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Raimo Anttila

Scientific Vocabulary

1. Introduction

Scientific language is a technical language used by the experts of a scientific discipline to express its content. Because the Greeks had no earlier (foreign) scientific knowledge to build upon, Greek scientific language is Greek-based and closer to daily language than most of modern scientific languages, whose vocabularies are mainly based on Latin or Greek roots (→ Root Structure (and Ablaut)).

To discuss scientific problems, scientists need to use a language that enables them to achieve two goals, both as precisely as possible: 1) to describe a physical phenomenon, often previously unknown; 2) to derive conclusions from a set of assumptions.

To a large extent the former goal pertains to natural sciences, which privilege the phenomenological description of the world in an attempt to understand it; the latter goal is typical of 'deductive' sciences like mathematics. Scientific language adopts two different strategies to achieve each goal. Greek medicine and biology are the best examples to discuss the language used to achieve goal 1, while mathematical language is the best example for goal 2.

2. Technical Terminology for Descriptive Sciences

Greek scientific terminology is especially well developed in the field of medicine and biology where a precise description of tissues, organs, illnesses, and so on is most important (→ Medical Vocabulary). In order to create a scientific vocabulary there are three linguistic strategies. The first and most ancient one is the use of existing terms. Already the Presocratics resemanticized common Greek words with more specific or charged meanings (e.g. *arkhḗ*, 'beginning', but also 'principle'; *lógos*, 'reason', but also 'rational principle' behind the cosmos). Hippocratic writers also adopted commonly used terms for organs like *phlébes*, generically 'blood-vessels' in 'daily' Greek but specifically 'veins' (opposed to 'arteries') in Hippocrates (→ Semantic Change).

The second strategy consists in the coinage of new terms. The Greek language is particularly generative through suffixation and compounding (→ Word Formation (Derivation, Compounding); → Derivational Morphology; → Compounding/Derivation/Construction Morphology). Typical suffixes used in medicine to denote diseases, inflammations and other sicknesses are: *-íē*/*-ía* (e.g. *haimorragía*, 'hemorrhage'); *-îtis* (e.g. *arthrîtis*, 'inflammation of the joints'); *-aina* (e.g. *gángraina*, 'gangrene'); *-smós* (e.g. *pepasmós*, 'suppuration'); *-dṓn* (e.g. *spadṓn*, 'convulsion'). Adjectives in *-ikós* often mean 'suffering from' (e.g. *husterikós*, 'suffering in the womb'). Qualities are described using suffixes *-ótēs* for nouns (e.g. *stegnótēs*, 'density') and *-(i)ṓdēs*/*-eidḗs* for → adjectives (e.g. *ikter(i)ṓdēs*, 'jaundiced', *kirsoeidḗs*, 'varicose' from *kirsós*, 'enlargement of the vein'). → Verbs indicating 'to suffer from' are often → denominal in *-(i)áō* (e.g. *podagr(i)áō*, 'to have gout'), in *-éō* (e.g. *kephalalgéō*, 'suffer from headache'), and in *-aínō* (e.g. *puretaínō*, 'to be feverish'). Compounding (→ Word Formation (paragōgḗ/súnthesis), Ancient Theories of) is less used than suffixation, but we find privative *a-* (e.g. *a-phlégmantos*, 'free from inflammation'), *dus-* (e.g. *dus-sárkōtos*, 'healing with difficulty', of ulcers), and *eu-* (e.g. *eú-sarkos*, 'fleshy'). Sometimes prepositional prefixes are used (e.g. *hupó-leukos*, 'whitish'; *perí-psukhros*, 'very cold').

The third strategy consists in using terms from other semantic fields metaphorically: words from daily language indicating a common object or phenomenon are used for a 'new', unknown scientific object somehow resembling (usually in its appearance or, more rarely, in its function) the common one. Metaphors (→ Metaphor; → Metaphor (Metaphorá), Ancient Theories of) are especially used in anatomy and pathology. They can come from similarity in shapes like, for example, for bones: e.g. *kerkís*, 'tibia', but lit. 'weaver's shuttle'; *kotúlē*, 'socket of a joint', but lit. 'cup'. Herophilus (*ca.* 330–260 BCE) even

called a pointed bone in the skull 'pharoid process' in analogy to the Pharos of Alexandria. Organs are also named metaphorically like *îris*, lit. 'rainbow', but also 'iris' of the eye. In pathology, *khálaza*, lit. 'hail', is a small eye-cyst or a pimple in a swine.

Metaphors can also originate from similarity in function: e.g. *pulōrós*, the 'gate-keeper', is the 'pylorus' regulating what exits from the stomach; *póros*, lit. 'strait' in the sea, indicates also a 'passage' ('pore') in the skin as well as other ducts of the body (e.g. womb, ovaries, esophagus). Many internal membranes are called *khitṓn*, 'tunic'.

Even internal parts of the human body are metaphorically called by the name of external – hence known – parts of the human body with which they share some similarities: e.g. the 'head' (*kephalḗ*) of the femur or of the heart; the 'mouth' (*stóma*) used for various orifices.

A particular subcategory of metaphors based on the similarity between the anatomical part and another 'known' object or reality includes those taken from other disciplines. Metaphors borrowed from biology include *mûs*, 'mouse', indicating the human muscle, or *kókkux*, 'cuckoo', for the coccyx. Pathology also borrows from the animal world: *karkínos*, 'crab', for cancer; *polúpous*, 'octopus', for a skin excrescence (→ Zoonyms (Names of Mammals)). Botany provides e.g. *rhíza*, 'root' of a tooth, eye, or tongue; *sûkon*, 'fig', and *krithḗ*, 'barley', for excrescences in the eye (→ Phytonyms (Names of Trees)).

Cross-borrowing happens between anatomy and mechanics. Erasistratus (ca. 315–240 BCE) describes the heart as a pump with valves. Conversely, machines can be described as human bodies: for example, war-machines can have 'legs' (*skélē*), 'heels' (*ptérnai*), 'arms' (*ankônes*), and 'hands' or 'claws' (*kheîres*).

As for the criteria for medical and biological terms, the names of the diseases are chosen after the sick part of the body (e.g. *nephrîtis*, 'kidney disease'), how the body is affected (e.g. *lipothumía*, 'swoon', from *leípein*, 'to leave', 'to be lacking', and *thumós*, 'life', 'spirit'), how the affected part looks (e.g. *alphoí*, 'dull-white leprosy'), or how the patient feels (e.g. *kaûsos*, a bilious remittent fever causing a 'burning' sensation). Some diseases are named after the first who suffered from it: Galen knows of a 'Chironian' and a 'Telephian' type of ulcers. Similarly, medical herbs are called after their first user (e.g. Chiron's and Asclepius' all-heals), discoverer (e.g. *gentianḗ*, 'gentian' from the Illyrian king Gentian) or from the place they grow (e.g. *stoikhás*, the French lavender, from the Stoichades, the modern Îles d'Hyères off the Côte d'Azur). The 'anatomical' place is also used to name parts of the body in relation to others, e.g. *metakárpion* indicating the bones of the hand 'after' (*metá*) the *karpós*, 'wrist'.

Greek terminology for descriptive sciences is thus rich and sophisticated. However, it is far from perfect; for example, in medicine there is no standardized and monosemous language and the same organs can be named in different ways (→ Dictionaries of Scientific Vocabulary: Antiquity and Byzantine Period).

The → syntax used by descriptive sciences is rather standard. Some medical texts are characterized by a pronounced rhetorical style, especially those aimed at 'persuading' laypeople that medicine is more accurate than magic, like *The Art of Medicine* (→ Secret Language/Codes/Magical Language). Sometimes the first person (→ Deixis (including 1st and 2nd Person)) is used when the doctor wants to highlight his own contribution to scientific research (following the model of Herodotus' *historíē*). Also, medical prose is sometimes not 'syntactically' correct; for example, the *Epidemics* are rich in elliptic and anacoluthic syntax more typical of notes than polished prose (→ Literary Prose), as a consequence of the 'research in progress' that many of these texts record.

3. Technical Syntax for Deductive Sciences

Beyond 'naming' new phenomena, objects, organs, etc., science needs to convey logical reasoning. The deductive and abstract science *par excellence* in Greece is geometry, which for us represents the bulk of Greek mathematical production and its most deductive branch. Geometry is not so much concerned with 'describing' because geometric objects are small in number. Therefore, geometric terminology, as compared to medical terminology, is rather limited: e.g. *sēmeîon*, 'sign', hence 'point'; *gōnía*, 'corner', hence 'angle'; *kúklos*, 'ring', hence 'circle'; *lógos*, 'reckoning', hence mathematical 'ratio'; *stereós*, 'firm', hence geometric 'solid'; *sphaîra*, 'ball', hence 'sphere'. Compounds are, for example, *trígōnon*, 'triangle', and *tetrágōnon*, 'quadrilateral' (but lit. 'quadrangle'). Metaphorical names are

pleurá, lit. 'ribs', for 'side' of figures, and *kéntron*, originally the horse-goad, then used for any pointed objects, among which are the points of a pair of compasses and hence the 'center' of the circle.

In a proposition, however, geometric objects are also named in a more abstract way, using the letters of the → alphabet (denotative letters); e.g. *tò A*, said of point (*sēmeîon*) A; *hē AB*, said of straight line (*eutheîa grammḗ*) AB; *hē hupò tôn AB, BC*, said of angle (*gōnía*) (contained by lines) AB, BC; *tò ABC*, said of triangle (*trígōnon*) ABC; *tò apò tês AB*, said of square (*tetrágōnon*) (described) on (straight line) AB.

These are precise designations of geometric figures; however, they do not use any 'technical' terminology, but only → definite articles, letters, and → prepositions. Articles and letters in particular helped the reader to identify clearly (with the denotative letters) and unambiguously (with the definite articles) the geometric objects dealt with in the text in a time when symbolism was absent from mathematical language.

Each mathematical proposition (i.e., either a theorem or a problem) can be divided into five parts (the fifth one being attested only in Euclid's *Elements*): 1. Enunciation (*prótasis*); 2. Setting-out and determination (*ékthesis* and *diorismós*); 3. Construction (*kataskeuḗ*); 4. Proof (*apódeixis*) and 5. Conclusion (*sumpérasma*).

In the enunciation, geometrical figures are simply named without letters; theorems are expressed with a → conditional clause of the type: *eán*, 'if', + aorist or present → subjunctive in the protasis and present or future indicative in the apodosis (e.g. Euc. *El.* 1.13: "If (*eán)* a straight line set up on a straight line make (*poiêi*) angles, it will make (*poiḗsei*) either two right angles or angles equal to two right angles"); problems are formulated by the → infinitive used as → imperative (e.g. Euc. *El.* 6.11: "To two given straight lines, to find (*proseureîn*) a third proportional") (→ Mood and Modality; → Mood (énklisis); → Tense/Aspect; → Tense (khrónos)).

Setting-out, determination and construction are characterized by the imperative (→ present or → perfect) in the → middle → passive: the → focus is on the geometrical object being set out or constructed rather than on the → agent (e.g. Euc. *El.* 8.22: "Let there be (*éstōsan*) three numbers A, B, C in continued proportion"; Euc. *El.* 2.7: "Let a square ADEB be described (*anagegráphthō*) on AB"); here the resultative force of the perfect helps to visualize the result of the construction.

The beginning of the proof is a paraconditional structure introduced by *epeí*, 'since', but the rest of the proof is characterized by parataxis and the use of many particles (→ Particles) that help to develop deductive arguments: *allá*, 'but'; *ára*, 'therefore'; *gár*, 'for'; *dé*, 'while'; *dḗ*, 'hence'. In proofs, hypotaxis is present almost only in 'reductio ad absurdum' proofs which use *ei*, 'if', + present indicative in the protasis, and the present or future indicative or imperative in the apodosis: "For if possible (*ei gàr dunatón*), let (some property) be (*éstō*) (true)", which is always ring-compositionally concluded by: "therefore (*ára*) . . . which is impossible (*hóper estìn adúnaton*). Therefore (*ára*) . . . (→ negation of the property)".

In the conclusion, which repeats the enunciation, denotative letters are absent (theorems) or they are present, but the verb (→ Verb (rhêma), Ancient Theories of) is conjugated into the perfect tense (problems).

Such a language with a small lexicon and very peculiar syntactical choices tends to be repetitive, so that scholars even speak of '→ formulaic language' for Greek mathematics. This language is also impersonal, as the first person is rarely used and the author tends to disappear. A notable exception is Diophantus, who often employs the first person within proofs, while normally the first person is limited in Euclid (*fl.* 300 BCE) and Archimedes (*ca.* 287–212 BCE) to the determinations, introduced by "I say that" (*légō hóti*), and to a handful of formulaic expressions within the proof, such as "similarly we shall prove" (*homoíōs dè deíxomen*).

4. Between Descriptive and Deductive Sciences

The language of mechanics used for example in Hero's *Pneumatica* (first century CE) is hybrid: superficially it is mathematical (use of denotative letters and identical structure of a proposition); however, there is no real proof and no use of inferential particles. Rather, this part is substituted with a description of how the machinery works. Hero's *Belopoeica* still uses denotative letters and often imperatives when describing the constructions of the machineries, but in general it is much more personal (frequent use of

verbs in the first person) and closer to standard Greek prose.

Philo of Byzantium's *Belopoeica* and what remains of his *Mēkhanikḕ Súntaxis* (early second century CE?) are even more discursive, with a few cases of denotative letters but far less mathematical structure. Mechanics seems thus generally much more concerned with terminology to 'describe' the machines rather than with the syntax to explain them. However, like in medicine, in Hero and Philo terminology is still not unified and monosemous.

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Francesca Schironi

Scribes, Mycenaean

1. Introduction

Mycenaean scribes are the anonymous individuals (Bennett 1960) who wrote, in the → Linear B script, texts on the clay administrative documents discovered in excavations of important sites (most often *palatial* centers) throughout clearly defined territories of the central and southern Greek mainland and the island of Crete during the period roughly 1450–1200 BCE.

The Linear B texts do not preserve any identifiable words used to denote (a) the acts of writing or reading, (b) individuals who write or read, (c) the materials that are used to write (writing implements, parchment or papyrus scrolls or pages, various forms of clay documents) or (d) the places where written materials are stored (archives, deposits, formal libraries). This sets Mycenaean 'scribes' and scribal systems (→ Mycenaean Script and Language) epistemologically apart from their counterparts in the cuneiform and hieroglyphic cultures of ancient Mesopotamia, Anatolia, the Levant and Egypt.

The English word 'scribe' has many associations from the long history of its use in studying the education, training, work habits, assignments, and the social, economic and political statuses and functions of writers of formal documents within the power hierarchies of different cultures, ancient and modern (Pluta 2011:250–256). Because of these strong associations and the restricted uses of writing attested in the Mycenaean palatial culture, the term 'tablet-writers' has been used lately in discussing the roles of Mycenaean 'scribes' (Palaima 2011:34, 55 n. 39). Sumerian and Akkadian scribes in fact are literally called 'tablet-writers': DUB.SAR and *ṭupšarru*, respectively.

In contrast to Near Eastern scribes, Mycenaean tablet-writers are distinguished by their anonymity and by the limited range of areas of social, political, economic or religious activity for which writing was used. None of the names