a circular motion. The movement of the soul returns to itself, as in the case of thinking about thinking, it moves itself. If the movement of a soul is circular and as we mentioned before if a circle is eternity, then the life of a soul is perpetual (Nicholas of Cusa, 2000, p. 1197). Cusanus proves at this point [6]. The immortality of the soul mainly on the basis of the roundness of its moves.

The metaphor of a sphere finds its reflection also in ethical deliberations. In the game described in the dialog, a bowling-ball has to be thrown from an agreed place so that it stops closest to the center of a previously drawn circle. Around the central point there are larger and larger circles drawn, which are given a specified number of points. Depending on the circle in which a bowling-ball stops, the player gets the respective amount of points (the closer to the center – the higher the score). The one who obtains 34 points first is the winner. The format of the game symbolizes the movement of our soul. Each bowling-ball sets out an adequate shape of movement, there is also no possibility that two bowling-balls

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6. The notion of proof is not used here in a strictly mathematical sense; it rather stands for speculative reasoning in the scope of metaphysics or mathematical mysticism.

could stop at the same place. The aim of the game is the same as in life: to get as close as possible to the center of the circle which symbolizes God. In order to ensure that the bowling-ball stops near the center, the player must have some experience, which may be achieved only thanks to continual attempts. It is similar to one's exercising in virtue (Nicholas of Cusa, 2000, p. 1029):

> (...) each man, by exerting himself, must govern the inclinations and tendencies of his own bowling-ball. After a while, made temperate in this manner, he strives to find a way whereby the curvature of his bowling-ball does not prevent its arriving at the Circle of Life. This is the symbolic power of the game: that even a curved bowling-ball can be controlled by the practice of virtue, so that after many unstable deviations of movement, the ball stops in the Kingdom of Life.

In the dialog *The Bowling-Game* a famous metaphor also appears, the traits of which Borges was tracking in the essay referred to above "The Fearful Sphere of Pascal". In the version presented by Nicolas of Cusa instead of a sphere a circle is present: "(...) God is a Circle whose Center is everywhere (...)" (Nicholas of Cusa, 2000, p. 1226). The second part of the metaphor describing the circumference not existing anywhere was here omitted. It is worth observing that the metaphor makes sense both in the case of a sphere and a circle, because the center and the circumference are the basic properties of both objects. Only the dimension is different in which the two versions of metaphors are submerged. For those to whom the three-dimensional dimension seemed to be the highest one, a sphere (a closed ball) had to be the most appropriate object to present God. However today, assuming the existence of infinite dimensions, we would not tie the idea of perfection to a particular dimension, so we would not relate more perfection to a three-dimensional sphere (a closed ball) than to a two-dimensional circle (a disk). Perhaps also the thought of Nicolas of Cusa who did prove the identicality of a circle and a sphere, would have gone that direction [7].

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7. Rudiments of many concepts characteristic for contemporary mathematics may be found in the papers of Nicolas of Cusa, among others from the area of non-Euclidean geometry and topology.

3. Circle in epistemological metaphors

3.1. Scientific knowledge as a dynamic circle

Willard Van Orman Quine, in *Two Dogmas of Empiricism* – one of the most influential philosophical essays of the 20th century – states that: "(. . .) total science is like a field of force whose boundary conditions are experience. A conflict with experience at the periphery occasions readjustments in the interior of the field" (Quine, 1951, p. 39). Explaining the interior structure of the area of the circle of scientific knowledge, in particular the relations between its outline and the interior, Quine writes: "The edge of the system must be kept squared with experience; the rest, with all its elaborate myths or fictions, has as its objective the simplicity of laws" (1951, p. 42). The *force field* referred to by Quine is naturally associated with a certain roundness – a circle or a sphere. Bearing that in mind Michał Heller developed the following metaphor: (1997, p. 7)

> If following Quine we compare scientific knowledge to the interior of a circle, what is yet unexamined will remain on the outside of the circle, and the circumference of the circle will be the boundary of knowledge – a place in which our knowledge meets ignorance. The circumference of that circle is constructed out of scientific questions – problems arising out of what we know (from the interior of the circle) but directed towards our ignorance (towards the exterior of the circle). Along with the advance of knowledge, in line with the growth of scientific achievements, the circle symbolizing scientific knowledge widens. Let us note however that at the same time the circumference of that circle grows too – the number of question marks increases! [8]

It should be emphasized that there is a significant difference between the two approaches. As long as Quine does not specify the shape and the size of the force field expressly focusing mainly on the changes that go on inside it (as a result of the reaction with experience), Heller accentuates the very process of the circle's circumference growth, which would indicate accepting the cumulative model of knowledge. Whereby, obviously, Heller's metaphor does not exclude the modification of the inside of the circle.

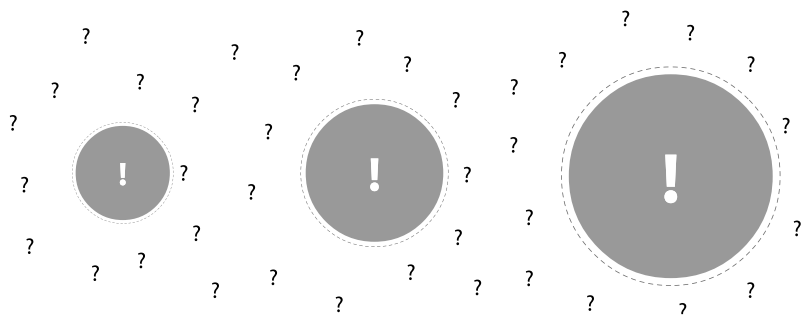8. Transl. A. & J. Hamilton.

Figure 2. Model of evolution of a growing circle of knowledge according to Heller.

The increase of new questions noted by Heller which continuously accompanies the progress of scientific knowledge allows for a new – dynamic – reading of the Socratic maxim "I know that I know nothing". If we recognize that along with the advance of knowledge the number of unsolved problems also grows and that the process may have no end, the constatation that the area of ignorance indefinitely surpasses the area of our knowledge is justified. The vision presented here seems pessimistic at first glance – we will never reach or at least approximate the completeness of knowledge about the world. Nevertheless, this metaphor may also be read as optimistic, as indicating the potential for perpetual development. If there are always new problems which require solving, the scholars will never rest in their quest. Such an optimistic overtone we can find in the words by Bertrand Russell, who described the consequences of the discovery of non-Euclidean geometries in the spirit of Heller's metaphor (Russell, 1912, pp. 230–231):

> Thus, while our knowledge of what is has become less than it was formerly supposed to be, our knowledge of what may be is enormously increased. Instead of being shut in within narrow walls, of which every nook and cranny could be explored, we find ourselves in an open world of free possibilities, where much remains unknown because there is so much to know.

The metaphor of the circle of knowledge also constitutes an interesting illustration of relations which take place between the science and philosophy. According to Russell (1912, p. 240) "those questions which are already capable of definite answers are placed in the sciences, while those only to which, at present, no definite answer can be given, remain to form the residue which is called philosophy". Referring to Heller's metaphor we may say that the domain of philosophy spreads right beyond the circumference of the circle of knowledge.

3.2. Approximation of an ideal circle in metaphors of the pursuit of truth and knowledge

Nicolas of Cusa assumed a geometrical circle as the symbol of absolute truth, whereas the human quest to learn the truth he presented as a process of approximating the circle by polygons inscribed in it (Nicholas of Cusa, 1985, p. 8):

> Hence, the intellect, which is not truth, never comprehends truth so precisely that truth cannot be comprehended infinitely more precisely. For the intellect is to truth as [an inscribed] polygon is to [the inscribing] circle. The more angles the inscribed polygon has the more similar it is to the circle. However, even if the number of its angles is increased ad infinitum, the polygon never becomes equal [to the circle] unless it is resolved into an identity with the circle.
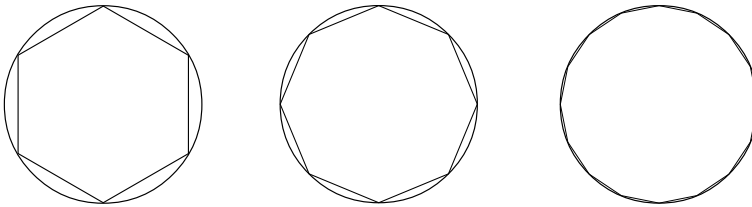
Figure 3. Visualization of the pursuit of truth by the intellect according to Nicolas of Cusa.

This metaphor is based on the mathematical *method of exhaustion* known since antiquity which has been used to approximate the area of figures and volume of solids of which it was not known how to measure them in a direct way. In order to approximate the area of a given figure, simpler figures of which the area it was known how to measure were circumscribed about and inscribed in that figure. The action was similar in terms of solids. Eudoxus is considered the inventor of the method of exhaustion whereas it was perfected by Archimedes who was able to approximate the area of a circle with astonishing accuracy by circumscribing about and inscribing regular polygons into it, starting with a hexagon and ending with as much as a 96-sided regular polygon (Katz, 2009, p. 101). Along with the increase of the number of angles, the values of the areas of the circumscribed and inscribed polygons approach each other and the area of a circle included within them was approximated more and more precisely (fig. 4).
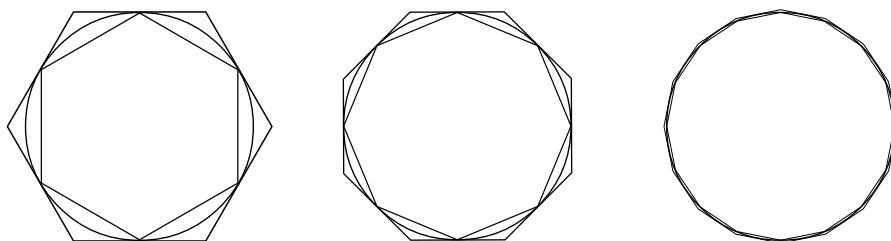
Figure 4. Area of a circle approximated in the method of exhaustion by circumscribing and inscribing regular polygons in it.

Although the method of exhaustion theoretically enabled the calculation of the circle's area with an arbitrary accuracy, its absolute value could not be measured [9]. It is not surprising then that Nicolas of Cusa employed the visualization of that method (fig. 3) in his metaphor of pursuing the truth. In illustrating the pursuit of human intellect he limited it only to polygons inscribed in a circle since the circle here symbolizes the truth about the world which is the property of God (or even is identified with God). It would be incorrect to illustrate human intellect in the form of circumscribed polygons because they transgress the limits of a circle.

Contemporarily it is assumed that all the geometrical properties of a circle have already been discovered (Davis and Hersh, 1981). What is interesting is that when we visualize that figure, in practice we use the archaic method of approximation which is much less subtle than the ancient method of exhaustion. On digital screen circles, ellipses or any curves are represented with the help of tiny squares – pixels. What to us seems like a smooth circle in reality is only its illusion. The visual effect of smoothness achieved through increasing the resolution of the matrix (increasing the number of pixels and decreasing their size) but also through using additional algorithms of optical edge smoothing which is called *antialiasing* (Hearn and Baker, 1997, pp. 171–180).

With reference to Heller's growing circle of knowledge and the discrete structure of screen matrix, an artistic work was created which is an individual visual metaphor of the evolution of scientific knowledge (*The Circle of Knowledge/Koło wiedzy*, J. Jernajczyk, 2008). The idea of complete knowledge was expressed here similarly to the way it was done by Cusanus, in the form of a circle. The limited human knowledge is presented by a figure built out of pixels which approximates an ideal circle.

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9. Currently we are also unable to measure the value of a circle of a given radius, because in the ratio of the area and the radius the irrational number pi is included, which cannot be represented as terminating or repeating decimals. Every final result is then only an approximation.

The evolution of knowledge corresponds with the process of smoothing the edges of that figure. The first rough approximation of a circle is a square which through dichotomist divisions that take place in two dimensions slowly start transforming into a shape which resembles a circle more and more. As a result of consecutively dividing the pixels which are its constituents are becoming ever finer. The ones which are located outside the limits of the model circle are rejected and the entire figure is smoothed (fig. 5). Despite the fact that at some point we may have the impression that we are looking at a smooth circle, blowing up any fragment of the figure reveals that the pixels exist there permanently. The smoothing process, similar to the development of knowledge, potentially may go on *ad infinitum*[10].

Figure 5. Selected stages of a figure's evolution in the interactive installation *The Circle of Knowledge* (*Koło wiedzy*, J. Jernajczyk, 2008).

This metaphor similar to the metaphor of Cusanus is Platonic in character because it assumes that the ideal of absolute knowledge exists. Here it is presented as a circle which is the aim one should pursue. The essence of that evolution is not expanding the area of the figure like it was in Heller's metaphor but smoothing its edges. The development of knowledge is therefore presented here as a process of making continuous corrections and detailing and not a cumulative process which consists in the permanent growth of factual resources. An essential element of that process is rejecting former statements and convictions which along with the development of science have turned out to be outdated[11]. Falsified statements are symbolized here by falling off pixels which are beyond the perimeter of the ideal circle.

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10. Three epistemological metaphors based on the circle which are discussed in this section, pertain only to the relationship between the "knowledge field" and experience. They describe what happens on the contact point of knowledge and ignorance. They do not discuss changes which happen inside that field. Quine pointed out in his essay that under the impact of experience, the internal organisation of the knowledge field is changed (Quine, 1951).

11. An example of such obsolescence of knowledge was the fate of Aristotelian physics.

Figure 6. *The Circle of Knowledge/Koło wiedzy* (J. Jernajczyk, digital print, 100 × 100 cm, 2008). Graphic version presenting 4 stages of the figure's evolution in one image (dynamic version can be find on: https://youtu.be/TIw5o2Gjaks).

3.3. Metaphor of the research circle by Kazimierz Twardowski

Considering the two key aspects of the circle – its center and circumference – for each direction set out by radii, two directions may be distinguished: from the center to the circumference and from the circumference to the center.
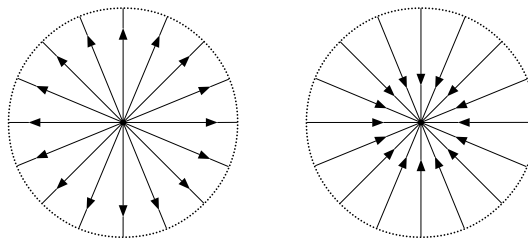

Figure 7. Circles with reversed directions of radii.

Heller's metaphor presented above – of the development of knowledge as a continuously growing circle – is an example of the first variant. Kazimierz Twardowski, the founder of the famous Polish philosophical school called the Lviv-Warsaw School, describing the process of cognition, focused on the direction from the circumference to the center. During the first meeting of the Polish Philosophical Society he is known to have said (Twardowski, 1904, p. 241):

> Like all radii of a circle, although they come from different points of the circumference, connect and meet in the center of the circle, the same is for us who want for all the directions of work and philosophical beliefs in our Society to pursue that one aim, the exhibition of truth [12].

Twardowski in that fragment refers to a circle as a circle of exercising philosophical knowledge, the circle of practicing philosophy. Despite the variety of specialization, diversity of approaches and ways of thinking, all of them should equally pursue true cognition. The truth, which is the circle's center, has therefore become the aim of philosophical pursuit.

The interpretation of Twardowski's visualization may be easily expanded if we consider not only the areas of philosophy and truth as a property of judgments. On the grounds of the high specialization of all detailed sciences and the atomization of scientific research arising out of that, research projects which combine more than one field of science have been created. Specialized sciences like biology or sociology, although they use different methodologies, often research the same subject, for example, the human being – only in different aspects; biology in an organic aspect, sociology in the aspect of social behaviors. They are located in different parts of the circle's circumference however they direct their attention towards its center – towards one and the same subject. That subject may be a tangible one, but it could also be an abstract problem. The unity of the subject enables cross-field research.

Conclusions

The circle and the sphere – mathematical objects – in visual-philosophical speculations take up an important spot. As early as in ancient cosmogonies the world appeared to the philosophers as rounded and similar to a sphere. Perfection based on the idea of an equal distance between the circumferential points from the center was presented with the use of a circle and a sphere. Each point of the circle to the same degree is its

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12. Transl. A. & J. Hamilton.

beginning and its end, therefore essentially there is no beginning or ending point. As a result of that the circle has been and still is the symbol of eternity, everlasting without beginning or end. In popular geometrical approaches, God, the highest entity, was presented as an infinite circle or sphere, the center of which is everywhere and the circumference nowhere.

The circle may also serve as a visualization of cognitive processes. Presenting the development of scientific knowledge in the form of an ever-growing circle aids to visualize that along with the progress of knowledge – the growth of the circle's area, its circumference which sets out the scope of ignorance also grows. On the other hand, the regular polygon with a larger and larger number of sides and the figure constructed out of ever finer pixels, during further divisions become visually indistinguishable from the circle which defines their limits, however, they will never be identical with it. These metaphors reflect the essence of practicing knowledge in the classic sense, i.e. the essence of pursuing the truth – although we are closer to the truth, reaching its complete cognition will be impossible. The circle also helps to express the unity of cognition independent of how many people (or groups of scholars) participate in that process. The points of circumference symbolize various points of view, however from each of these points of view one and the same point may be seen: the circle's center. That point links various societies of researchers and that metaphor visualizes the interdisciplinary character of contemporary science. Amongst the points of circumference which are at the same distance, there is also room for an artistic perspective which complements the scientific image of the world in a creative way.

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