

last idea, we may observe, is met with already in the earlier metaphysical literature, for example RV IV.1.11, where Agni is described as "hiding both his ends (*guhāmāno antā*)"; AB III.43, "the Agniṣṭoma is like a chariot wheel, endless (*ananta*)"; JUB I.35, "the Year is endless (*ananta*), its two ends (*antā*) are Winter and Spring . . . so is the endless chant (*anantaṃ sāman*)." These citations suggest that it may be possible to account for the later mathematicians' selection of technical terms by reference to an earlier usage of the same or like terms in a purely metaphysical context.

Our intention being to demonstrate the native connection of the mathematical terms *kha*, etc., with the same terms as employed in purely metaphysical contexts, it will be necessary to prepare the diagram of a circle or cosmic wheel (*cakṛa*, *maṇḍala*) and to point out the significance of the relationships of the parts of such a diagram according to universal tradition and more particularly in accordance with the formulation of the *Rg Veda*. Take a piece of blank paper of any dimensions, mark a point anywhere upon it, and with this point as center draw two concentric circles of any radii, but one much less than the other; draw any radius from the center to the outer circumference. With exception of the center, which as a point is necessarily without dimension, note that every part of our diagram is merely representative; that is, the number of circles may be indefinitely increased, and the number of radii likewise, each circle thus filled up becoming at last a plane continuum, the extended ground of any given world or state of being; for our purpose we are considering only two such worlds—mythologically speaking, Heaven and Earth, or psychologically, the worlds of subject and object—as forming together the world or cosmos, typical of any particularized world which may be thought of as partial within it. Finally, our diagram may be thought of either as consisting of two concentric circles with their common radii and one common center, or as the diagram of a wheel, with its felly, nave, spokes, and axle-point.

Now in the first place, as a geometrical symbol, that is to say with respect to measure or numeration, our diagram represents the logical relationships of the concepts naught or zero, innumerable unity, and indefinite multiplicity; the blank (*śūnya*) surface having no numerical significance; the central point (*indū*, *bindū*) being an innumerable unity (innumerable, *advaita*, because there cannot be conceived a second center); and either circumference an endless (*ananta*) series of points, which may be thought of as numbers; the totality (*sarvam*) of the numbered,

Kha and Other Words Denoting "Zero,"

in Connection with the

Indian Metaphysics of Space

Kha, cf. Greek *χᾶος*, is generally "cavity"; and in the *Rg Veda*, particularly "the hole in the nave of a wheel through which the axle runs" (Monier-Williams). A. N. Singh has shown conclusively that in Indian mathematical usage, current during the earlier centuries of the Christian era, *kha* means "zero";¹ Sūryadeva, commenting on Āryabhata, says that "the *khas* refer to voids (*khāni śūnyā upa lakṣitāni*) . . . thus *khadvinake* means the eighteen places denoted by zeros." Among other words denoting zero are *śūnya*, *ākāśa*, *vyoma*, *antarikṣa*, *nabha*, *ananta*, and *pūrṇa*.² We are immediately struck by the fact that the words *śūnya*, "void," and *pūrṇa*, "plenum," should have a common reference; the implication being that all numbers are virtually or potentially present in that which is without number; expressing this as an equation, $0 = x - x$, it is apparent that zero is to number as possibility is to actuality. Again, employment of the term *ananta* with the same reference implies an identification of zero with infinity; the beginning of all series being thus the same as their end. This

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¹ *Journal of the United Provinces Historical Society*, VII, 44-45, 62.

² It may as well be pointed out here that although "the decimal notation must have been in existence and in common use among the mathematicians long before the idea of applying the place-value principle to a system of word names could have been conceived" (*ibid.*, p. 61), and although a decimal scale has actually been found at Mohenjo Daro (E. J. H. Mackay, "Further Excavations at Mohenjodaro," *Journal of the Royal Society of Arts*, LXXXII, 1934, 222) it is by no means the intention of the present article to present an argument for a *Rg Vedic* knowledge of either the decimal system or the concept of "zero" as such. Our purpose is merely to exhibit the metaphysical and ontological implications of the terms which were later on actually used by Āryabhata and Bhāskara, etc., to designate "zero," "one," and some higher numbers.

that is to say individual, points representing the sum of a mathematically infinite series extending from one to "infinity," and conceivable as plus or minus according to the direction of procedure. The whole area (*śarīra*) delimited corresponds to place (*déśa*), a revolution of the circles about their center corresponds to time (*kāla*). It will be observed further that any radius connects analogous or corresponding points or numbers on the two circumferences;³ if, now, we suppose the radius of one or both circles indefinitely reduced, which brings us to the central point as limiting concept (that is also "as it was in the beginning"), it is evident that even this point can be thought of only as a plenum of all the numbers represented on either circumference.⁴ On the other hand, this point, at the same time that it represents an innumerable unity and, as we have seen, a plenum, must also be thought of as representing, that is, as the symbol of, zero, for two reasons: (1) inasmuch as the concept to which it refers is by definition without place and without dimensions, and therefore nonexistent, and (2) the mathematically infinite series, thought of as both plus and minus according to direction, cancel out where all directions meet in common focus.

So far as I know, Indian literature does not provide a specifically geometrical exegesis exactly corresponding to what is given in the preceding paragraph. What we do find in the metaphysical and religious traditions is a corresponding usage of the symbol of the Wheel (primarily the solar chariot, or a wheel thereof), and it is in this connection that we first meet with some of the most significant of those terms which are later on employed by the mathematicians. In RV 1.155.6 and 1.164.2, II, 13, 14, 48; AV x.8.4-7; KB xx.1; JUB 1.35; BU 1.5.15; Śvet. Up. 1.4; Praśna Up. vi.5-6, and like texts, the Year as an everlasting sequence is thought of as an unwasting wheel of life, a revolving wheel of the Angels, in which all things have their being and are manifested in succession; "none of its spokes is last in order" (RV v.85.5). The parts of the wheel are named as follows: *āni*, the axle-point within the nave (note that the axle causes revolution, but does not itself revolve); *ḥha*, *nābhi*, the nave (usually as space within the hub, occasionally as the hub itself); *ara*, spoke, connecting hub and felly; *nemi*, *pavi*, the felly. It should be observed that *nābhi*, from $\sqrt{\text{nabh}}$, to expand, is also "navel"; similarly in anthropomorphic formulation, "navel" corresponds to "space" (MU

³ The familiar principle "as above, so below" is illustrated here.

⁴ The notion of exemplarism is expressed here, with respect to number or mathematical individuality.

vi.6); in the *Rg Veda*, the cosmos is constantly thought of as "expanded" ($\sqrt{\text{pin}}$) from this chthonic center.

Certain passages indicating the metaphysical significance of the terms *āni*, *ḥha*, and *nābhi* in the *Rg Veda* may now be cited. It should be premised that we find here in connection with the constant use of the wheel symbol, and absence of a purely geometrical formulation, the term *āni* employed to express ideas later on referred to by the words *indu* or *bindu*.⁵ Vedic *āni*, being the axle-point within the nave of the wheel, and on which the wheel revolves, corresponds exactly to Dante's "il punta dello stelo al cui la prima rota va dintorno" (*Paradiso* XIII.11-12). The metaphysical significance of the *āni* is fully brought out in RV 1.35.6, *ānim na rathyam amṛtā adhi tashuh*, "as on the axle-point of the chariot wheel are actually existent the undying [Angels or intellectual principles]," which also supplies the answer to the well-known problem, "How many Angels can stand on the point of a needle?" More often the nave of the wheel, rather than the axle-point specifically, is treated as its center; nor need this confuse us if we reflect that just as under limiting conditions (indefinite reduction of the radius, or when the central point has been identified but the circle not yet drawn) the center represents the circle, so under similar conditions (metaphysically, in *principio*) the axle-point implies the nave or even the whole wheel—the point without dimension, and a principal space not yet expanded (or as the *Rg Veda* would express it, "closed") being the same in reference. The nave then, *ḥha* or *nābhi*, of the world wheel is regarded as the receptacle and fountain of all order, formative ideas, and goods: for example, II.28.5, *rāhyāma te varuṇa ḥhām rasya*, "may we, O Varuṇa, win thy nave of Law"; VI.41.6, where in Trīta Āptya "all oracles (*ḥavyā*) are set as is the nave within the wheel (*caḥre nābhir iva*)"; IV.28, where Indra opens the closed or hidden naves or rocks (*apihitā . . . ḥhāni* in verse 1, *apihitāni ānā* in verse 5) and thus releases the Seven Rivers of Life.⁶ In v.32.1, where

⁵ *Indu* occurs in the *Rg Veda* as "drop" in connection with Soma: in AV VII.109.6 as "point on a die"; and grammatically as the designation of *Anusvāra*. PB VI.9.19-20 is of interest: *indava iva hi pitarah, manu iva*, i.e., "the Patriarchs are as it were drops (*indu* in pl.), as it were the intellectual principle." In RV VI.44.22, *Indu* is evidently Soma; in VII.54.2, *Vāstospati*.

⁶ The Rivers, of course, represent ensembles of possibility (hence they are often spoken of as "maternal") with respect to a like number of "worlds," or planes of being, as in 1.22.16, *prthivyā sapta dhāmabhiḥ*. Our terms *ḥha*, *āna*, etc., are necessarily employed in the plural when the "creation" is envisaged with respect to the cosmos not as a single "world," but as composed of two, three, or seven originally unmanifested but now to be conceptually distinguished "worlds"; the solar chariot

Indra breaks open the Fountain of Life (*utsam*), this is again an emptying out of the hollows (*kāni*), whereby the fettered floods are released.

According to an alternative formulation, all things are thought of as *ante principium* shut up within, and in *principio* as proceeding from, a common ground, rock, or mountain (*budhna*, *adri*, *parvata*, etc.): this ground, thought of as resting island-like within the undifferentiated sea of universal possibility (x.89-4, where the waters pour *sāgarasya budhnāt*), is merely another aspect of our axle-point (*āni*), regarded as the primary assumption toward which the whole potentiality of existence is focused by the primary acts of intellection and will. This means that a *priori* undimensioned space (*kha*, *ākāśa*, etc.) underlies and is the mother of the point, rather than that the latter has an independent origin; and this accords with the logical order of thought, which proceeds from potentiality to actuality, nonbeing to being. This ground or point is, in fact, the "rock of ages" (*āsmāny anante*, I.130.3; *adrim* . . . *acyutam*, VI.175). Here *ante principium* Agni lies occulted (*guhā santam*, I.141.3, etc.) as Ahi Budhnya, "in the ground of space, concealing both his ends" (*budhne rajato* . . . *guhāmāno antā*, IV.1.11, where it may be noted that *guhāmāno antā* is tantamount to *ananta*, literally "end-less," "in-finite," "eternal"), hence he is called "chthonic" (*nābhīr agni prthivya*, I.59.2, etc.), and is born in this ground (*jāyata prathamah* . . . *budhne*, IV.1.11) and stands erect, Janus-like, at the parting of the ways (*ayor ha śkambha* . . . *pathām visarge*, x.5.6); hence he gets his chthonic steeds and other treasures (*āsvabudhnā*, x.8.3; *budhnyā vasūni*, VII.6.7). It is only when this rock is cleft that the hidden kine are freed, the waters flow (I.62.3, where Bṛhaspati *bhinad adrim* and *vidadgāh*; V.41.12, *śṛṅvanty āpah* . . . *adreh*). This is, moreover, a center without place, and hence when the Waters have come forth (that is, when the cosmos has come to be) one asks, as in x.111.8, "where is their beginning (*agram*), where their ground (*budnah*), where now, ye Waters, your innermost center (*madhyam* . . . *antah*)?"

having one, two, three, or seven wheels, accordingly. It is perhaps because the chariot of the Year is more often than not thought of as two-wheeled (Heaven and Earth), and therefore provided with two analogous axle-points, that *āni* was not later employed as a verbal symbol of "one."

⁷ *Madhya* is "middle" in all senses, and also algebraically "mean." For the metaphysical values, cf. RV *madhye samudre*, and *utsasya madhye* = *sindhinām upodaye*, as the place of Agni or Varuṇa, and in CU III.11.1, *ekāta madhye sthāne*, "single in the midmost station."

Thus metaphysically, in the symbolism of the Wheel, the surface—blank (*śūnya*) in the initial nonbeing (*asat*) of any formulation (*samkhalpa*)—represents the truly infinite (*aditi*) and maternal possibility of being; the axle-point or nave, exemplary being (*viśvam ekam*, RV III.54.8 = integral omnipresence); the actual construction, a mentally accomplished partition of being into existences; each spoke, the integration of an individual as *nāma-rūpa*, that is, as archetypal inwardly and phenomenal outwardly; the felly, the principle of multiplicity (*viśamatva*). Or, employing a more theological terminology: the undetermined surface represents the Godhead (*aditi*, *parabrahman*, *tamas*, *apah*); the axle-point or immovable rock, God (*āditya*, *aparabrahman*, *īśvara*, *ijyoti*); the circle of the nave, Heaven (*svarga*); any point on the circumference of the nave, an intellectual principle (*nāma*, *deva*); the felly, Earth with its analogous (*anurūpa*) phenomena (*viśvā rūpāni*); the construction of the wheel, the sacrificial act of creation (*karma*, *ṛṣi*), its abstraction, the act of dissolution (*laya*). Furthermore, the course (*gati*) of any individual upon the pathway of a spoke is in the beginning centrifugal (*pravṛtta*) and then again centripetal (*nivṛtta*), until the center (*madhya*) is found; and when the center of individual being coincides with the center of the wheel, he is emancipated (*mukta*), the extension of the wheel no longer involving him in local motion, at the same time that its entire circuit now becomes for him one picture (*jagaccitra*)⁹ seen in simultaneity, who as "round-about-seer," *paridraṣṭṛ*, now "overlooks everything," *viśvam* . . . *abhicaste*, I.164-44.

In order to understand the use of terms for "space" (*kha*, *ākāśa*, *anta*, *rikṣa*, *śūnya*, etc.)¹⁰ as verbal symbols of zero (which represents privation of number, and is yet a matrix of number in the sense $0 = x - x$),¹¹ it must be realized that *ākāśa*, etc., represent primarily a concept not of physical space, but of a purely principal space without dimension, though the matrix of dimension.¹² For example, "all these beings arise out of the

⁹ For the construction of the wheel, cf. RV VIII.77-3, *ākḥidat kḥe arāṇ iṣa kḥedayā*, and the discussion in Coomaraswamy, "Angel and Titan: An Essay in Vedic Ontology," 1935.

¹⁰ Sankarācārya, *Sūātmānirūpaṇa* 95.

¹¹ *Śūnya* does not appear in RV, though *śūnam* occurs in the sense of "privation."

¹² Observe that the dual series of plus and minus numbers represents "pairs of opposites," *dvandvāva*.

¹³ C. A. Scharbrau, "Transzendenter Raum der Ewigkeit ist der Ākāśa vor allem auch da, wo er als Ausgangspunkt, als Schöpfungsgrund und als Ziel, als A und O

space (*ākāśād samapadyanta*) and return into the space (*ākāśam praty-astam yanti*). For the space is older than they, prior to them, and is their last resort (*parāyanam*), CU 1.9.1; "space is the name of the permissive cause of individual-integration (*ākāśo vai nāma nāmarūpāyor nirvāhītā*), CU VIII.14; and just as Indra "opens the closed spaces (*apīhītā kṣānti*)," RV IV.28.1, so the Self "awakens this rational [cosmos] from that space (*ākāśāt eṣa kṣhalu idam cetāmātram dōbhayati*)," MU VI.17, in other words, *ex nihilo fit*. Furthermore, the locus of this "space" is "within you": "what is the intrinsic aspect of expansion is the supernal fiery energy in the vacance of the inner man (*tas svarūpam nabhasaḥ kṣhe antarbhūtasya yat param tejah*)," MU VII.11;¹³ and this same "space in the heart" (*antarhṛdaya ākāśa*) is the locus (*āyatana, vēśma, nīda, kṣōsa*, etc.) where are deposited in secret (*guhā nihitam*) all that is ours already or may be ours on any plane (*loka*) of experience (CU VIII.1.1-3). At the same time, in BU VI.1, this "ancient space" (*kṣha*) is identified with Brahman and with the Spirit (*kṣham brahma, kṣham purānam, vāyuram kṣham itī*), and this Brahman is at the same time a plenum or pleroma (*pūrṇa*) such that "when plenum is taken from plenum, plenum yet remains."¹⁴

Here we get precisely that equivalence of *kṣha* and *pūrṇa*, void and plenum, which was remarked upon as noteworthy in the verbal notation of the mathematicians. The thought, moreover, is almost literally repeated when Bhāskara in the *Bijaganitā*¹⁵ defines the term *ananta* thus: *ayam ananto rāśīḥ kṣhara ity ucyate. Asmin vikārah kṣhahare na rāsāvāpi pravṛtṣevāpi nihṛtṣesu bahuvāpi syāl layaṣṭīkāle nante 'cyute bhūtaganesu yadvat*, that is, "This fraction of which the denominator is zero, is called an infinite quantity. In this quantity consisting of that which has cipher for its divisor, there is no alteration, though many be added or subtracted; just as there is no alteration in the Infinite Immovable (*anante acyute*)¹⁶ at the time of the emanation or resolution of worlds, though hosts of beings are emanated or withdrawn."

der Welt angeschaut wird," *Die Idee der Schöpfung in der vedischen Literatur* (Stuttgart, 1932), p. 56; "size which has no size, though the principle of size," Meister Eckhart, Evans ed., I, 114.

¹³ *Nabhā*, from *√ nabh*, to "expand," etc., as also in *nābhī*, "navel" and "nave." A secondary sense of *nabh* is "to destroy."

¹⁴ This text occurs in almost the same form in AV X.8.29.

¹⁵ Calcutta, 1917, pp. 17-18.

¹⁶ Cf. *āmāny anante* and *adṛim acyutam* cited above, with the meaning "rock of Ages."

It may be observed further that while in the *Rg Veda* we "do not find the use of names of things to denote numbers, we do find instances of numbers denoting things."¹⁷ In VII.103.1, for example, the number "twelve" denotes the "year"; in X.71.3, "seven" stands for "rivers of life" or "states of being." It is thus merely a converse usage of words when the mathematicians make use of the names of things to denote numbers; to take the most obvious examples, it is just what should be expected, when we find that 1 is expressed by such words as *adi, indu, abja, pṛthvi*; 2 by such as *yama, aśvinā*; 3 by such as *agni, vaiśvānara, haranetra, bhuvana*; 4 by *veda, dī, yuga, samudra*, etc.; 5 by *prāna*; 6 by *rtu*; and so forth. It is not to be understood, of course, that the number-words are all of Vedic origin; many suggest rather an Epic vocabulary, e.g., *pāṇḍava* for 5, while others, such as *netra* for 2, have an obvious and secular source. In certain cases an ambiguity arises, for example, *loka* as representing either 3 or 14, *dī* as representing 4 or 10, but this can be readily understood; in the last-mentioned case, for example, the quarters have been thought of in one and the same cosmology as either four, or if we count up eight quarters and half-quarters, adding the zenith and nadir, as ten. Taken in its entirety as cited by Singh, the numeral vocabulary can hardly antedate the beginning of the Christian era (we find that 10 is represented, among other words, by *avatāra*; and 6 by *rāga*).

If we attempt to account for the forms of the ideograms of numbers in a similar fashion, we shall be on much less certain ground. A few suggestions may nevertheless be made. For example, a picture-writing of the notion "axle-point" could only have been a "point," and of the concept "nave" could only have been a "round O," and both of these signs are employed at the present day to indicate "zero." The upright line that represents "one" may be regarded as a pictogram of the axis that penetrates the naves of the dual wheels, and thus at once unites and separates Heaven and Earth. The Devanāgarī and Arabic signs for "three" correspond to the trident (*triśūla*), which is known to have been from very ancient times a symbol of Agni or Śiva. *A priori* it might be expected that a sign for "four" should be cruciform, following the notion of extension in the directions of the four airs (*dī*); and in fact we find in Saka script that "four" is represented by a sign X, and that the Devanāgarī may well be thought of as a cursive form derived from a like prototype. Even if there be sufficient foundation for such suggestions, it is hardly likely that a detailed interpretation of ideograms of numbers

¹⁷ Singh, p. 56, (as cited in n. 1).

arts¹⁸ who were very surely, as their own words prove, deeply versed in and dependent upon an older and traditional metaphysical interpretation of the meaning of the world; and on the other, that had it not been for its boasted and long-maintained independence of traditional metaphysics (in which the principles, if not the facts, of relativity are explicit),¹⁹ modern scientific thought might have reached much sooner than has actually been the case a scientifically valid formulation and proof of such characteristic notions as those of an expanding universe and the finity of physical space. What has been outlined above with respect to the special science of mathematics represents a principle no less valid in the case of the arts, as could easily be demonstrated at very great length. For example, what is implied by the statement in AB VI.27, that "it is in imitation of the angelic works of art that any work of art such as a garment or chariot is made here,"²⁰ is actually to be seen in the hieratic arts of every traditional culture, and in the characteristic motifs of the surviving folk arts everywhere. Or in the case of literature: epic (*Volsunga Saga*, *Beowulf*, the Cuchullain and Arthurian cycles, *Mahābhārata*, *Buddhacarita*, etc.) and fairy tale (notably, for example, *Jack and the Beanstalk*) repeat with infinitely varied local coloring the one story of *jātavidyā*, Genesis.²¹ The whole point of view can, indeed, be recognized in the Indian classification of traditional literature, in which the treatises (*śāstras*) on auxiliary science such as grammar, astronomy, law,²² medicine, architecture, etc., are classed as Vedāṅga, "limbs or powers of the Veda," or as Upaveda, "accessory with respect to the Veda"; as

¹⁸ "The place system of the Babylonians . . . fell on fertile soil only among the Hindus. . . Algebra, which is distinctly Hindu . . . uses the principle of local value" (M. J. Babb, in JAOS, LI, 1931, 52). That the "Arabic" numerals are ultimately of Indian origin is now generally admitted; what their adoption meant for the development of European science need not be emphasized.

¹⁹ Āryabhata, *Āryabhaṭīya* IV.9, "As a man in a boat going forward sees a stationary object moving backward, just so at Laṅkā a man sees the stationary asterisms moving backward."

²⁰ See Coomaraswamy, *The Transformation of Nature in Art*, 1934, p. 8 and n. 8.

²¹ Cf. Ernest Stecke, *Die Liebesgeschichte des Himmels* (Strassburg, 1892); and Alfred Jeremias, *Handbuch der altorientalischen Geisteskultur* (Berlin, 1929), p. x: "Die Menschheitsbildung ist ein einheitliches Ganzes, und in den verschiedenen Kulturen findet man die Dialekte der einen Geistesprache."

²² Even the "Machiavellian" *Arthashastra* (1.3) proceeds from the principle *svadharmah svargāya ānanyāya ca, tasya atikrame lokah saṅkṛatā acchidyeta*, "vocation leads to heaven and severitenity; in case of a digression from this norm, the world is brought to ruin by confusion."

above four could now be deduced. We can only say that the foregoing suggestions as to the nature of numerical ideograms rather support than counter the views of those who seek to derive the origins of symbolism, script, and speech from the concept of the circuit of the year.

It is, however, beyond question that many of the verbal symbols—the case of *kha* for "zero" is conspicuous—used by Indian mathematicians had an earlier currency, that is to say before a development of mathematical science as such, in a more universal, metaphysical context. That a scientific terminology should thus have been formulated on the basis of a metaphysical terminology, and by no means without a full consciousness of what was being done (as the citation from Bhāskara clearly shows), is not only in accordance with all that we know of the natural course of Indian thought, which takes the universal for granted and proceeds to the particular, but also admirably illustrates what from a traditionally orthodox point of view would be regarded as constituting a natural and right relationship of any special science to the metaphysical background of all sciences. One is reminded of words in the *Encyclical* of Pope Leo XIII, dated 1879, on the "Restoration of Christian Philosophy": "Hence, also, the physical sciences, which now are held in so much repute, and everywhere draw to themselves a singular admiration, because of the wonderful discoveries made in them, would not only take no harm from a restoration of the philosophy of the ancients, but would derive great protection from it. For the fruitful exercise and increase of these sciences it is not enough that we consider facts and contemplate Nature. When the facts are well known we must rise higher, and give our thoughts with great care to understanding the nature of corporeal things, as well as to the investigation of the laws which they obey, and of the principles from which spring their order, their unity in variety, and their common likeness in diversity. It is marvelous what power and light and help are given to these investigations by Scholastic philosophy, if it be wisely used . . . there is no contradiction, truly so called, between the certain and proved conclusions of recent physics, and the philosophical principles of the Schools." These words by no means represent a merely Christian apologetic, but rather enunciate a generally valid procedure, in which the theory of the universal acts at the same time with suggestive force and normatively with respect to more specific applications. We may reflect, on the one hand, that the decimal system, with which the concept "zero" is inseparably connected, was developed by Indian schol-

