ISSN 2187-3321

# 福島県立医科大学
# 総合科学教育研究センター 紀要

Volume 8　November 2019

公立大学法人 福島県立医科大学
総合科学教育研究センター

Vol. 8, 2019

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論文



総合科学研究会報告

原著論文

HEALING HEROES: THE TEXT OF THE HIPPOCRATIC OATH

# Healing Heroes: surveying the Greek text of the Hippocratic Oath

## (Part I: Comments on sections **1.i.–2.ii.)**

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Abstract

This essay considers the Greek text of what has come down to us as the Oath of Hippocrates. Particular attention has been paid to the contemporary meaning and connotation of the language of the text, as well as style and register in general, in an attempt to gain a clearer overall understanding of the canonical version of the Hippocratic Oath in terms of the culture and prevailing usage of the period. By so doing, the essay also addresses the question of how we might view the composition date of the oath, which has until recently been thought to date to the end of the fifth or beginning of the fourth century BC.

*Keywords*: Hippocratic Oath, Hippocrates, ancient Greek medicine, *technē*, *bios*

## Introduction

Ancient Greek texts whose authorship and date remain largely unclear have had an extraordinary influence on the formation of Western thought and values. Although what has come down to us as the Hippocratic Oath, or Oath of Hippocrates, can in no way be likened to the Greek New Testament in terms of size or impact, it has, nonetheless, come to assume an almost Biblical aura, despite the absence of substantive clues regarding by whom and when it was formulated. This text of 20-odd lines bears the title ΌΡΚΟΣ (horkos), which means *oath* or *an oath*: There is no article in the title, and ancient Greek had no indefinite article as such. Jones in his informative essay *The Doctor's Oath*[1] refers to the oath as *Oath*; as it seems to me that this is the most faithful rendering, this is how I shall refer to it, too. After all, as Steven Miles says, "The *Oath* may be the only survivor of dozens of such oaths."[2]

The swearing of oaths permeated every area of Greek society: government, social administration, law, commerce, and a vast spectrum of public and private human interactions. Oaths were accordingly part of the Greek formal and colloquial language and of everyday

1 W. H. S. Jones, *The Doctor's Oath* (Cambridge: Cambridge University Press, 1924).
2 Steven H. Miles, *The Hippocratic Oath and the Ethics of Medicine* (Oxford: Oxford University Press, 2004), 3.

consciousness. The presence of oaths in Greek culture constituted a cohesive force in society. Oaths had shaped the action of the *Iliad* and had continued to appear as crucial elements in Greek literature ever since.[3] An understanding of the significance of oaths in the lives of the ancient Greeks is essential to forming any meaningful interpretation of their motivations and the dynamic forces that shaped their culture. Alan H. Sommerstein, with reference to Richard Janko's scholarly definition in his commentary on the *Iliad*,[4] proceeds to define an oath as "an utterance whereby the speaker—the *swearer*—does the following three things simultaneously": (1) makes a declaration, either assertory or promissory; (2) specifies superhuman power(s) as witnesses thereto and guarantors of its truth; (3) invites a conditional self-curse.[5] As we will see, *Oath* meets these three basic criteria of a classical Greek oath.

I was prompted to look at the Greek text of *Oath* as a result of reading two papers by Heinrich von Staden: *'The Oath', the Oaths, and the Hippocratic Corpus*[6] (von Staden, 2007) and *"In a Pure and Holy Way": Personal and Professional Conduct in the Hippocratic Oath?* (von Staden, 1996).[7] While both of these papers scrutinize the text of Oath in different ways, the later paper examines the language of *Oath* in terms of the Hippocratic writings in general and particularly those regarded as having been composed in the classical era. In addition to asking how far *Oath* shows signs of conforming to classical Hippocratic usage or otherwise, von Staden's paper also considers the extent to which *Oath* is typical of conventions of the genre of oath, such a pervasive element of ancient Greek culture. In his introductory remarks to this paper, von Staden states: "Some, though not all, of the results of the analysis that

3 Jouanna 2018 (Budé I (2)), XXXVIII: "Le *Serment* n'est que la garantie qui en appelle aux dieux pour une bonne exécution du contrat, comme c'était le cas déjà chez Homère où le serment était une garantie d'un pacte entre deux parties."

4 Richard Janko, *The Iliad: A Commentary* IV: Books 13-16 (general ed. G. S. Kirk) (Cambridge: Cambridge University Press, 1992), 194, on *Iliad* 14.271–9.

5 Alan H. Sommerstein, "What Is an Oath," in *Oaths and Swearing in Ancient Greece*, Alan H. Sommerstein and Isabelle C. Torrance, (Berlin, Boston: De Gruyter, 2014), 2, retrieved 3 May. 2017, http://www.degruyter.com/view/product/43685.

6 Heinrich von Staden, "'The Oath,' the Oaths, and the Hippocratic Corpus," in *La science médicale antique: Nouveaux regards* eds. V. Boudon-Millot, A. Guardasole, and C. Magdelaine, (Paris: Beauchesne, 2007), 425–66.

7 Heinrich von Staden, "'In a Pure and Holy Way': Personal and Professional Conduct in the Hippocratic Oath," *Journal of the History of Medicine and Allied Sciences* 51 (1996): 406–37.

follows in fact suggest that a re-examination of the date of the *Oath* might be called for..." Von Staden's relatively brief study is, for all its brevity, highly significant although he stops short of articulating any definite conclusion on the matter. On the other hand, Jouanna (2018) argues that in any attempt to date *Oath*, quite apart from internal linguistic comparisons and matters related to the genre of oaths in contemporary society, importance should also be accorded to a study of the legal ramifications of the ξ(σ)υγγραφή that prevailed in classical times.[8]

Scholarly opinion still dates *Oath* to the classical period.[9] On this point, Jones' approach is still very convincing: "It is indeed hard to believe that the nucleus, at least, of *Oath* does not go back to the 'great' Hippocrates himself."[10] Whether it ultimately goes back to Hippocrates or not, it seems likely that what is now the canonical version[11] may well be viewed as a later accretion around an earlier nucleus.[12] This canonical version of *Oath* is based largely on what is known as the MV manuscript tradition, informed in recent studies by reference to the former section of *Ambrosianus gr.* 134 (B 113 sup.) and *P. Oxy.* XXXI 2547.[13]

I have based my comments largely on the text adopted by von Staden (2007), while also preserving his division of the text and numeration. I have departed from von Staden's 2007 text only at 6.ii φθορίης, τῆς τε ἄλλης, where I have preferred Jouanna's φθορῆς τε τῆς ἄλλης. Elsewhere, where von Staden's adopted text differs from Jouanna (2018),[14] I have

8 Jacques Jouanna, *Hippocrate*, Tome I (2): Le serment; Les serments chrétiens; La loi, (Paris: Les Belles Lettres, 2018). (Hereafter, Budé I (2)), XXXVII–XXXVIII.

9 Jacques Jouanna, *Hippocrates*, trans. M.B. DeBevoise (Baltimore: Johns Hopkins Press, 1999), 401–2.

10 Jones, 1924, 40–45.

11 Jacques Jouanna, Budé I (2), 1–5. Also, Jacques Jouanna, "Un témoin méconnu de la tradition hippocratique: l'Ambrosianus gr. 134 (B 113 sup.), fol. 1-2 (avec une nouvelle édition du Serment et de la Loi)," in *Storia e ecdotica dei testi medici greci. Atti del II Convegno Internazionale, Parigi 24–26 maggio 1994*, ed. A. Garzya, (Naples 1996), 253–272.

12 *The Oxford Classical Dictionary, 4th ed., s.v. "Asklepios."* Interestingly, in this entry (p. 181), we find: "The site of an early sanctuary is uncertain; when in 366/5 BC, the city of Cos was rebuilt, Asklepios received a sanctuary in a grove of Apollo Cyparissius (LSAM 150A, dated 325–300 BC); the famous oath, sworn to Apollo, Asklepios (his daughters) Hygieia and Panacea, and 'all the gods and goddesses', belongs to the same period."

13 For details of the manuscript tradition and other historical aspects of the origin of the text of *Oath*, see note 11.

14 J. Jouanna, Budé I (2).

indicated this in parentheses, as well as adding Jouanna's numbering and translation. Apart from Jouanna's translation of *Oath*, which I give for reference as being the latest available at the time of writing, translations or paraphrases are mine unless indicated. Except in the initial exposition of the text of *Oath*, I have entered examples of text in the original Greek rather than in a transcription into the Roman alphabet, in the belief that *all* medical students should invest the short time it takes to learn the Greek alphabet, as a knowledge of Greek, no matter how basic, will enrich their study of medicine and its language.

### Note on Hippocratic texts used

When referring to the text of treatises in the *Hippocratic Corpus*, I have mainly used Littré's *Oeuvres completes* and the 11-volume Loeb set as listed below. Volumes of the Budé edition reached me as I was finishing this essay, so I had but little opportunity to consult these most recent and authoritative editions.

- **Littré**

Emile Littré, *Oeuvres completes d'Hippocrate,* 11 volumes (Paris, 1839-1861) (cited as *Littré, volume number, page number, line number*)

- **Loeb**

W.H.S. Jones, E.T.Withington, P. Potter, W. D. Smith, *Hippocrates,* 11 Volumes in the Loeb Classical Library (Cambridge, Massachusetts: Harvard University Press)
(Volume I: Ancient Medicine. Airs, Waters, Places. Epidemics 1 and 3. The Oath. Precepts. Nutriment.
Volume II: Prognostic. Regimen in Acute Diseases. The Sacred Disease. The Art. Breaths. Law. Decorum. Physician (Ch. 1). Dentition.
Volume III: On Wounds in the Head. In the Surgery. On Fractures. On Joints. Mochlicon.
Volume IV: Nature of Man. Regimen in Health. Humours. Aphorisms. Regimen 1–3. Dreams.
Volume V: Affections. Diseases 1–2.
Volume VI: Diseases 3. Internal Affections. Regimen in Acute Diseases.
Volume VII: Epidemics 2 and 4–7.
Volume VIII: Places in Man. Glands. Fleshes. Prorrhetic 1–2. Physician. Use of Liquids. Ulcers. Haemorrhoids and Fistulas.
Volume IX: Anatomy. Nature of Bones. Heart. Eight Months' Child. Coan Prenotions. Crises. Critical Days. Superfetation. Girls. Excision of the Fetus. Sight.
Volume X: Generation. Nature of the Child. Diseases 4. Nature of Women. Barrenness.
Volume XI: Diseases of Women 1–2.)
(cited as *Loeb, volume number, page number, line number*)

- **Budé** (volumes consulted)

J. Jouanna, *Hippocrate*, Tome I (2): Le serment; Les serments chrétiens; La loi, (Paris: Les Belles Lettres, 2018). (cited as *Budé I (2), page number*)
J. Jouanna, *Hippocrate*, Tome II (1): L'Ancienne Médecine, (Paris: Les Belles Lettres, 1990). (cited as *Budé II (1), page number*)
M. P. Duminil, R. Joly and J. Jouanna (1996). *Hippocrate*, Tome II (2): Airs, eaux, lieux. (Paris: Les Belles Lettres, 1996). (cited as *Budé II (2), page number*)
J. Jouanna, *Hippocrate*, Tome III (1): Pronostic, (Paris: Les Belles Lettres, 2013). (cited as *Budé III (1), page number*)
J. Jouanna, *Hippocrate*, Tome V (1): Des Vents - De L'art, (Paris: Les Belles Lettres, 2003). (cited as *Budé V (1), page number*)
J. Jouanna, *Hippocrate*, Tome X (2) Maladies (Paris: Les Belles Lettres, 2003). (cited as *Budé X (2), page number*)

| **Oath: Greek text**<br>(as numbered by Heinrich von Staden 2007; J:=Jouanna 2018) | **Oath: translation**<br>(J:=Jouanna 2018) |
|---|---|
| **1.i. (J: 1a.)** Ὀμνύω (Omnuō) | **1.i.** I swear (J: Je jure) |
| **1.ii.** Ἀπόλλωνα ἰητρὸν καὶ Ἀσκληπιὸν καὶ Ὑγείαν καὶ Πανάκειαν καὶ θεοὺς πάντας τε καὶ πάσας, ἵστορας ποιεύμενος, (Apollōna iētron, kai Asklēpion, kai Hygeian, kai Panakeian, kai theous pantas-te kai pasas, historas poioumenos,) | **1.ii.** by Healing Apollo, Asklepios, Hygeia (goddess of health), Panakeia (goddess of universal remedy), and by all the gods and goddesses, invoking them as my witnesses (judges), (J: par Apollon médecin, par Asclépios, par Hygie et Panacée, et par tous les dieux et toutes les déesses, les prenant à témoin,) |
| **1.iii.** ἐπιτελέα ποιήσειν κατὰ δύναμιν καὶ κρίσιν ἐμὴν ὅρκον τόνδε καὶ συγγραφὴν τήνδε· (epitelea poiēsein kata dynamin kai krisin emēn horkon tonde kai xungraphēn tēnde:) | **1.iii.** to fulfill this oath and contract to the best of my ability and judgment. (J: d'exécuter, selon ma capacité et mon jugement, ce serment et ce contrat;) |
| **1.iv. (J: 1b.)** ἡγήσασθαί τε τὸν διδάξαντά με τὴν τέχνην ταύτην ἴσα (J: ἶσα) γενέτῃσιν ἐμοῖσι (hēgēsasthai men ton didaxanta me tēn technēn tautēn isa genetēisin emoisi) | **1.iv.** [I swear] to regard him who has taught me this *technē* as equivalent to my parents, (J: (Je jure) de considérer d'abord mon maître en cet art à l'égal de mes propres parents;) |
| **1.v.** καὶ βίου κοινώσασθαι καὶ χρεῶν χρηίζοντι μετάδοσιν ποιήσασθαι· (kai biou koinōsasthai, kai chreōn chrēizonti metadosin poiēsasthai:) | **1.v.** to live my life communally with him and to share what I have with him whenever he is in need, (J: de mettre à sa disposition des subsides et, s'il est dans la besoin, de lui transmettre une part de mes biens;) |
| **1.vi.** καὶ γένος τὸ ἐξ αὐτοῦ (J:αὐτέου) ἀδελφοῖς ἴσον (J: ἶσον) ἐπικρινέειν ἄρρεσι, (kai genos to ex autou adelphois ison epikrineein arresi) | **1.vi.** and to judge his offspring (issue) in the same terms as my male siblings, (J: de considérer sa descendance mâle à l'égal de mes frères;) |
| **1.vii. (J: 1c.)** καὶ διδάξειν τὴν τέχνην ταύτην, ἢν χρηίζωσι μανθάνειν, ἄνευ μισθοῦ καὶ ξυγγραφῆς, (kai didaxein tēn technēn tautēn, en xrēizōsi manthanein, aneu misthou kai zungraphēs) | **1.vii.** and to instruct them in this *technē* without fee or contract if they desire to learn it, (J: et de leur enseigner cet art, s'ils désirent l'apprendre, sans salaire ni contrat;) |
| **1.viii.** παραγγελίης τε καὶ ἀκροήσιος καὶ τῆς λοιπῆς ἁπάσης μαθήσιος μετάδοσιν ποιήσασθαι υἱοῖσι τε ἐμοῖσι καὶ τοῖσι τοῦ με (J: ἐμὲ) διδάξαντος καὶ μαθητῇσι συγγεγραμμένοισί τε καὶ ὡρκισμένοις (J: ὡρκισμένοισι) νόμῳ ἰητρικῷ, ἄλλῳ δὲ οὐδενί. (parangeliēs te kai akroēsios kai tēs loipēs | **1.viii.** and to share rules, lectures, and all the rest of learning with my sons, the sons of my teacher, and such apprentices as are bound by contract and oath in accordance with the code of medical practice, but with no other person. (J: de transmettre les préceptes, les leçons orales et tout le reste de l'enseignement à mes fils et à ceux de mon maître, et aux disciples liés par un contrat et un serment, suivant la loi médicale, et à nul autre.) |

| **Oath: Greek text**<br>(as numbered by Heinrich von Staden 2007; J:=Jouanna 2018) | **Oath: translation**<br>(J:=Jouanna 2018) |
|---|---|
| hapasēs mathēsios metadosin poiēsasthai huioisi te emoisi, kai toisi tou eme didaxantos, kai mathētaisi sunngegrammenoisi te kai hōrkismenois nomōi iētrikōi, allōi de oudeni.) | |
| **2.i. (J: 2.)** Διαιτήμασί τε πᾶσι χρήσομαι ἐπ᾽ ὠφελείῃ καμνόντων κατὰ δύναμιν καὶ κρίσιν ἐμήν, (Diaitēmasi te chrēsomai ep᾽ ōpheleiēi kamnontōn kata dunamin kai krisin emēn,) | **2.i.** I will use all forms of regimen for the benefit of patients to the best of my ability and judgment, (J: J'utiliserai tout le régime pour l'utilité des malades selon ma capacité et mon jugement;) |
| **2.ii.** ἐπὶ δηλήσει δὲ καὶ ἀδικίῃ εἴρξειν κατὰ γνώμην ἐμήν. (epi dēlēsei de kai adikiēi eirxein kata gnōmēn emēn.) | **2.ii.** [while also swearing] to the best of my conscience to safeguard patients from wrongdoing and anything likely to cause them harm. (J: mais si c'est pour leur perte ou pour un injustice à leur égard, (je jure) d'y faire obstacle selon ma conscience.) |
| **3.i. (J: 3.)** Οὐ δώσω δὲ οὐδὲ φάρμακον οὐδενὶ αἰτηθεὶς θανάσιμον, (Ou dōsō de oude pharmakon oudeni aitētheis thanasimon) | **3.i.** I will not give any individual any drug that might result in death even if requested. (J: Je ne remettrai à personne une drogue mortelle si on me la demande,) |
| **3.ii.** οὐδὲ ὑφηγήσομαι ξυμβουλίην τοιήνδε· (oude huphēgēsomai zumbouliēn toiēnde;) | **3.ii.** Neither will I take any initiative in suggesting anything of the sort. (J: ni ne prendrai l'initiative d'une telle suggestion.) |
| **3.iii.** ὁμοίως δὲ οὐδὲ γυναικὶ (J: γυναιξὶ) πεσσὸν φθόριον δώσω. (homoiōs de oude gynaiki pesson phtorion dōsō.) | **3.iii.** By the same token, I will not give an abortive pessary to a woman. (J: De même, je ne remettrai pas non plus aux femmes un pessaire abortif.) |
| **4.i. (J: 4.)** Ἁγνῶς δὲ καὶ ὁσίως (Hagnōs de kai hosiōs) | **4.i.** In a spirit of purity and holiness (J: C'est dans la pureté et la piété) |
| **4.ii.** διατηρήσω (diatērēsō) | **4.ii.** will I guard constantly (J: que je passerai) |
| **4.iii.** βίον ἐμὸν καὶ τέχνην ἐμήν. (bion emon kai technēn emēn.) | **4.iii.** my life (*bios*) and profession (*technē*). (J: ma vie et exercerai mon art;) |
| **5.i. (J: 5.)** Οὐ τεμέω δὲ οὐδὲ μὴν λιθιῶντας, (Ou temeō de oude mēn lithiōntas,) | **5.i.** I will not perform surgery—least of all on patients suffering from urinary stones, (J: Je n'inciserai pas non plus les malades atteints de lithiase,) |
| **5.ii.** ἐκχωρήσω δὲ ἐργάτῃσιν ἀνδράσι πρήξιος τῆσδε. (ekchōrēsō de ergatēisin andrasi prēxios tēsde.) | **5.ii.** but I will give way to specialists versed in this practice. (J: mais je laisserai cela aux hommes spécialistes de cette intervention.) |
| **6.i. (J: 6.)** Ἐς οἰκίας δὲ ὁκόσας ἂν ἐσίω, ἐσελεύσομαι ἐπ᾽ ὠφελείῃ καμνόντων, (Es oikias de hokosas an esiō, eseleusomai ep'ōpheleiēi kamnontōn,) | **6.i.** Into whatever household I may enter, I will enter for the benefit of patients, (J: Dans toutes les maisons ou je dois entrer, je pénétrerai pour l'utilité des malades,) |

| **Oath: Greek text**<br>(as numbered by Heinrich von Staden 2007; J:=Jouanna 2018) | **Oath: translation**<br>(J:=Jouanna 2018) |
|---|---|
| **6.ii.** ἐκτὸς ἐὼν πάσης ἀδικίης ἑκουσίης καὶ φθορῆς τε τῆς ἄλλης (instead of von Staden's φθορίης, τῆς τε ἄλλης) καὶ ἀφροδισίων ἔργων ἐπί τε γυναικείων σωμάτων καὶ ἀνδρείων, ἐλευθέρων τε καὶ δούλων. (ektos eōn pasēs adikiēs hekousiēs kai phthoriēs, tēs te allēs kai aphrodisiōn ergōn epi gunaikeiōn sōmatōn kai andreiōn, eleutherōn te kai doulōn.) | **6.ii.** remaining beyond all deliberate wrongdoing, corruption, and particularly sexual acts on male or female persons, whether they be free or enslaved. (J: me tenant à l'écart de toute injustice volontaire, de toute acte corrupteur en général, et en particulier des relations sexuelles avec les femmes ou les hommes, libres ou esclaves.) |
| **7.i. (J: 7.)** Ἃ δ' ἂν ἐν θεραπείῃ ἢ ἴδω ἢ ἀκούσω ἢ καὶ ἄνευ θεραπείης κατὰ βίον ἀνθρώπων, ἃ μὴ χρή ποτε ἐκλαλέεσθαι ἔξω, (Ha d'an en therapeiēi ē idō ē akousō ē kai aneu therapeiēs kata bion anthrōpōn, ha mē pote eklaleesthai exō,) | **7.i.** In regard of such things I see or hear in the course of treatment or even in the course of human life outside treatment as should never be spoken of indiscreetly outside, (J: Tout ce que je verrai ou entendrai au cours du traitement, ou même en dehors du traitement, concernant la vie des gens, si cela ne doit jamais être répété au-dehors,) |
| **7.ii.** σιγήσομαι, ἄρρητα ἡγεύμενος εἶναι τὰ τοιαῦτα. (sigēsomai, arrēta hēgeumenos einai ta toiauta.) | **7.ii.** I will hold my tongue, because I regard such things as unutterable secrets. (J: je le tairai, considérant que de telles choses sont secrètes.) |
| **8.i.a.** (J: 8.) Ὅρκον μὲν οὖν μοι τόνδε ἐπιτελέα ποιέοντι, καὶ μὴ συγχέοντι, (horkon men oun moi tonde epiteleia poieonti, kai mē xuncheonti,) | **8.i.a.** Accordingly, if I fulfill this oath and do not seek loopholes, (J: Eh bien donc, si j'exécute ce serment et ne l'enfreins pas,) |
| **8.i.b.** εἴη ἐπαύρασθαι καὶ βίου καὶ τέχνης (eiē epaurasthai kai biou kai technēs) | **8.i.b.** may it be my fate to enjoy the fruits of both my life (*bios*) and profession (*technē*), (J: qu'il me soit donné de jouir de ma vie et de mon art,) |
| **8.i.c.** δοξαζομένῳ παρὰ πᾶσιν ἀνθρώποις ἐς τὸν αἰεὶ (J: ἀεὶ) χρόνον, (doxamenō para pasin anthrōpois es ton aiei chronon,) | **8.i.c.** being held in high esteem by all men until the end of time. (J: honoré de tous les hommes pour l'éternité.) |
| **8.ii.a.** παραβαίνοντι δὲ καὶ ἐπιορκοῦντι, (parabainonti de kai epiorkounti,) | **8.ii.a.** If, on the other hand, I infringe the oath and perjure myself, (J: En revanche, si je le transgresse et me parjure,) |
| **8.ii.b.** τἀναντία τούτων (J: τουτέων). (tanantia toutōn) | **8.ii.b.** may the opposite fate befall me. (J: que ce soit le contraire de cela.) |

## 1. Invoking Olympian patrons as witnesses and judges to an oath and contract (1.i., 1.ii.)

A solemn oath is in fact a prayer, and *Oath* is no exception, not unnaturally opening with the performative verb ὀμνύω, *I swear*, in the first person singular, indicating both the personal and formal nature of what is to come.[15] Sommerstein notes significantly that oaths beginning thus (*omnumi oaths*) are "not as frequent in our data as one might expect." He also points out that oaths "administered by the state or by other bodies such as local communities or religious societies are hardly ever, to our knowledge, expressed in this [*omnuo*/*omnumi*] way."[16] Next follow in the accusative case the gods invoked as witnesses and judges to the act of swearing: Ἀπόλλων ἰητρός (Apollōn iētros), Apollo the Healer; Ἀσκληπιός, Asklepios; Ὑγεία, Hygeia; Πανάκεια, Panakeia, and, as if for good measure, θεοί πάντες τε καὶ πάσαι, *all the gods*, *both male and female*. The inclusion of all the gods and goddesses is a relatively common formula characteristic of particularly solemn oaths.[17] As noted by von Staden (2007) and Jouanna (2018), evidence from epigraphy and papyrus, while telling us much about such ritual conventions of oath as the roll call of divine witnesses, tends to point to the Hellenistic period.[18]

15 ὄμνυμι, ὀμνύω: Although thematic verb forms generally gave way to athematic forms in the development of Greek, the process is sporadic and complex. (*LSJ*: "for pres. ind. the Trag. and Ar. use only ὄμνυμι, Hdt. and Att. Prose writers also ὀμνύω ..." In *Oath*, therefore, the athematic form in no way points to a later date of composition. The form ὄμνυμι is found, ironically, in some versions the so-called metric oath (Hp., *Iusi*. *II*), where it is incompatible with the meter. Ὄμνυμι is also found in *Ambrosianus*. See Jouanna 2018 (Budé I (2)), 8–9. Also see: Geoffrey Horrocks, *Greek: A History of the Language and its Speakers* (Wiley-Blackwell, 2010), 303–310.

16 Alan H. Sommerstein, "How Oaths Are Expressed," in *Oaths and Swearing in Ancient Greece*, Alan H. Sommerstein and Isabelle C. Torrance, (Berlin, Boston: De Gruyter, 2014), 76-77, retrieved 3 May. 2017, http://www.degruyter.com/view/product/43685.

17 Sommerstein and Torrance, 2014, 376.

18 von Staden, 2007, 435 ("The first unambiguously attested example of this structure [list of deities + all the other gods and goddesses] dates to 310 BC..." Jouanna 2018 (Budé I (2)), 12–13.

### 1.1 Apollo

The role of Apollo in Greek mythology is complex, as is amply described by Fritz Graf.[19] Here in *Oath*, the Olympian is invoked in conjunction with the *epiklēsis* ἰητρός (iētros, the Ionic form of ἰατρός (iatros)). In hierarchical terms, therefore, as the only Olympian named, Apollo represents the head of the swearer's profession (*technē*), ἰητρός serving as a focusing epithet to maximize the efficacy of the prayer by pointing to that deity's relevance to the context. The epithet ἰητρός / ἰατρός in conjunction with Apollo is found in Aristophanes' *Birds* (584) and on occasion in inscriptions.[20] Graf tells us that Appolon Iatros was central in Miletus' colony Olbia, founded in 600 BC, suggesting that the cult was imported from Miletus itself at an even earlier stage.[21] The deity's appearance in *Oath*, however, is the only case of Apollo being invoked as the witness to an oath under the *epiklēsis* ἰητρός / ἰατρός. The nearest we come to Apollo Iētros / Iatros as an oath witness in classical Greek literature is Apollo Paian, which can also be translated as *Apollo the Healer*. There is a distinct possibility that the god Paiawon, attested in two Linear B texts from Knossos on Crete, is the same as the epithet Paian. Indeed, Homer's Παιήων[22] is presented as a deity, physician to the gods rather than to mortals, possibly distinct from Apollo.[23] Apollo, incidentally, does not appear to figure in Linear B texts, and, with a high degree of probability is non-Mycenaean.[24] In the context of oaths, the speculation that Apollo could have made his first appearance in human records as a guarantor or witness of a treaty is highly seductive: The Alaksandus treaty (c.1280 BC) between the Hittites and Wilusa (?Troy / Ilios?) ends with a list of guarantors, one of which is

19 Fritz Graf, *Apollo*, Taylor & Francis, 2008.
20 von Staden, 2007, 429; Jouanna 2018 (Budé I (2)), 10.
21 Graf, 2008, 69–70.
22 *Il.* 5. 401, 899.
23 In the *Odyssey* (4.232), Paiēōn is associated with Egypt: "And in medical knowledge the Egyptian leaves the rest of the world behind. He is a true son of Paeeon the Healer." (Rieu) ἰητρὸς δὲ ἕκαστος ἐπιστάμενος περὶ πάντων / ἀνθρώπων: ἦ γὰρ Παιήονός εἰσι γενέθλης.
24 Graf, 2008, 67.

Appaliuna. In this treaty, the gods on the side of Wilusa are: "The Stormgod of the Army, [one name lost,] *x-ap-pa-li-u-na-as,* the male and female gods, mountains, rivers, [springs] and the subterranean river(?) of Wilusa:"[25]. Interestingly, this ancient treaty also echoes our *Oath* with the "male and female gods" being an invocation common to both, while the "subterranean river" is reminiscent of power of the Styx as primeval guarantor of oaths in Hesiod[26] and Homer,[27] among others.

As for Apollo, however, Homer shows no ambiguity in portraying this Olympian as firmly on the side of Troy. Indeed, if we equate King Alaksandus with Alexandros (Paris) of Troy, the parallel is borne out in Homer's depiction of Apollo as the deity who aided Paris in the killing of Achilleus. It was Apollo, after all, that built the walls of Troy. His first appearance on the stage of Greek literature is as destroyer, as the bringer of plague: the offended who judges and exacts revenge. It is through divination that Apollo is transformed from instigator of pestilence into healer.[28] We might even refer to Apollo as the *wounding healer*. As we see from Hesiod's *Works and Days*,[29] disease was early conceived as a postlapsarian evil beyond the control of mortals. The epithet ἰητρός focuses the Olympian's role as the prime deity invoked, a role which can be ambiguous in its breadth: just as the sun's rays can heal, they can also scorch. Ἰητρός points to healer in its broadest sense, in the context of a cosmology in which Apollo fends off evil as a purifying force. Apollo as a healing force can better be appreciated in terms of *iatromantis* (ἰατρόμαντις), whose role as the prophet and interpreter of Zeus, is powerfully described in Aeschylus' *Eumenides*. In

25 "The identity of [ ]appaliunas with Apelion/ Apollon is possible – some would even say probable – but cannot be considered proven." Hans G. Güterbock "Troy in Hittite Texts? Wilusa, Ahhiyawa, and Hittite History." In *Troy and the Trojan War: Proceedings of a Symposium Held at Bryn Mawr College*, October 1984, ed. Machteld J. Mellink, 33–44. Bryn Mawr, Penn.: Bryn Mawr College. Also, see Graf, 2008, 108–9.

26 *Thg*. 784, 793.

27 *Il*. 2.755, *Il*. 8.369, *Il*. 14.271, *Il*. 15.37, *Od*. 10.514.

28 *Il*. 1. 473.

29 Hes. *WD* 90–91:...ἄτερ χαλεποῖο πόνοιο / νούσων τ' ἀργαλέων...; *WD* 102: νοῦσοι δ' ἀνθρώποισιν ἐφ' ἡμέρῃ, αἳ δ' ἐπὶ νυκτὶ...

Aeschylus, both Apollo and Asklepios are referred to as *iatromantis*.[30] It is the meditative element that most likely gives us our word *medicine*, the *medi* of medicus and medicina.[31] After all, the healer is one capable of divining the cause of disease. Originally, the diviner's role had been to identify just which of the *gods* had been offended, a role that gradually developed into what we see argued in the *The Sacred Disease*—to look instead to the *symptoms* for an aetiology.

Apollo had long been identified with the Asclepiads, who had played a significant role in the "sacred wars" fought to secure the shrine to Apollo at Delphi.[32] Asclepiads of Cos and Cnidus had issued a decree that required an Asclepiad arriving in Delphi and hoping to consult the oracle there to swear an oath that he is an Asclepiad by male descent. From this, we see that Asclepiads were accorded certain religious privileges in Delphi.[33]

For all this, the author of *The Sacred Disease* would argue against the efficacy of ritual cures by a seer, denying the intervention of deities as the cause and urging us to look for the remedy in the affairs of man.[34] *The Sacred Disease*, in arguing for a more rational approach to medical aetiology, is arguing more against the divinatory nature of incubation; this treatise maintains, however, a healthy concept of ὅσιος and εὐσεβής.[35] *Oath*, likewise, upholds a simultaneous awareness of the divine and the human, both being intertwined from the very opening of *Oath* and maintained until its close.

30 Aesch. *Eum*. 62.; Aesch. *Supp*. 263.

31 It is in all probability not the case that the *medi* of medicine can be identified with the *medi* of mediator. See Thelma Charen. "The Etymology of Medicine." *Bulletin of the Medical Library Association* 39.3 (1951): 216–221. Print.

32 Jouanna, 1999, 13.

33 Jouanna, 1999, 34-35. Also, on the differences between the applications and implications of the *Delphic Oath* and *Hippocratic Oath*, see Jacques Jouanna, Philip J. Van Der Eijk, and Neil Allies, *Greek medicine from Hippocrates to Galen: selected papers* (Leiden: Brill, 2012), 117.

34 *Morb. sacr*.: ὥστε τὸ θεῖον μηκέτι αἴτιον εἶναι, ἀλλά τι ἀνθρώπινον (Loeb, *Hippocrates II*, 144).

35 *Regimen in Acute Diseases* describes the diametrically opposed diagnoses of contemporary medical practitioners as no doubt appearing to laymen as the contradicting conclusions of diviners. (*Acut*. Loeb II, 68 VIII, 5–15).

## 1.2 Asklepios

Asklepios, son of Apollo, brings us to a different domain. Whereas the age-old epithets describing Apollo had included ἑκάεργος, ἑκηβόλος and ἕκατος, which all emphasize agency intervening from a *distance*,[36] Asklepios brings us into a closer, more recent cosmology. Asklepios was not nurtured by his father in any way, let alone in the healing arts, but by Chiron, the centaur of superior pedigree, dual in nature and educator to heroes. Though himself immortal, Chiron was to fall victim to the ambiguity of *pharmakon* smeared on the arrowheads of Heracles, and in the ensuing agony to renounce his immortality. While the remote Apollo *works from afar*, Asklepios is characterized by a willingness to engage with the sick in person as healing *craftsman*. In fact, his love for humanity extends to self-sacrifice. He occupies two realms at the same time: half man and half god, with the power to mediate between the living and the dead, a power he ultimately uses to resurrect mankind from the dead. It is in this extreme form of mediation that lies his destruction at the hands of Zeus. Duality is central to the identity of Asklepios. Just as hero and demigod Asklepios is the issue of Apollo, the family of Hippocrates saw itself as being descended from Asklepios through his sons the warrior physicians Machaon and Podalirius. The duality that characterizes Asklepios also extends to his origins: Messenia and Tricca in Thessaly, according to local myths already established in the sixth century BC.[37] In Homer, Asklepios is the "blameless physician,"[38] while Pindar depicts him as "Asklepios, the gentle hero, craftsman in remedies for the limbs of men tormented by disease."[39] For craftsman, Pindar uses the word τέκτων, bringing to mind τέχνη, concept central to *Oath* and Greek medicine

36 This etymology (*working from afar* or *striking from afar*) is in fact doubtful, being a construction of later grammarians. For more likely etymologies, see *LSJ*, s.v. ἑκάεργος, ἑκηβόλος and the web-based *Greek-English etymological dictionary* (Ελληνικά-Αγγλικά ετυμολογική λεξικό), s.v. ἑκάεργος: (http://etymology_el_en.enacademic.com/2230/%E1%BC%91%CE%BA%E1%BD%B1%CE%B5%CF%81%CE%B3%CE%BF%CF%82).

37 *The Oxford Classical Dictionary, 4th ed.,* s.v. *"Asklepios."*

38 *Il.* 4. 194, 11. 518; ἀμύμων, "blameless," is significantly an epithet never used of the gods (*LSJ*).

39 Jouanna, 1999, 43.

in general. Asklepios' role as a context-specific witness is far more clearly defined than that of Apollo. Interestingly but not surprisingly, oaths sworn by Asklepios tended to be male oaths, as is precisely the case with *Oath*.[40]

Any ambiguity with Asklepios lies in the fundamental duality that underlies *pharmakon* as a tool of the medical practitioner, perhaps most poignantly expressed in Socrates' final words at the close of Plato's *Phaedo*.[41] This ambiguity is also evident in the contributions of the Asclepiads to the "holy wars."[42] Both these cases, in which *pharmaka* are used in human affairs to destroy human life, first in the name of justice and then in the name of military strategy, are addressed head-on by *Oath*: *I will not give any individual any drug that might result in death even if requested*. However, it is not so much ambiguity as duality that gave Asklepios his appeal: he has the status of both god and man, having been snatched from the womb of his mortal mother Coronis as she was consumed on the pyre, victim to the anger of either Asklepios' father Apollo, or possibly Apollo's sister Artemis. Humans were no doubt able to identify more with Asklepios than with Apollo; after all, Asklepios had craved immortality. While, in the hierarchical order of the Olympians, it is natural that Asklepios come second to Apollo (which is always the case on official inscriptions at Epidaurus),[43] of the four gods named as judges to *Oath*, Asklepios is the most essential entity in any consideration of ancient Greek medicine. Indeed, he is synonymous with the centers and practitioners of Greek healing: The blameless physician of the Iliad, where his deity is not in evidence, had become a cult that enjoyed vigorous expansion during the fifth and fourth centuries BC to the extent of virtually covering the Mediterranean world in Asclepian

40 Sommerstein and Torrance, 2014, 376.

41 Pl. *Phd*. 118: ὦ Κρίτων, ἔφη, τῷ Ἀσκληπιῷ ὀφείλομεν ἀλεκτρυόνα· ἀλλὰ ἀπόδοτε καὶ μὴ ἀμελήσητε. *Crito, we owe Asklepios a cockerel. Make sure our debt is paid*. With but a few minutes left to live, Socrates is aware that the *pharmakon* has had its desired effect and that now payment should be made. The dosage had been meticulously measured out, thus preventing Socrates from repaying his debt in the form of a libation.
Colin Wells, "The Mystery of Socrates' Last Words" *Arion* 16.2 Fall 2008.

42 Jouanna, 1999, 13.

43 Fritz Graf, "Healing (Chapter 34): Healing in the Temple: The Epidaurian Iamata and Related Texts," in *The Oxford Handbook of Ancient Greek Religion*, ed. Esther Eidinow, Julia Kindt (Oxford, 2015), 506.

incubation shrines. How the blameless physician became a god whose cult spread with such phenomenal speed and momentum is not fully understood. It is, however, significant that Asklepios was known to reveal himself to devotees as a deity *personally* concerned with their well-being.[44]

### 1.3 Hygeia, Panakeia, and all the gods

Unlike the Olympian Apollo and the heroic Asklepios, whose etymologies are obscured in the mists of time, Hygeia and Panakeia are respective personifications (*hypostases*) of health and universal remedy respectively. There is little ambiguity in either of these designations. The most frequently depicted daughter of Asklepios in the Asclepian cult, Hygeia had been the *epiklēsis* of Athena, and clearly the deity had a profound connection with healing.[45] An inscription tells us that Hygeia accompanied Asklepios to Athens in 420 BC.[46] Apollo, Asklepios, and Hygeia appear as a trio in a dedication from Epidaurus: Ἀπόλλωνι, Ἀσκλαπιῶι, Ὑγιείαι.[47] Interestingly, Aristophanes in his late work *Plutus* (388 BC), omits Hygeia, introducing the variation of Iaso (goddess of *recovery* or *recuperation*) and Panakeia accompanying Asklepios ministering to sufferers at an incubation sanctuary.[48] Hygeia and Panakeia, the third generation of the divinities invoked as judges to the oath-taking, both extend the unbroken genealogy and strike a balance with the two male divinities. The other offspring of Epione and Asklepios, namely the divine Iaso, Akeso, and Aegle are not invoked. The appeal of Hygeia lies in the *maintenance of health* through preventative medicine, while that of Panakeia lies in the *restoration of health* through remedy. There are no recorded

44 Anja Klöckner, "Getting in Contact: Concepts of Human-Divine Encounter in Classical Greek Art," in *The Gods of Ancient Greece: Identities and Transformations*, eds. Jan N. Bremmer and Andrew Erskine, (Edinburgh, 2010).

45 Jouanna, 1999, 323.

46 *Inscriptiones Graecae* II2. 4960a.

47 Jouanna 2018 (Budé I (2)), 10.

48 Aristoph. *Pl*. 701–702: οὔκ, ἀλλ' Ἰασὼ μέν τις ἀκολουθοῦσ' ἅμα / ὑπηρυθρίασε χὴ Πανάκειἀπεστράφη / τὴν ῥῖν' ἐπιλαβοῦσ': οὐ λιβανωτὸν γὰρ βδέω. While Asklepios does not react to Cario's farting, Iaso blushes and Panakeia turns away and holds her nose.

instances of Panakeia otherwise appearing with the other three deities named in *Oath*.[49] The order in which the gods are invoked naturally reflects the divine hierarchy, but also the characteristic of *Oath* to move from the general to the particular. The invocation also forestalls the structural balance and the striving for a universal inclusiveness that characterize *Oath*.

The expression θεοὺς πάντας τε καὶ πάσας is a dramatic flourish that indicates how universal ("all encompassing": Torrance[50]) *Oath* sets out to be. Apart from the enclitic (which allows it to trip splendidly off the tongue), instances of this formula occur in Xenophon[51] and Demosthenes,[52] although θεός is generic (as ἀδελφός later), making the τε καὶ πάσας emphatic yet strictly speaking unnecessary.[53]

The participial phrase ἵστορας ποιεύμενος requires that we supplement an object to precede the complement ἵστορας or take the preceding list of deities as the object of ποιεύμενος, in which case the deities become the objects of both ὀμνύω and ποιεύμενος.[54] It is interesting to speculate as to what degree ἵστωρ and μάρτυς (the more common word for *witness* in oaths) are indeed synonyms in this context. Sharing an identical etymology with the English "witness" (both the English and the Greek signifying *one who knows* or *one who is privy to critical knowledge*), ἵστωρ is certainly the less common word. Lycurgus uses ἵστωρ

49 von Staden, 2007, 432.

50 Isabelle C. Torrance, "The Hippocratic Oath," in *Oaths and Swearing in Ancient Greece*, Alan H. Sommerstein and Isabelle C. Torrance, (Berlin, Boston: De Gruyter, 2014), 379, retrieved 3 May. 2017, http://www.degruyter.com/view/product/43685.

51 Xen. *An*. 6. 1. 31 and 7. 6. 18.

52 Dem. *De cor*. 141.

53 See, for example, Xen. *Symp*. ὄμνυμι πάντας θεούς and Xen. *Cyr*. πάντας τοὺς θεούς, in addition to the famous instances in Eur. *Med*. 747: θεῶν τε συντιθεὶς ἅπαν γένος and 752: ὄμνυμι Γαῖαν Ἡλίου θ' ἁγνὸν σέλας / θεούς τε πάντας ἐμμενεῖν ἅ σου κλύω.

54 Alan H. Sommerstein, "The Language of Oaths," in *Oaths and Swearing in Ancient Greece*, Alan H. Sommerstein and Isabelle C. Torrance, (Berlin, Boston: De Gruyter, 2014), 76, retrieved 3 May. 2017, http://www.degruyter.com/view/product/43685.

with ποιεῖσθαι, while μάρτυρας with ποιεῖσθαι is far more common, occurring routinely in Thucydides.[55] In the *Iliad*, for example, ἴστωρ always tends toward *umpire* or *arbiter*, which might entitle us to regard this word as being the weightier of the two in the context of *Oath*.[56] Rather than equating the gods with simple *witnesses* to an oath, who do not normally punish any transgression, it is more accurate to see the gods as *arbiters*, who are more likely also to decide what punitive measures are to be taken against the transgressor.[57] The compound ξυνίστωρ is similarly used in tragedy, reinforcing the literary and dramatic nature of the word.[58] Jouanna (2018) denies that ἴστωρ is particularly poetic, seeing it rather as a characteristic of the underlying Ionic dialect.[59] Nonetheless, both subsequent reciters and readers of *Oath* would no doubt have felt a difference in register—an exalted, epic quality that ἴστωρ brings when compared with the Attic equivalent.

### 1.4 Verbal and written commitment (1.iii.)

The swearer promises to fulfill this (the following) oath and this (the following) contract (ξ(σ)υγγραφή: *written set of conditions*, introducing the dual nature of *Oath*: the verbal nature of an oath and the more lasting documentary nature of a contract) to the best of his ability and judgment. This contract was not simply a documentary version of *Oath*, but would have been drafted to reflect the circumstances of each of the swearers.[60] Jouanna (2018) notes that it is this pair of entities, the oath and the contract, that have the greatest

55 *The Peloponnesian War*, Book 1, chapter 78; Book 2, chapter 71; Book 4, chapters 28, 87.

56 "The old sacramental formula *ístō Zeús* is an appeal to the divinities as eyewitnesses and consequently as irrefutable judges ..." Center for Hellenic Studies, Harvard University, *The Oath in Ancient Greece*, https://chs.harvard.edu/CHS/article/display/3963.8-the-oath-in-geece, retrieved 5/5/2018.

57 Kenneth James Dover, *Greek Popular Morality in the Time of Plato and Aristotle* (Indianapolis: Hackett, 1994), 249.

58 Soph. *Phil*. 1293; Eur. *Supp*. 1174.

59 Jouanna 2018 (Budé I (2)), 14–15.

60 ibid., 16–17: "Le serment (ὅρκος) qui doit nécessairement être prononcé pour être efficace (même s'il est écrit) est le garant du «contrat» écrit (ξυγγραφή) qui a été rédigé entre le maître et le disciple et se trouve présent aussi (cf. τήνδε) lors de la prestation du serment. Ce contrat n'est évidemment pas la copie écrite du *Serment*, mais le contrat particulier a chaque disciple qui varie en fonction de ses biens et de ses ressources."

claim to our attention in interpreting *Oath* as a whole: the ξ(σ)υγγραφή being a significant legal device of the classical era, to which an oath was a verbal adjunct. Jouanna points to examples of the classical era from Demosthenes and Plato.[61] Consisting of individually tailored clauses varying in accordance with individual circumstances and the monetary sums involved, ξ(σ)υγγραφαί are, according to Jouanna, central not only to the interpretation of *Oath*, but also to any attempt to date it.

The adverbial phrase κατὰ δύναμιν is fairly standard in classical Greek (e.g., Hdt. 3.142), also appearing in the Corpus (*On Joints* and *Letters*)[62] as an adverbial phrase meaning *in as far as possible*. Although the phrase also appears in oaths of the Hellenistic period, the combination κατὰ δύναμιν καὶ κρίσιν ἐμὴν does not occur at any period.[63] Nonetheless, as a neat, economic turn of phrase, it is extremely effective and characteristic of *Oath*'s leanness of expression. While κρίσις in the *Hippocratic Corpus* is normally used to mean a *medical crisis*, the word is used twice in the sense of *judgment*.[64] Still, κατὰ κρίσιν, in the sense of *to the best of one's judgment*, is a rarity at any period.[65] Judgment regarding the timing of a physician's intervention surrounding medical crisis is a *critical* Hippocratic skill, a paramount element of *technē*. The expression κατὰ κρίσιν is therefore powerful in contextual associations. Κατὰ δύναμιν καὶ κρίσιν ἐμὴν also puts the person of the swearer emphatically at the center of *Oath* as one who strives to fulfill his potential through the application of

61 Jouanna 2018 (Budé I (2)), XXXII.

62 *On Joints* (listed by Erotian, end of fifth century or beginning of fourth) Littré *Art*. 4,106,14; 286,13. Loeb III, 224, 30; 364, 55. Letters (non-Erotian, first century at earliest) Littré *Ep*. 9,366,21: κατὰ δύναμιν ἰδίην « selon ce qu'il peut. »

63 von Staden, 2007, 436–7.

64 *Aph*. 1.1; *Morb*. 3.1.2 (excluding post-classical works) In the case of *Aph*. 1.1, ἡ δὲ κρίσις χαλεπή, while the meaning is clearly *judgement/decision is difficult*, it could equally in any other context be *the crisis is distressing*.

65 Polyb. 6.11.8 κατὰ κρίσιν means "deliberately" "as a result of the deliberate decision to do so."

individual will and personal responsibility: he calls on the gods as judges to his integrity, not as aids in his endeavor.

Extremely emphatic, the recurring ἐμὴν can but be interpreted as "my own personal" (i.e., being swayed by no other), thus reinforcing the element of personal commitment. Also, in this connection, we need to recall Sommerstein's observation that oaths administered by official bodies do not, as a rule, belong to the category of *omnumi oath*. Thus, the first person singular is exceptionally prominent from the very first word of *Oath*, which simultaneously demonstrates an official (in some respects at least) yet intensely personal register, successfully unifying these elements in a highly convincing format.

## 2. Conditions of the inter-generational transmission of *technē* (1.iv.–1.viii)

Following on from ποιήσειν as the first infinitive and direct object of ὀμνύω, the second infinitive ἡγήσασθαι initiates this relatively long grammatical unit. Unlike ποιήσειν, it is not, however, a future infinitive; it is aorist, as are the following κοινώσασθαι and ποιήσασθαι. Jones[66] notes that "manuscript authority in favour [of the aorists] is overwhelming." In *The Doctor's Oath* (1924), Jones leaves them as aorists, while emending them to future infinitives in his Loeb edition. Thus emended, the future infinitives, being consistent with ἐπικρινέειν and διδάξειν, also reinforce promissory nature of *Oath*.[67] However, it is worth bearing these aorist alternative readings in mind and considering the essential differences between the future infinitive and the aorist infinitive in this context.[68]

66 Jones, 1924, 43.

67 It is worth returning to the Greek grammars concerning the infinitive in ancient Greek:
Albert Rijksbaron. *The syntax and semantics of the verb in classical Greek*. The University of Chicago Press, 2006, 109, 44–45.
Herbert Weir Smyth. *A Greek grammar for colleges*, American Book Company, 1920: *§§*1998, *§§*1999, *§§*2024. Also see Jouanna 2018 (Budé I (2), 18).

68 The mixing of future and aorist infinitives is "not an uncommon usage" according to Edelstein. See Ludwig Edelstein, *Ancient Medicine: The Selected papers of Ludwig Edelstein*, ed. Oswei Temkin and C. Lilian

Jouanna makes the most sense in this regard when he remarks that it seems unlikely that the original had a neat string of future infinitives, some of which were subsequently rewritten as aorist infinitives. He therefore recommends leaving the mixed sequence as it is rather than emending for contrived coherence.[69]

At all events, this passage brings us to the specifics of ὅρκος ὅδε καὶ ξυγγραφὴ ἥδε in respect of what von Staden describes as "the socio-pedagogic dimensions"[70] of the oath-taker's *technē*. In this sense, therefore, *Oath* turns from the divine to the human and the obligations that bind the three generations of practitioners of *technē*: the oath-taker himself, his forbears and his offspring, or successors, the demigod Asklepios being the bridge in the professional lineage, linking the divine and the human.

## 2.1 Transmitters of *technē* to be viewed as having parental status (1.iv.)

While one would expect ἶσον, which would parallel the following ἀδελφοῖς ἶσον, ἴσα, a neuter plural, is a common adverbial from Homer onward, although, as von Staden points out, it occurs but once elsewhere in the *Hippocratic Corpus*, where it is distinctly Hellenistic. Likewise, διδάσκειν with a double accusative is predominantly Hellenistic in the Corpus.[71] Nonetheless, each of these has sufficient precedent in classical Greek. What is significant is the noun γενέτης, which the context requires that we translate *parents* or *begetters*. There are, however, instances of γενέτης[72] having been used in the sense of

Temkin. (Baltimore and London: The Johns Hopkins University Press, 1967, note 160), 49. Edelstein also takes up in the same note the significance of the grammatical shift from infinitive to clause including future finite verb in the first person: "that it is indicative of an original independence of the two sections is quite possible."

69 Jouanna, 2018, 18 (Budé I (2), 18): "Il paraît peu vraisemblable qu'il y ait eu à l'origine une séquence régulière d'infinitifs futurs qui ait été transformée de façon si irrégulière en infinitifs aoristes. Il vaut mieux laisser le texte tel qu'il est, plutôt que reconstituer une cohérence qui risque d'être artificielle."

70 von Staden, 2007, 438.

71 von Staden, 2007, 439–440.

72 For Erotian's gloss on this lexical item, see Jouanna 2018 (Budé I (2)), XIII, CXVIII–CXIX.

ancestors and male offspring, which incidentally reinforces the inter-generational currents and elevated ring that pervades *Oath*.[73] *Technē*, at once diachronic and synchronic as the professional core of *Oath*, is qualified by the demonstrative οὗτος, not infrequently to be differentiated from ὁδέ, the demonstrative used with *oath* and *covenant* immediately preceding. Οὗτος rather suggests that we know largely what is involved.[74] Interestingly, *Ambrosianus* gives τήνδε rather than ταύτην.

## 2.2 Communal brotherhood (1.v.)

Hard on the heels of τέχνη comes βιός (*bios*, object of the third infinitive κοινώσασθαι), a word closely bound up with *technē* in *Oath* and here most likely to be interpreted as *livelihood*, which the swearer promises to share with the one who has taught him the *technē*. Κοινώσασθαι and μετάδοσιν ποιήσασθαι are differentiated despite having a degree of semantic overlap, leading to both often being rendered "share." This differentiation is significant in how we interpret *bios* in this context. The verb κοινόειν occurs nowhere else in the Hippocratic texts, whereas we do find relatively frequent instances of the similar verb κοινωνεῖν—for example, in relation to the working of joints.[75] In classical Greek generally, this verb can denote communal participation in something, as κοινόειν might be interpreted as doing here. Κοινώσασθαι is an aorist *middle* infinitive rather than the future active infinitive

73 Jones, 1924, 44-45: "It should be noticed that all the linguistic peculiarities of Oath occur in the passage that bind the apprentice to his guild." A rare occurrence in Classical literature occurs in Euripides (*Or*. 1011), where it can only be interpreted as *my son*.

74 Egbert J. Bakker, "Pragmatics: Speech and Text, Deictics in speech" in *A Companion to the Ancient Greek Language* ed. E. J. Bakker (Wiley, 2010), 153–154.

75 *Index Hippocraticus*, 1989, s.v. κοινωνῶ.

we might have expected.[76] Might not the middle voice here express *reciprocity*? After all, if we think of livelihood as "a means of securing the necessities of life,"[77] then we would have a degree of repetition with these two verbs of sharing, repetition which is uncharacteristic of our sparsely worded *Oath*. Might not κοινώσασθαι be expressing a form of communal living that extends beyond the sharing of daily necessities into the sharing of the more abstract—ideas, values, culture? At all events, *to share one's life/livelihood* is a rare and striking expression, inevitably bringing to mind the κοινόν (*koinon*: association of physicians) constituted by the male lineage of the Asclepiads,[78] which is, in revolutionary fashion, being redefined here in terms of *bios* and *technē* both.

Χρέος often indicates an obligation or debt that needs to be paid, but in this context, the plural rather denotes that which is necessary in the course of *bios*, or according to *LSJ*, "anything useful or serviceable." Jouanna (2018) comments that χρέος belongs to the Ionic Greek of the classical period, occurring five times in Herodotus.[79] The lack of determiner must be significant in exactly how we interpret *bios* in this instance. This also goes for the presence and absence of determiners (possessive adjectives and articles) with the operative nouns throughout *Oath* as a whole, which is not strictly consistent. As noted above, the lack of definite article, in conjunction with the middle voice of the infinitive might enable us to interpret βίου κοινώσασθαι as something wider and more reciprocal than *share my livelihood* in this context, extending to "shared values in life." It is not going too far to see in this striking phrase multiple individual synchronic entities (*bioi*) acting reciprocally in the service of the diachronic *technē*.

76 Interestingly, κοινωνεῖν is middle in its future form, and also has a stronger tendency to take a genitive of the thing shared.
77 English Oxford Living Dictionaries: https://en.oxforddictionaries.com/definition/livelihood.
78 Jouanna, 1999, 51–2.
79 Jouanna 2018 (Budé I (2)), 20.

Μετάδοσιν ποιέω, equivalent of μεταδίδωμι,[80] echoes κοινόω, both taking a genitive of the thing shared.[81] Von Staden[82] points to Deichgräber's illuminating suggestion of an allusion to Hesiod.[83] Whatever the truth of the matter, this passage in Hesiod is a fine example of βιός in the sense of *livelihood*, informing and illuminating the interpretation of this crucial word, which von Staden discusses at length.[84]

### 2.3 Redefining lineage (1.vi.)

The hefty and portentous phrase γένος τὸ ἐξ αὐτοῦ is consistent with the exalted (epic) register of *Oath*, also being a characteristic expression of curses.[85] While this turn of phrase is thus highly consistent with the formal genre of the oath, we might have expected to see it somewhat later—in expressing the element of self-curse that normally concludes an oath. Γένος does have the meaning of offspring in classical Greek, although this is predominantly poetic.[86] Also, γένος is highly resonant as a term in the sense of the Asclepiad *lineage*.[87]

Ἄρρεσι is thrown into an emphatic position as if to stress "maleness" as a condition of what could be a generic use of the noun. This adjective would normally be redundant, except that here it expresses maleness as a crucial condition.[88] This expression is strongly reminiscent of κατ' ἀνδρογένειαν, the extremely rare noun common to the speech of

80 Geoffrey Horrocks, *Greek: A History of the Language and its Speakers* (Wiley-Blackwell, 2010), 75.

81 Notable in this context is the usage of Galen at *Opera* II, 280: καὶ τοῖς ἔξω τοῦ γένους ἔδοξε καλὸν εἶναι μεταδιδόναι τῆς τεχνῆς...ἐκοινώνουν τῆς τεχνῆς.

82 von Staden, 2007, 441.

83 Hes. *Op*. 499, 501.

84 von Staden, 1996, 419–423.

85 von Staden, 2007, 441, who, while citing instances of curses containing this phrase, also notes that the *Hippocratic Corpus* contains no other instances of the word in the sense of *offspring*.

86 Significant combination of γένος καὶ οἰκίαν, in the setting of a curse, is found in Demosthenes: Dem. 19.71.

87 Jouanna 2018 (Budé I (2)), XIII.

88 See Jones, *Hippocrates II*: regarding ἠδελφισμένος in *Precepts* V. Edelstein (*Ancient Medicine*, 46) suggests the translation "brothers of male lineage."

Thessalus in *Speech of the Envoy* (*Or.Thess.* 9.416.17) and an inscription from Delphi.[89] It is this latter that reveals the existence of a κοινόν comprising Asclepiads of both Cos and Cnidus, although *Speech of the Envoy* had indicated only Cos. Κοινόν, a *league* or *association*, is also strongly suggestive of siblinghood and shared interests (cf. βίου κοινώσασθαι).

## 2.4 Immunity from fees and contracts (1.vii.)

Μισθός is the word used for fee or payment in Plato's *Protagoras*.[90] Χρηίζω occurs for a second time in a brief space; while the first instance suggests need, this second instance indicates desire, which accounts for the infinitive that follows as object.[91] This verb is important in that it stresses personal desire to learn or individual calling to the profession rather than descent from the ancestors of Asklepios. Διδάσκειν, hitherto in the form of an aorist participle referring to the one who *taught* the swearer, now assumes futurity in the form of the future infinitive with the swearer as notional subject, undertaking to teach the healing craft to such as may wish to learn it, as if to unify the past, the present and the future into a lineage of shared knowledge, shared livelihood, and shared values to be augmented with each passing generation or unit of *bios*.

89 Jean Bousquet, "Inscriptions de Delphes (7. Delphes et les Asclepiads)," *BHC* 80 (1956), 579–591.

90 For physicians and teaching in Plato, see Plat. *Laws* 4.720 and Plat. *Prot*. 311b.

91 von Staden: "unique within the Corpus." However, the use with an infinitive has an elevated tone in keeping with *Oath*. For example, Aesch. *PV 235, 285*. Also, of incidental contextual interest (though indicating need with genitive nouns) are: Hom. *Il*. 11. 835: χρηΐζοντα καὶ αὐτὸν ἀμύμονος ἰητῆρος (of Machaon himself) and Hes. *Op*. 499, 501: χρηίζων βιότοιο, κακὰ προσελέξατο θυμῷ. / ἐλπὶς δ᾽ οὐκ ἀγαθὴ κεχρημένον ἄνδρα κομίζει, / ἥμενον ἐν λέσχῃ, τῷ μὴ βίος ἄρκιος εἴη.
Jouanna (2018) (Budé I (2)), 20–21 comments that this verb is a familiar presence in Herodotus, 18 times in all: four times with the genitive and three times with the infinitive.

## 2.5 Who qualifies for transmission of *technē*? (1.viii.)

Here we have the specifics of what is involved in the transmission of the *technē* to aspirants from a variety of possible backgrounds in addition to the hereditary lineage.[92] The same periphrasis for *sharing* occurs again within a short space of time. The sharing described occurs over three generations, as if to reflect the three generations of gods named as guarantors. Significantly, the first to be shared is παραγγελία (παραγγελίη, rare Ionic form), which, although meaning a *set of rules* or *precepts* in this context, retains connotations of παραγγέλλω, with its original meaning of *transmitting* or *passing on a message*. Miles very plausibly equates these rules with "medical precepts such as the diagnostic, therapeutic and prognostic inferences contained in works like *Aphorisms*, *Precepts*, or *Prorrhetic I*."[93]

Παραγγελία (παραγγελίη) in the plural form appears, of course, as the title of the work *Precepts*,[94] but nowhere else in the Hippocratic texts. An interesting instance of the word occurs in Aristotle's *Nikomachean Ethics*, where it signifies "professional tradition" and is used in tandem with τέχνη.[95] Ranging from *command* to *advice*, παραγγελία also seems to have a ring somewhat similar to our *manual*.

Ἀκρόασις, literally *that which is listened to*, is used in the sense of a *lecture*. The only other unquestioned occurrence of the word in the Corpus is in *Precepts*.[96] Polybius also uses the word in this sense,[97] which is otherwise uncommon and predominantly post-classical. Jones interprets this word as some reference to esoteric teaching.[98] Miles comments that the

92 Jones, Loeb II, 276 (in his introduction to *Decorum*): "Precept, oral instruction and all other teaching," is a curiously verbose expression, and may very well allude, among other things, to mystic λόγοι imparted to initiated members of a physicians' guild."

93 Miles, 2004, 36.

94 Jouanna 2018 (Budé I (2)), 23: "C'est un traité déontologique [*Préceptes*], mais trop récent pour apporter quelque lumière sur le Serment."

95 Arist. *Eth*. *Nic*. 1104a: οὔτε γὰρ ὑπὸ τέχνην οὔθ' ὑπὸ παραγγελίαν οὐδεμίαν πίπτει.

96 *Praec*. 12. See Jouanna 2018 (Budé I (2)), 23.

97 Plb. 32.2.5.

98 Jones, 1924, 46.

term in this setting "refers to synthetic presentations by respected teachers as exemplified by *Prognostic*, *Joints*, or *Fractures*."[99]

Μάθησις signifies the act of learning, education or instruction, which Miles believes "may refer to speculations about the science of medicine." Herein lies *Oath*'s link with the contents of the *Hippocratic Corpus*, namely a gathering of teaching materials, whether lecture notes, textbooks, research findings or essays on wider philosophical themes.[100] In its broadest interpretation, we could see this as involving teaching from texts, teaching orally, and teaching in a clinical setting. Jouanna admits that the designation of this word can not be pinned down, but suspects that it largely has to do with *practical* learning.[101] The swearer is hereby committing himself to the dissemination of both transmitted knowledge and personal insights through lecturing and writing. Παραγγελία is the *technē* as handed down to the present. Ἀκρόασις is the transmission of knowledge in the present, while such ἅπασα μάθησις as remains is the *technē* augmented in a universal setting. This sequence of nouns is characteristic of *Oath* in its comprehensiveness and awareness of chronological flow.

Not only does the undertaking to share include sharing with the sons of the swearer and with the sons of the one who has instructed the swearer, but it also extends to the obligation to share with any pupil bound by the act of swearing and of becoming a signatory to a contract. A standard word in classical Greek for disciple or apprentice, μαθητής, is otherwise used in the Corpus only in the late works *Prorrheticus II* and *Decretum*.[102] Here it is qualified by two participles, dramatic reminders of and parallels to *Oath*'s portentous opening:

99 Miles, 2004, 36.

100 Jones, Loeb I, xxii: "In the first place the heterogeneous character of the Corpus should be observed. It contains:

(1) "Text-books for physicians; (2) Text-books for laymen; (3) Pieces of research or collection of material for research. (4) Lectures or essays for medical students and novices. (5) Essays by philosophers who were perhaps not practising physicians, but laymen interested in medicine and anxious to apply to it the methods of philosophy. (6) Note-books or scrap-books."

101 Jouanna 2018 (Budé I (2)), 23: "Ce qui constitue le reste de l'enseignement n'est pas précisé: on pense surtout à l'enseignement pratique."

102 *Index Hippocraticus*, 1989, s.v. μαθητής.

ἐπιτελέα ποιήσειν ... ὅρκον τόνδε καὶ ξυγγραφὴν τήνδε. Συγγεγραμμένος is the perfect participle of the middle συγγράφεσθαι, while ὡρκισμένος is the perfect participle passive of the verb ὁρκίζειν, a causative verb that literally means "make swear."[103] The participles clearly express the resultative / perfective aspect of both verbs, namely "once they have put their signature to a contract and have been *sworn in*." The difference in the voice of the two verbs is intriguing, ὡρκισμένος reminding one of ἠδελφισμένος at *Precepts V*. The dative adverbial νόμῳ ἰητρικῷ is to be taken as modifying both συγγεγραμμένος and ὡρκισμένος. Given the legal importance of the contract set before the swearer of *Oath*, it makes sense that νόμῳ ἰητρικῷ apply just as much to συγγεγραμμένος. Von Staden discusses in some detail the expression νόμῳ ἰητρικῷ.[104] Rarity though the collocation νόμος ἰατρικός is, ἰητρική τέχνη is the central theme of what Jones describes as the "quaint little piece called *Law*" (Νόμος), enabling us to see the phrase νόμος ἰατρικός as representing the conditions conducive to the ideal attainment of ἰητρική τέχνη.[105] In the treatise Νόμος, however, the word νόμος makes no appearance other than in the title; nor is the phrase νόμος ἰατρικός anywhere to be found. Yet, surely *Oath* sees itself as the embodiment of νόμος ἰατρικός. Νόμος and *Oath* are inextricably bound up with δίκη, whose original significance leans heavily toward *custom*, *usage*.[106] Interestingly, at *Fractures VII*, νόμος is qualified by δίκαιος to indicate "correct procedure." Νόμος is frequently used in the treatises concerning the

103 Interestingly, ὁρκίζω, having since lost its causative nature, is used in the modern Greek translation of *Oath* as the equivalent of ὄμνυμί/ὀμνύω.

104 von Staden, 2007, 441–442.

105 Jones, Loeb II, 275: "Note that allusion is made to νόμος ἰατρικός, and that it is at the end of our Νόμος that the reference to initiation occurs."

106 Dover, 1994, 253: The relationship of νόμιμος (in accordance with customary procedure) and ὅσιος is telling.

treatment of joints and fractures[107] to signify procedure, and although it is overwhelmingly used in the singular, it *is* used in the plural when indicating a number of different procedures (*Mochl.* 41). This makes it less likely that *procedure* is the meaning here in *Oath*, where the singular is more likely to mean something nearer *code of practice*.[108]

This stipulation governing the scope of sharing closes with a negative, the first to appear in *Oath*: ἄλλῳ δὲ οὐδενί, which can be interpreted in two ways. Von Staden translates the dative thus: "—to my sons and the [sons] of him who has taught me and to the pupils who have both made a written contract and sworn by a medical convention but *by no other*," whereas a more traditional interpretation is the one we find in Jones[109]: "—to my sons, to the sons of my teacher, and to pupils who have signed the indenture and sworn obedience to the physicians' Law, but *to none other*." Jouanna (2018) likewise translates as "—et *à nul autre*." Whichever of these interpretations is the more consistent with the original intent of *Oath*, it constitutes a stricture, a limitation to what is otherwise a generous opening up of the Asclepian hereditary guild, while at the same time committing the swearer to what is the first of two pledges to professional secrecy.

## 3 Principles of therapy (2.i.–5.ii.)

This section of *Oath* turns to specific questions of medical practice. The change in theme is signaled grammatically: infinitives as object of *I swear* give way to finite verbs in the first person singular. It is significant that the first sentence of this section marks its transitional nature by creating a grammatically awkward combination of a finite first person

107 *Off.* 8, *Fract*. 7, *Art*. 18, 87.

108 Jouanna 2018 (Budé I (2)), 22. notes that ὡρκισμένοισι νόμῳ ἰητρικῷ is probably echoed in Scribonius Largus' Epistula 3–4: "Idcirco ne hostibus quidem malum medicamentum dabit qui sacramento medicinae legitime est obligatus..."

109 Jones, 1924, 9.

future and a future infinitive.[110] The sequence of what the swearer undertakes to do and not to do is: I WILL > I WILL > I WILL NOT > I WILL NOT >I WILL NOT > I WILL > I WILL NOT > I WILL.

Accompanying this grammatical shift there comes a thematic change of direction from social obligations to pledges regarding specific areas of medical therapy. The first sentence of this transition is significantly hybrid in nature, containing a finite first-person future χρήσομαι, harking forward and then reverting fleetingly to a future infinitive εἴρξειν, as if to direct our gaze backwards.

### 3.1 All manner of regimen (2.i.)

The neuter plural διαιτήματα,[111] like the feminine singular διαίτα, in a medical context most often signifies a mode of living or regimen,[112] whether constituting diet or otherwise.[113] While much attention has been devoted to such "prohibitions" as appear in *Oath*, which are nothing more than personal pledges to avoid certain conduct, not enough weight has been given to this positive commitment of the swearer to avail himself of ***all*** [kinds of]

110 Jouanna 2018 (Budé I (2)), 24: remarks on this mix of finite verb and infinitive thus: "On laissera l'alternance entre le mode personnel et l'infinitif sans chercher à corriger un texte dont la souplesse est parfois déroutante."

111 For the collocation διαιτήμασί τε χρῆσθαι as used in the Corpus, see von Staden, 2007, 443. διαιτήμασί (διαίτῃ)...χρῆσθαι is regularly used in *Regime I*, the verb χρῆσθαι also being used with the adjuncts of regimen.

112 For a caution regarding the "semantic field covered by *diaita*, see Hynek Bartoš, *Philosophy and dietetics in the Hippocratic "On Regimen": a delicate balance of health* (Leiden: Brill, 2015), 14.

113 When the writer wants to be more specific or amplify the meaning, for example, he will augment διαιτήματα/διαίτα/διαιτητική (e.g., *Hp.Acut.(Sp.)54*) / διαιτῶμαι with ἐσθίω, πίνω, προσφέρομαι, τροφή etc. Types of food (σιτία) and drink (ποτά) and an intermediate form of nourishment known as ῥύφημα (soup / gruel) are the elements of diet. Elements of diet are seen by the author of *Regimen I* (Loeb IV, 226) as each having a natural potency as well as a potency through the agency of human τέχνη. A similar distinction is made (ibid.) between types of exercise – natural and artificial – which must be used in the correct proportion to food, constitution, age, location, season and climate. As far as the translation of διαιτήματα goes, Edelstein translates this as "dietetic measures" (Ludwig Edelstein, *Ancient Medicine* (Baltimore and London: Johns Hopkins, 1967), 6.) while von Staden translates as "regimens" (von Staden, 1996, 407). Jones, on the other hand, simply says "treatment" (Jones, Loeb, 1939, 299) and Temkin says "dietetic regimens" (Owsei Temkin, "*On Second Thought" and Other Essays in the History of Medicine and Science* (Baltimore/London: Johns Hopkins University Press, 2002), 23). Jouanna translates as "(tout) le régime" Jouanna 2018 (Budé I (2)), 3.

regimen (dietetic treatment). After all, what is more central to the Hippocratic world of medicine than how the writers viewed regimen itself both as part of *technē* and the philosophy that imbued *technē*?

When the writer of *Ancient Medicine* states that only medicine will lead to a clear understanding of "natural science," he points to the duty of the physician as lying in the study of what man is in relation to what he drinks and eats and in his relation to his routine pursuits.[114] It is these elements that are the subject of regimen. The evidence from the *Hippocratic Corpus* frequently shows regimen to have taken the form of a diet prescribed in stages and designed to correspond to such stages of the patient's condition as led up to and away from the crisis. The estimation of when the crisis is most likely to occur (timing = καιρός[115]) is a crucial element of διαιτητική (and thus *technē* as a whole). *Regimen in Acute Diseases* particularly reinforces the impression that of the three elements of nutrition (solids, soups (semi-liquids), and liquids), solids were avoided surrounding crisis while diet was particularly sparse preceding crisis (ἄχρι ἂν κριθῇ ἡ νοῦσος). This treatise and *Ancient Medicine* give a similar description of the significance of considering diet, the former asserting that such inquiries are pertinent to the greater part of the most essential elements of *technē*, being *conducive to health in cases of illness, to freedom from illness in states of health, to good condition in athletes in training, and to attaining whatever state anyone should wish*.[116] Similarly, the author of *Ancient Medicine* sees an awareness of the properties

114 *VM*. Budé II (1), (XX), 146, 17–19: ὅ τί τέ ἐστιν ἄνθρωπος πρὸς τὰ ἐσθιόμενά τε καὶ πινόμενα καὶ ὅ τι πρὸς τὰ ἄλλα ἐπιτηδεύματα.

115 Κρίσις (medical crisis), κρίσις (judgment), and καιρός (timing of medical intervention) are inextricably bound in Greek medicine.

116 *Acut*. Loeb II, (IX) 70, 1–6: πάγκαλον εἶναι τοῦτο τὸ σκέμμα καὶ ἠδελφισμένον τοῖσι πλείστοισι τῶν ἐν τῇ τέχνῃ καὶ ἐπικαιροτάτοισιν: καὶ γὰρ τοῖσι νοσέουσι πᾶσιν ἐς ὑγείην μέγα τι δύνασθαι, καὶ τοῖσιν ὑγιαίνουσιν ἐς ἀσφαλείην, καὶ τοῖσιν ἀσκέουσιν ἐς εὐεξίην, καὶ ἐς ὅ τι ἂν ἕκαστος ἐθέλῃ.

and nature of nutriment as essential, for, he maintains, it is upon these that the *entire life* of men depends whether *in health*, *in recovery* or *in sickness*.[117]

In the Hippocratic treatise *Regimen I* (end of fifth century or first half of fourth century), the claims made for regimen are medically and philosophically of great significance: used correctly (εἰ δε ὀρθῶς διαιτῷ(ν)το), regimen can improve even the innate disposition of a person. *Regimen I* states that administration of an effective regimen is thought to benefit the constitution of the soul by improving the balance of the dual fundamental elements of living organisms: water (the cold, humid nourishing force) and fire (the hot, dry mobilizing force).[118] For example: "Given the right kind of regimen, a patient will become even more intelligent and astute than his natural disposition."[119] Again, we see that the innate properties of the soul can be *improved* or *refined* through regimen: εἰ δε ὀρθῶς διαιτῷντο, βελτίους γίνοιντο ἂν καὶ οὗτοι.[120] Conversely, bad regimen will cause deterioration of the soul.[121]

In certain places, the *Hippocratic Corpus* suggests that dietary medicine was a relatively recent innovation in contrast with other more traditional interventions.[122] As we have just seen, however, it is clear that the writer of *Ancient Medicine* saw a consciousness of the role of regimen as the necessary origin of the medical art itself.[123] Yet, the concept of regimen, or dietetics, has in the treatises of the Corpus evolved into a therapeutic speciality independent, say, of even purging, venesection (which naturally involves *cutting*), and certain

117 *VM*. Budé II (I), (XIV), 135, 11–13: καὶ διὰ τούτων πᾶς ὁ βίος καὶ ὑγιαίνοντι καὶ ἐκ νούσου ἀνατρεφομένῳ καὶ κάμνοντι.

118 "It is the *blending* that causes 'intelligence' or the lack thereof": *Vict I*: Περὶ μὲν οὖν φρονίμου καὶ ἄφρονος ψυχῆς η σύγκρησις αὕτη αἰτίη ἐστίν...(Loeb IV (XXXVI) 292, 1–2).

119 *Vict. I*: εἰ δε ὀρθῶς διαιτῷτο, καὶ φρονιμώτερος καὶ ὀξύτερος γένοιτο. (Loeb IV (XXXV) 282, 25–26)

120 *Vict. I*: Loeb IV (XXXV) 286, 69–70.

121 βελτίων δε καὶ οὗτος ὀρθῶς διαιτεόμενος γίνοιτο ἄν, καὶ κακιῶν μὴ ὀρθῶς. (Loeb IV, (XXXV) 288, 92–93).

122 *Acut*. Loeb II (III), 64, 4–6), from which we can gather that regimen was initially no great concern of the Cnidians.

123 *VM*. Budé II (1), (III), 120–121.

pharmaceutical interventions.[124] A medically prescribed diet was seen as quite distinct from medicating, purging, cauterizing or surgery.[125] Nonetheless, given that a considerable amount of what we know of Hippocratic dietetics is found in *Regimen in Acute Diseases*, it is necessary to remember that regimen can variously indicate therapeutic dietetics, scrupulously timed interventions surrounding crisis, and regimens prescribed in therapy of non-critical ailments. In addition, the final nine chapters of *Nature of Man* (*Regimen in Health*, Loeb IV, 43–59) deal with regimen as a means of *maintaining* health by varying intake of fluids and solids according to age, season, physique and so on.

By their very nature, regimens generally took time as somewhat prolonged courses of treatment, involving not only diet, but other aspects of lifestyle (ἐπιτηδεύματα) such as exercise, bathing, sleep, clothing, administering of emetics and clysters, and sexual conduct.[126] For example, adjuncts of regimen that figure in *Regimen I* XXV alone include: runs (δρόμοι), massages (τρίψεις), wrestling (πάλη), walks (περίπατοι), vomiting (ἔμετοι), purging (καθαίρεσθαι), unction (χρίεσθαι), bathing (λούεσθαι), sexual intercourse (λαγνεύειν), exercise (πόνοι/γυμνασία), and vapour baths (πυριᾶσθαι). It is also worth considering to what extent praying (εὔχεσθαι) and other religious conduct played a part in what was regarded as regimen.[127] Prayer certainly appears to be an adjunct of regimen, as is suggested by *Regimen IV*, which ends thus: "A person who follows these recommendations as they have been recorded will experience a life of health. Indeed, I have discovered regimen, in as far as

124 Bartoš, 2015, 100–102.
125 See 187 and 188.
126 Jouanna, 1999, 161–162. Also *De Arte*, Loeb II*, (V)* 196, 14–18, where proof of the existence of *technē* is evinced in regard to what a patient *does* or *does not do* in his daily life even without medical intervention.
127 G. E. R. Lloyd, *In the grip of disease: studies in the Greek imagination* (Oxford: Oxford University Press, 2008). See also Jouanna, Van Der Eijk, and Allies, 2012, 110 concerning the exceptional combination of prayer with the rational.

it is possible for a mortal to discover it, with [the aid of] the gods."[128] In fact, there are only two other places in the *Hippocratic Corpus* where Apollo, principal witness to *Oath*, makes an appearance, one of these also being in *Regimen IV*. Here, interestingly, it is prescribed that, in conjunction with modified regimen (ἐκδιαιτᾶσθαι), prayers be made to Apollo whenever "heavenly signs" are propitious.[129]

In contrast, Plato's view of the relatively new dietetic approach is divided. On the one hand, he has Socrates speak favorably of "curing the part along with the whole" in the *Charmides*.[130] Conversely, however, the *Republic* reveals Plato as one who views the practice of dietetics (μακρὰν δίαιταν) as contrasted with the patient's customary diet (εἰωθυῖαν δίαιταν) or swifter interventions such as medication, purging, cauterizing or surgery (φάρμακον πιὼν ἐξεμέσαι τὸ νόσημα, ἢ κάτω καθαρθεὶς ἢ καύσει ἢ τομῇ χρησάμενος) as an impediment to the smooth working of society: normal diet will either restore a patient or kill him; either way is preferable to neglecting one's work.[131] However one regards the matter, such forms of treatment would presumably have been the preserve of those with sufficient leisure to fulfill the prescription.

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128 The final sentence of *Regimen* IV, Loeb IV, 446: τούτοισι χρώμενος ὡς γέγραπται, ὑγιανεῖ τὸν βίον, καὶ εὕρηταί μοι δίαιτα ὡς δυνατὸν εὑρεῖν ἄνθρωπον ἐόντα σὺν τοῖσι θεοῖσιν.

129 *Vict. IV*: Loeb IV, 436, 128–131: καὶ τοῖσι θεοῖσιν εὔχεσθαι, ἐπὶ μὲν τοῖσιν ἀγαθοῖσιν Ἡλίῳ, Διὶ οὐρανίῳ, Διὶ κτησίῳ, Ἀθηνᾷ κτησίῃ, Ἑρμῇ, Ἀπόλλωνι ...

130 Pl. *Chrm.* 156b3-c6. See also Pl. *Tim*. 89C: διὸ παιδαγωγεῖν δεῖ διαίταις πάντα τὰ τοιαῦτα, καθ' ὅσον ἂν ᾖ τῳ σχολή: That is, *regimen is to be preferred to medication for the "control" of disease providing one has the time*.

131 Pl. *Resp*. 3.15 (406d-e). Totelin (Laurence M. V. Totelin, *Hippocratic recipes: oral and written transmission of pharmacological knowledge in fifth- and fourth-century Greece: Studies in ancient medicine* (Boston: Brill, 2009), 132.) also points to Aristophanes' *Frogs* (*Ra*. 936–943), where current dietetic terms are used mockingly. (Ἀλλ' ὡς παρέλαβον τὴν τέχνην παρὰ σοῦ τὸ πρῶτον εὐθὺς\οἰδοῦσαν ὑπὸ κομπασμάτων καὶ ῥημάτων ἐπαχθῶν\ἴσχνανα μὲν πρώτιστον αὐτὴν καὶ τὸ βάρος ἀφεῖλον\ἐπυλλίοις καὶ περιπάτοις καὶ τευτλίοισι λευκοῖς\χυλὸν διδοὺς στωμυλμάτων ἀπὸ βιβλίων ἀπηθῶν: \εἶτ' ἀνέτρεφον μονῳδίαις)

Given that the version of *Oath* adopted by Jouanna (See note 9.) and von Staden reflects *Ambrosianus* and *P. Oxy.* XXXI 2547[132] by adding πᾶσι after regimens, it is all the more necessary when interpreting διαιτήματα to bear in mind the myriad facets of this term as evinced in the Corpus, and particularly the distinction between short-term dietetic interventions and regimens designed to be effective over the long term both for therapy and maintenance of health.

### 3.2 Guarding patients from harm and injustice (2.ii.)

This is a cardinal phrase in *Oath*, though it is somewhat cryptic in terms of language. Εἴργειν is by nature a transitive verb. It is therefore necessary to expand the statement thus: "to guard [them] [from that which is] to [their] harm and injustice." Perhaps the most famous use of this verb in the sense of *shutting out* or *keeping at a distance* can be found in the plea to Achilleus by the ghost of Patroklos.[133] Εἴργειν occurs with relative frequency and in a variety of guises in the Corpus, meaning *keep in* (*retain*), *keep out* / *away from*, or *abstain from*.[134]

Miles points out that "it seems quite unlikely that the parsimoniously written *Oath* would use *benefit the ill* and *guard them from injustice* to make a single point," concluding that the thrust of ἀδικίῃ εἴρξειν constitutes "a commitment to a medical ethic that looks outward to improve the public health by engaging public policy that unjustly harms health."[135] While such a reading is insightful, ἀδικίῃ εἴρξειν also foreshadows the personal pledges of self-restraint that come later in *Oath*: in other words, an implicit undertaking to safeguard patients from wrongdoing at the swearer's own hands (*abstain*), as well as any injustice from

132 See Jones, 1924, 18: "A few of its [*Ambrosianus*'] are merely errors, but the majority show that our vulgate represents but one line of descent, and that probably not the best."
133 *Il.* 23.72.
134 *Index Hippocraticus*, 1989, s.v. εἴργω.
135 Miles, 2004, 58-63.

without (*protect*). This turn of phrase is comprehensive, but certainly not prolix: for it is conceivable that physicians might *benefit* patients in terms of medical outcome without protecting them other forms of trickery and exploitation. In other words, *Oath* here calls on the swearer to pledge both excellence of *technē* and *bios* (character) in dealing with the suffering. The construction with εἴργειν here is highly elliptical, but *to keep someone away from something* or to *keep something away from someone* conceivably involves an element of coercion. If, however, we accept the reading of *Ambrosianus* at this point,[136] κατὰ γνώμην ἐμήν would mean *to the best of my conscience* (a well attested interpretation of γνώμη) just as much as *to the best of my judgment.*[137] Here ἀδικίη is coupled with δήλησις, both being set in contrast with ὠφελεία. Of a common origin with our word *deleterious* (τὸ δηλητήριον meaning *poison* in the apocryphal *Letters*[138]), δήλησις signifies that which is injurious both to health and to well-being in general, having much in common with φθόριος, especially when echoed by φθορῆς τε τῆς ἄλλης at 6.ii.[139] Δήλησις is used in Herodotus with the preposition ἐπί to mean the *general intent to harm someone*.[140]

136 von Staden, 2007, note 8 (428) and note 76 (443).

137 See, for example, Aesch. *Eum*. 674: ἀπὸ γνώμης φέρειν ψῆφον δικαίαν ("with a good *conscience*," *LSJ)* and Ar. *Ran* 355: ὅστις γνώμῃ μὴ καθαρεύει "has not a clear *conscience*," *LSJ*). The latter instance is more recently translated "pure mind," which has great bearing on the discussion of ἁγνῶς δὲ καὶ ὁσίως. Dover (1994, 123) comments on the "denotational field" of γνώμη thus: "Neither word [γνώμη or διανοία], however, is confined to decisions and conclusions which result from intellectual analysis; both could be applied to states or attitudes of mind which we would regard of affirmation of general moral principle or sustained orientation of the will."

138 *Ep*. 19.

139 For textual variants, *Ambrosianus* has ἐπὶ δόλοισι (the plural meaning *wiles*, *treachery* at *Il.* 3.202; 4.339, etc.; *Papyrus Oxyrhynchus* (*P.Oxy*. 2547) has ἐπ΄ὀλέθρωι, which signifies destruction, being very close to φθόριος.

140 Hdt. 1.41, 4.112.

Received 21 August 2019, Accepted 3 September 2019

原著論文

# Copper-Catalyzed Monochalcogenation of Terminal Alkyne Using Dichalcogenide Compound via Cleavage of the Dichalcogenide Bond

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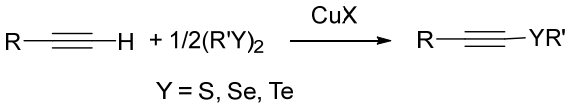



**Abstract:** The methodology for a copper-catalyzed chalcogenation of terminal alkynes with dichalcogenide in air. Numerous alkynyl sulfides, selenides or tellurides can be synthesized by the use of a CuCl catalyst and *N,N'*-dialkyl ethylenediamine. The employed diamine serves as a ligand of CuCl and a base facilitating the chalcogenation of alkynes. Furthermore, the present reaction can efficiently take advantage of two chalcogenide–groups in the dichalcogenide.

Received 27 August 2019, Accepted 4 September 2019

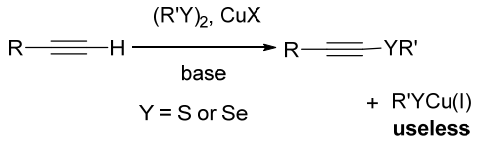
## Introduction

Alkynyl chalcogenides have found widespread utilization as convenient intermediates in organic syntheses.[1,2] To furnish these compounds,[3] the reaction of terminal alkynes with dichalcogenide under basic conditions has often been employed,[3a,3b,4] whereas in the traditional system one chalocogenide-group in the dichalcogenide is not used.

The cause is attributable to the generation of anion.[5] Similarly, when the chalcogenation of alkyne using copper salt is carried out under basic conditions, copper(I) chalcogenide is produced together with alkynyl chalcogenide (Scheme 1). However, no copper-chalcogenide performs the chalcogenation of alkynes under usual conditions. Moreover, it is well known that the reactivity of this complex is lower owing to the stability of the metal-chalcogenide bond.[6,7] Therefore, an approach using a transition-metal-catalyzed method which can use two chalcogenide-groups has been limited.[8].

In this paper, a copper-catalyzed preparation of alkynyl chalcogenide from a terminal alkyne with dichalcogenide will be described.

**Scheme 1.** The chalcogenation of alkyne with dichalcogenide via copper-acetylide




## Results and Discussion

Initial screening sulfidation of terminal alkyne was performed with copper(I) chloride as a catalyst (Table 1).

In air, when the phenylsulfidation of 1-octyne **1a** with diphenyl disulfide **2a** was executed using CuCl-bpy (10 mol%), 1-(phenylthio)-1-octyne was not detected at all (Table 1, entry 1). The employment of other diamines **7**, **8b** and **8c** or triethylamine **5** also did not produce satisfactory results owing to the dimerization of alkynes (Table 1, entries 2, 3, 4, and 5).

Fortunately, the combination of CuCl and *N,N'*-diethylethylenediamine **8a** (10 mol%) produced the corresponding sulfide **3aa** in 71% yield with the formation of diyne **4a** in 22% yield (Table 1, entry 6). Most notably, the reaction under nitrogen atmosphere using a balloon gave **3aa** in 90% yield, and

succeeded in suppressing the yield of **4a** (Table 1, entry 7).

A solvent such as DMF or toluene was unsuitable for the reaction (Table 1, entries 8 and 9). Although other copper catalysts were also examined, $Cu^{I}$ salts (CuI, CuBr and CuOAc) gave lower yields (Table 1, entries 10, 11, and 12), and $Cu^{II}$ salts ($CuCl_2$, $CuBr_2$ and $CuF_2$) could not advance the reaction (Table 1, entries 13, 14, and 15).

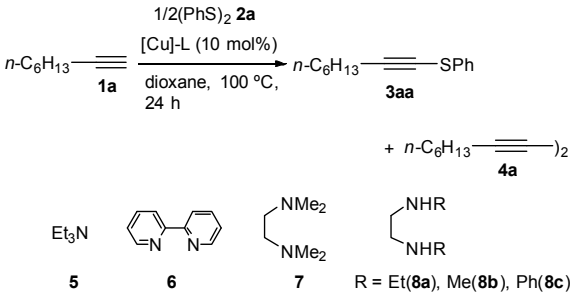
On the basis of the optimized result, we concurrently pursued the copper-catalyzed sulfidation and selenation of terminal alkynes using disulfide and diselenide (Table 2). When alkynes **1** (0.3 mmol), CuCl–**8a** or **8b** (10 mol%) and disulfides **2a**–**c** or diselenides **2d**–**e** were stirred in dioxane (0.5 mL) at 100 °C, alkynyl sulfides or selenides **3** were obtained in 60–94% yields. Regrettably, when ($n$BuS)$_2$ **2c** or propargyl amine was used, these yields decreased (Table 2, entries 3, 10 and 20). Thus this system could use the combination of miscellaneous alkynes with disulfides or diselenides.

Next, the synthesis of alkynyl tellurides was investigated. Unfortunately, employment of the previous conditions using the CuCl catalyst did not facilitate the telluridation owing to the dimerization of the alkyne (Table 3, entries 1, 2 and 3). To promote the expected reaction, the employment of other copper salts (CuBr, CuI, $CuCl_2$ or $CuBr_2$) was then examined, and, surprisingly, alkynyl telluride was produced in 47–60% yield (Table 3, entries 4, 5, 6 and 7). Furthermore, in the use of CuCl, the addition of $n$Bu$_4$NBr led effectively to completion of the reaction and produced 1-(phenyltelluro)-1-octyne (**9af**) in 85% yield without the formation of diyne (Table 3, entry 9). According developed procedure, a variety of alkynyl phenyl tellurides **9** could be synthesized in 70–92% yields by the mixture of terminal alkyne, $(PhTe)_2$, CuCl–**8b** (5 mol%) and $n$Bu$_4$NBr (20 mol%) treated in dioxane at 100 ºC (Table 4). In the present reaction, the production of **9** was not affected by the substrates.

Thus, the CuCl-catalyzed chalcogenation of terminal alkynes with dichalcogenides was achieved via cleavage of the dichalcogenide bond, and this system enabled the efficient use of two chalcogenide-groups in dichalcogenide.

Initially, to understand the reaction mechanism, the role of the copper catalyst was investigated in the case of sulfidation. The reaction of CuCl with diphenyl disulfide **2a** could not be promoted at all (Scheme 3), although the reaction of copper(I) phenylacetylide (0.3 mmol) with **2a** (0.15 mmol) produced the expected sulfide in 94% yield (Scheme 4). These results show that CuCl itself cannot cleave the disulfide bond, but the copper(I)-acetylide is formed in the first step of the catalytic cycle. Sequentially, both alkynyl sulfide and copper-sulfide were produced by the copper-acetylide reacting with disulfide.

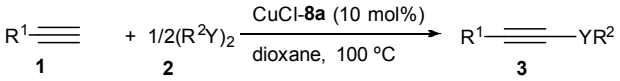
**Table 1.** Copper-catalyzed chalcogenation of 1-octyne with $(PhS)_2$




| Entry | [Cu] | Ligand | **3aa**[c] (%) | **4a**[c] (%) |
|---|---|---|---|---|
| 1[a] | CuCl | **6** | 0 | trace |
| 2[a] | | **5** | 17 | 70 |
| 3[a] | | **7** | 29 | 41 |
| 4[a] | | **8b** | 30 | 42 |
| 5[a] | | **8c** | trace | trace |
| 6[a] | | **8a** | 71 | 22 |
| 7[b] | | **8a** | 90 | trace |
| 8[b,d] | | **8a** | 0 | 42 |
| 9[b,e] | | **8a** | 39 | 40 |
| 10[b] | CuI | **8a** | 16 | 41 |
| 11[b] | CuBr | **8a** | 60 | 23 |
| 12[b] | CuOAc | **8a** | 7 | trace |
| 13[b] | $CuCl_2$ | **8a** | trace | 42 |
| 14[b] | $CuBr_2$ | **8a** | trace | 47 |
| 15[b] | $CuF_2$ | **8a** | trace | trace |

[a] Reaction was performed in air. [b] Reaction was performed under a nitrogen using the balloon. [c] Isolated yields after silica-gel chromatography. [d] DMF was used as a solvent. [e] $PhCH_3$ was used as a solvent.

**Table 2.** Copper-catalyzed preparation of alkynyl sulfides or selenides from terminal alkynes with dichalcogenide




$(PhS)_2$ **2a**, $(4\text{-}CH_3C_6H_4S)_2$ **2b**, $(n\text{BuS})_2$ **2c**, $(PhSe)_2$ **2d**, $(BnSe)_2$ **2e**

| Entry | Y | **1** | Time (h) | **3**[a] (%) | Entry | Y | **1** | Time (h) | **3**[a] (%) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | S | Ph— | 24 | 94 | 12 | S | *i*-$Pr_3Si$— | 18 | 89 |
| 2 | S | Ph— | 24 | 86 | 13[b] | Se | Ph— | 18 | 83 |
| 3 | S | Ph— | 48 | 53 | 14[b] | Se | Ph— | 24 | 91 |
| 4 | S | 4-$MeC_6H_4$— | 24 | 87 | 15[b] | Se | 4-$MeC_6H_4$— | 18 | 80 |
| 5 | S | *n*-$C_6H_{13}$— | 24 | 90 | 16[b] | Se | *n*-$C_6H_{13}$— | 18 | 85 |
| 6 | S | *n*-$C_4H_9$— | 48 | 72 | 17[b] | Se | *n*-$C_4H_9$— | 24 | 71 |
| 7 | S | HO, Me | 24 | 70 | 18[b] | Se | HO, Me | 24 | 75 |
| 8 | S | OH | 48 | 91 | 19[b] | Se | OH | 48 | 93 |
| 9 | S | HO— | 24 | 62 | 20[b] | Se | $Me_2N$— | 24 | 62 |
| 10 | S | $Me_2N$— | 18 | 60 | 21[b] | Se | | 24 | 77 |
| 11 | S | | 18 | 82 | 22[b] | Se | *i*-$Pr_3Si$— | 18 | 88 |

[a] Isolated yields after silica-gel chromatography. [b] *N,N'*-Dimethyethylenediamine **7b** (10 mol%) was used as a ligand.

In fact, the reaction in the sealed tube (condition A) gave the corresponding sulfide **3aa** only in 11% yield in the presence of 10 mol% of CuCl, although the reaction under a nitrogen atmosphere using the balloon (condition B) resulted in 87% yield.[9] Accordingly, it is clear that oxygen has been supplied in the balloon from the atmosphere.[10]

Next, the role of the combination of $Cu^{I}SPh$ and diamine was surveyed (Table 5). The treatment of a mixture of CuSPh-**8b** (100 mol%) and 1-octyne **1a** gave **3aa** in 46% yield (Table 5, entry 1), and the use of CuSPh-**8b** (10 mol%) produced **3aa** in 81% yield by the addition of hydrochloric acid (10 mol%) (Table 5, entries 3 and 4).[11] Interestingly, the system in the absence of diamines **8b** rarely had the reaction promoted (Table 5, entries 2 and 5), although the reaction of sodium acetylide with CuSPh gave **3aa** in 38% yield (Scheme 6). From these results, it is presumed that CuSPh works for the phenylsulfidation of the terminal alkyne by **8b** serving as a base and a ligand.

The $Cu^{I}SPh$ produced herein is necessary for oxygen in order to facilitate the sulfidation of alkynes. In fact, the reaction in the sealed tube (condition A) gave the corresponding sulfide **3aa** only in 11% yield in the presence of 10 mol% of CuCl, although the reaction under a nitrogen atmosphere using the balloon (condition B) resulted in 87% yield.[10] Accordingly, it is clear that oxygen has been supplied in the balloon from the atmosphere.[11]

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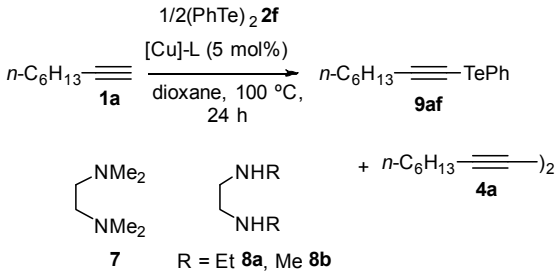
of the terminal alkyne by **8b** serving as a base and a ligand.

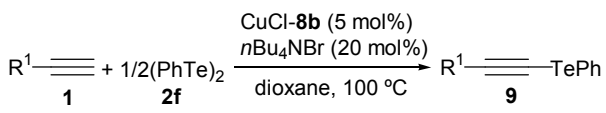
**Table 3.** Copper-catalyzed chalcogenation of 1-octyne **1a** with $(PhTe)_2$ **2f**[a]




| Entry | [Cu] | Ligand | Additive | **3af**[b] (%) | **4a**[b] (%) |
|---|---|---|---|---|---|
| 1 | CuCl | **7** | none | 0 | 92 |
| 2 | CuCl | **8a** | none | trace | 91 |
| 3 | CuCl | **8b** | none | trace | 95 |
| 4 | CuBr | **8b** | none | 50 | trace |
| 5 | CuI | **8b** | none | 47 | trace |
| 6 | $CuCl_2$ | **8b** | none | 51 | trace |
| 7 | $CuBr_2$ | **8b** | none | 60 | trace |
| 8 | CuCl | **8b** | $n$Bu$_4$NCl(20 mol%) | 47 | trace |
| 9 | CuCl | **8b** | $n$Bu$_4$NBr(20 mol%) | 85 | 0 |
| 10 | CuI | **8b** | $n$Bu$_4$NBr(20 mol%) | 80 | trace |
| 11 | CuBr | **8b** | $n$Bu$_4$NBr(20 mol%) | 76 | 0 |
| 12 | none | none | $n$Bu$_4$NBr(20 mol%) | 32 | 0 |

[a] Reaction was carried out under a nitrogen using the balloon. [b] Isolated yields after silica-gel chromatography.

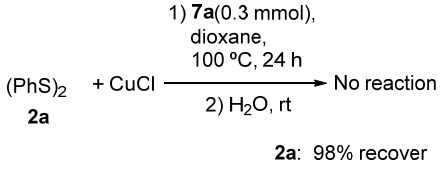
**Table 4.** Copper-catalyzed preparation of alkynyltellurides **9** from terminal alkynes with diphenyl ditelluride



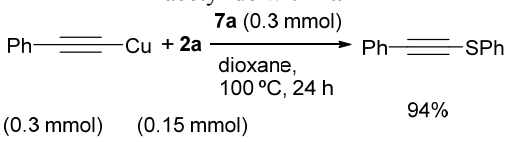

| Entry | **1** | Time (h) | **9** (%)[a] |
|---|---|---|---|
| 1 | Ph— | 24 | 82 |
| 2 | 4-Me$C_6H_4$— | 24 | 92 |
| 3 | $n$-$C_6H_{13}$— | 24 | 85 |
| 4 | HO, Me | 24 | 87 |
| 5 | OH | 36 | 89 |
| 6 | HO— | 24 | 78 |
| 7 | $Me_2N$— | 24 | 70 |
| 8 | | 24 | 81 |
| 9 | $i$-$Pr_3Si$— | 24 | 87 |
| 10 | $EtO_2C$— | 24 | 85 |

[a] Isolated yields after silica-gel chromatography.

**Scheme 3.** A reaction between $(PhS)_2$ with Cu(I)Cl

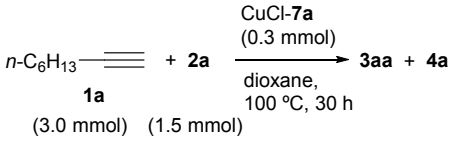



**Scheme 4.** A reaction between copper(I) phenyl acetylide with **2a**



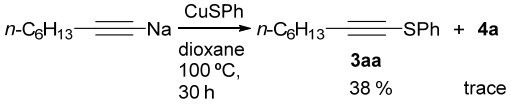

A proposed mechanism is outlined in Figure 1. In the first step, the reaction of copper-acetylide **10** with disulfide produces alkynyl sulfide **3** and $Cu^{I}SPh$ **11**. In the second step, a cuprate **12** as an intermediate is formed by the reaction of the generated **11** reacts with the terminal alkyne **1** in the presence of the diamines **8b**.[12] Finally, the alkynyl sulfide **3** is produced again by the oxidation of **12** and $Cu^{I}Cl$ is reproduced. Thus, this catalytic system can consume two chalcogenide-groups in the dichalcogenide.

**Scheme 5.** The large scale of sulfidation of **1a**




| Condition | **3aa** (%) | **4a** (%) | **2a** (%) |
|---|---|---|---|
| A | 11 | 8 | 71 |
| B | 87 | trace | trace |

A: in the sealed tube under $N_2$
B: under $N_2$ using the balloon

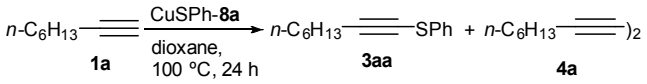



## Conclusion

In conclusion, we have achieved a copper-catalyzed chalcogenation of a terminal alkyne with dichalcogenide under a nitrogen atmosphere using a balloon. The present reaction enables the efficient use of two chalcogenide-groups in the dichalcogenide by the diamines serving as a ligand and a base.

**Scheme 6.** A reaction of sodium acetylide with CuSPh

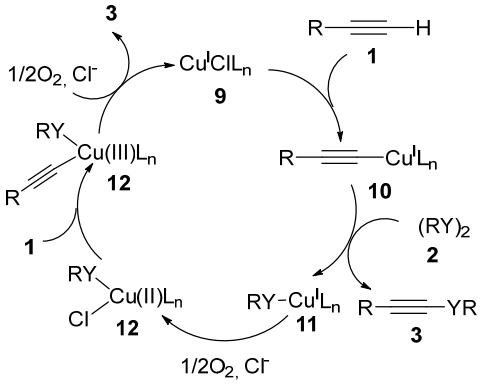
**Table 5.** Sulfidation of 1-octyne by Cu(I)SPh




| Entry | Reagent (mol %) | CuSPh (mol %) | **8a** (mol %) | Additive (mol %) | **3aa**[a] (%) | **4a**[a] (%) |
|---|---|---|---|---|---|---|
| 1[b] | none | 100 | 100 | none | 46 | 20 |
| 2 | none | 100 | none | none | 5 | trace |
| 3 | $(PhS)_2$(50) | 10 | 10 | none | 5 | 12 |
| 4[c] | $(PhS)_2$(50) | 10 | 10 | HCl(10) | 81 | 11 |
| 5 | $(PhS)_2$(50) | 10 | none | HCl(10) | trace | trace |

[a] Isolated yields after a silica-gel chromatography. [b] Reaction was carried out for 48 h in air.
[c] Hydrochloric acid used 37 wt.% in water.

**Figure 1.** A plausible reaction mechanism in the synthesis of alkynyl sulfide or selenide




## Experimental Section

**General.** All reactions were carried out under a nitrogen atmosphere using the balloon. NMR spectra were recorded on a JEOL EX-270 spectrometer (270 MHz for $^1$H, 67.5 MHz for $^{13}$C). Chemical shifts are reported in δ ppm referenced to an internal tetramethylsilane standard for $^1$H NMR and chloroform-*d* (δ 77.0) for $^{13}$C NMR. IR spectra were measured by Perkin-Elmer Spectrum One FT-IR spectrometer. Melting points were measured on a BÜCHI Melting Point B-540 apparatus. Elemental analysis was performed at the Instrumental Analysis Center for Chemistry, Tohoku University (Japan).

**Preparation of the alkynyl sulfides from terminal alkynes with disulfides**

A typical procedure is given for the reaction of ethynylbenzene with diphenyl disulfide **2a** giving phenylethynyl phenyl sulfide (entry 1 in Table 2): To the mixture of Cu(I)Cl (3.0 mg, 0.03 mmol), diphenyl disulfide (32.8 mg, 0.15 mmol), and *N*,*N*'-diethylethylenediamine **8a** (3.5 mg, 0.03 mmol) in dioxane (0.5 mL), ethynylbenzene (30.6 mg, 0.3 mmol) were added under a nitrogen atmosphere using the balloon. The mixture was stirred at 100 °C for 24 h. After the solvent was cooled to room temperature, the reaction mixture was dissolved in $Et_2O$. The solution was washed with $H_2O$ and saturated sodium chloride and dried over anhydrous magnesium sulfate. Chromatography on silica gel

(Hexane) gave 1-phenyl-2-(phenylthio) etyne (59.1 mg, 94%) as a colorless oil.

**1-Phenyl-2-(phenylthio) ethyne (Table 2, entry 1)**[2b, 8a]: $^1$H NMR ($CDCl_3$) δ 7.21 (t, *J* = 6.8 Hz, 1H), 7.31–7.36 (m, 5H), 7.45–7.52 (m, 4H); $^{13}$C NMR ($CDCl_3$) δ 75.5, 97.9, 122.9, 126.2, 126.5, 128.4, 128.6, 129.2, 131.7, 132.9; IR (neat) 2170, 1584, 1479 cm$^{-1}$; elemental analysis calcd for $C_{14}H_{10}S$ (210.30): C, 79.96; H, 4.79; found: C, 79.87; H, 4.82.

**1-Phenyl-2-(4-tolylthio) ethyne (Table 2, entry 2)**: $^1$H NMR ($CDCl_3$) δ 2.33 (s, 3H), 7.15 (d, *J* = 7.9 Hz, 2H), 7.29–7.39 (m, 5H), 7.45–7.54 (m, 2H); $^{13}$C NMR ($CDCl_3$) δ 20.9, 76.1, 97.2, 123.0, 126.6, 128.3, 128.4, 128.6, 130.0, 131.6, 136.6; IR (neat) 2169, 1595, 1491 cm$^{-1}$; elemental analysis calcd for $C_{15}H_{12}S$ (224.32): C, 80.31; H, 5.39; found: C, 80.37; H, 5.34.

**1-Phenyl-2-(butylthio) ethyne (Table 2, entry 3)**: $^1$H NMR ($CDCl_3$) δ 0.96 (t, *J* = 7.4 Hz, 3H), 1.44–1.55 (m, 2H), 1.73–1.84 (m, 2H), 2.81 (t, *J* = 7.2 Hz, 2H), 7.25–7.30 (m, 3H), 7.39–7.42 (m, 2H); $^{13}$C NMR ($CDCl_3$) δ 13.6, 21.4, 31.4, 35.5, 79.7, 92.8, 123.6, 127.9, 128.2, 131.4; IR (neat) 2930, 2959, 2166, 1595, 1486 cm$^{-1}$; elemental analysis calcd for $C_{12}H_{14}S$ (190.31): C, 75.74; H, 7.42; found: C, 75.61; H, 7.48.

**1-(4-Tolyl)-2-(phenylthio) ethyne (Table 2, entry 4)**: $^1$H NMR ($CDCl_3$) δ 2.35 (s, 3H), 7.12 (d, *J* = 7.9 Hz, 2H), 7.21 (t, *J* = 7.2 Hz, 1H), 7.33 (t, *J* = 7.2 Hz, 2H), 7.40 (d, *J* = 7.9 Hz, 2H), 7.47 (d, *J* = 7.2 Hz, 2H); $^{13}$C NMR ($CDCl_3$) δ 21.5, 74.4, 98.0, 126.1, 126.4, 127.5, 129.0, 129.1, 129.2, 131.8, 138.9; IR (neat) ν = 3058, 2167, 1582, 1507 cm$^{-1}$; elemental analysis calcd for $C_{15}H_{12}S$ (224.32): C, 80.31; H, 5.39; found: C, 80.39; H, 5.30.

**1-(Phenylthio)-1-octyne (Table 2, entry 5)**[2b,8a]: $^1$H NMR ($CDCl_3$) δ 0.90 (t, *J* = 5.6 Hz, 3H), 1.26–1.38 (m, 4H), 1.41–1.48 (m, 2H), 1.53–1.63 (m, 2H), 2.44 (t, *J* = 7.1 Hz, 2H), 7.18 (t, *J* = 7.6 Hz, 1H), 7.31 (dd, *J* = 7.9 and 7.6 Hz, 2H), 7.40 (d, *J* = 7.9 Hz, 2H); $^{13}$C NMR ($CDCl_3$) δ 14.0, 20.3, 22.5, 28.5, 28.6, 31.3, 64.5, 100.1, 125.7, 126.0, 129.0, 133.8; IR (neat) 2930, 2857, 2193, 1583, 1478 cm$^{-1}$; elemental analysis calcd for $C_{14}H_{18}S$ (218.36): C, 77.01; H, 8.31; found: C, 77.09; H, 8.30.

**1-(Phenylthio)-1-hexyne (Table 2, entry 6)**[2d, 14]: $^1$H NMR ($CDCl_3$) δ 0.94 (t, *J* = 7.2 Hz, 3H), 1.42–1.51 (m, 2H), 1.53–1.62 (m, 2H), 2.45 (t, *J* = 6.9 Hz, 2H), 7.18 (t, *J* = 7.6 Hz, 1H), 7.31 (dd, *J* = 7.9 and 7.6 Hz, 2H), 7.40 (d, *J* = 7.9 Hz, 2H); $^{13}$C NMR ($CDCl_3$) δ 13.5, 19.9, 22.0, 30.7, 64.5, 100.0, 125.7, 126.0, 129.0, 133.8; IR (neat) 2960, 2933, 2193, 1583, 1479 cm$^{-1}$; elemental analysis calcd for $C_{12}H_{14}S$ (190.31): C, 75.74; H, 7.42; found: C, 75.95; H, 7.53.

**1-(Phenylthio)but-1-yn-3-ol (Table 2, entry 7)**[2c]: $^1$H NMR ($CDCl_3$) δ 1.55 (d, *J* = 6.6 Hz, 3H), 2.02 (br, 1H), 4.75 (q, *J* = 6.6 Hz, 1H), 7.22 (t, *J* = 7.2 Hz, 1H), 7.34 (dd, *J* = 7.9 and 7.2 Hz, 2H), 7.42 (d, *J* = 7.9 Hz, 2H); $^{13}$C NMR ($CDCl_3$) δ 24.2, 59.3, 71.5, 100.6, 126.3, 126.6, 129.2, 132.4; IR (neat) 3550, 2982, 2183, 1582, 1478 cm$^{-1}$; elemental analysis calcd for $C_{10}H_{10}OS$ (178.25): C, 67.38; H, 5.65; Found: C, 67.63; H, 5.77.

**1-[(Phenylthio)ethynyl]-1-cyclohexanol (Table 2, entry 8)**[2a]: $^1$H NMR ($CDCl_3$) δ 1.26–1.31 (m, 1H), 1.51–1.76 (m, 7H), 1.97–2.03 (m, 2H), 2.13 (s, 1H), 7.21 (t, *J* = 7.2 Hz, 1H), 7.33 (dd, *J* = 7.9 and 7.2 Hz, 2H), 7.41 (d, *J* = 7.9 Hz, 2H); $^{13}$C NMR ($CDCl_3$) δ 23.2, 25.1, 39.8, 69.7, 70.6, 102.5, 125.9, 126.4, 129.2, 132.8; IR (neat) 3400, 2923, 2175, 1584 cm$^{-1}$; elemental analysis calcd (%) for $C_{14}H_{16}OS$ (232.34): C, 72.37; H, 6.94; found: C, 72.35; H, 6.94.

**1-(Phenylthio)but-1-yn-4-ol (Table 2, entry 9)**[8a]: $^1$H NMR ($CDCl_3$) δ 2.35 (s, 4H), 3.51 (s, 1H), 7.21 (t, *J* = 7.2 Hz, 1H), 7.33 (t, *J* = 7.9 and 7.2 Hz, 2H), 7.42 (d, *J* = 7.9 Hz, 2H); $^{13}$C NMR ($CDCl_3$) δ 44.1, 49.2, 70.8, 94.6, 126.1, 126.3, 129.1, 133.0; IR (neat) 3390, 2941, 2855, 1582, 1478, 1440 cm$^{-1}$; elemental analysis calcd for $C_{10}H_{10}OS$ (178.25): C, 67.38; H, 5.65; found: C, 67.49; H, 5.79.

**1-(Phenylthio)-3-dimethylaminopropyne (Table 2, entry 10)**[15]: $^1$H NMR ($CDCl_3$) δ 2.35 (s, 6H), 3.51 (s, 2H), 7.21 (t, *J* = 7.2 Hz, 1H), 7.33 (t, *J* = 7.9 and 7.2 Hz, 2H), 7.42 (d, *J* = 7.9 Hz, 2H); $^{13}$C NMR ($CDCl_3$) δ = 44.1, 49.2, 70.8, 94.6, 126.1, 126.3, 129.1, 133.0; IR (neat) 2972, 2821, 2775, 2171, 1583, 1478, 1441 cm$^{-1}$; elemental analysis calcd for $C_{11}H_{13}NS$ (191.29): C, 69.07; H, 6.85; found: C, 68.80; H, 7.03.

**1-[(Phenylthio)ethynyl] cyclohexene (Table 2, entry 11)**[2a]: $^1$H NMR ($CDCl_3$) δ 1.52–1.69 (m, 4H), 2.10–2.22 (m, 4H), 6.19–6.23 (m, 1H), 7.19 (t, *J* = 7.3 Hz, 1H), 7.31 (dd, *J* = 7.6 and 7.3 Hz, 2H), 7.41 (d, *J* = 7.6 Hz, 2H); $^{13}$C NMR ($CDCl_3$) δ 21.4, 22.2, 25.7, 29.1, 71.9, 100.1, 120.7, 125.8, 126.2, 129.0, 129.1, 136.1; IR (neat) 2930, 2136, 1625, 1583, 1478 cm$^{-1}$; elemental analysis calcd for $C_{14}H_{14}S$ (214.33): C, 78.45; H, 6.58; found: C, 78.31; H, 6.59.

**1-(Phenylthio)-2-(tri-isopropylsilyl) ethyne (Table 2, entry 12)**: $^1$H NMR ($CDCl_3$) δ 1.12 (s, 21H), 7.20 (t, *J* = 7.3 Hz, 1H), 7.32 (dd, *J* = 7.9 and 7.3 Hz, 2H), 7.44 (d, *J* = 7.9 Hz, 2H); $^{13}$C NMR ($CDCl_3$) δ 11.4, 18.6, 91.1, 103.2, 126.0, 126.3, 129.1, 132.8; IR (neat) 2942, 2865, 2092, 1583, 1462 cm$^{-1}$; elemental analysis calcd for $C_{17}H_{26}SSi$ (290.54) C, 70.28; H, 9.02; found: C, 70.45; H, 8.90.

**Preparation of the alkynyl selenides from terminal alkynes with disselenides**

A typical procedure is given for the reaction of ethynylbenzene with diphenyl diselenide **2d** giving phenylethynyl phenyl selenide (entry 13 in Table 2): To the mixture of Cu(I)Cl (3.0 mg, 0.03 mmol), diphenyl diselenide (46.8 mg, 0.15 mmol), and *N*,*N*'-dimethylethylenediamine **8b** (2.6 mg, 0.03 mmol) in dioxane (0.5 mL), ethynylbenzene (30.6 mg, 0.3 mmol) were added under a nitrogen atmosphere using the balloon. The mixture was stirred at 100 °C for 18 h. After the solvent was cooled to room temperature, the reaction mixture was dissolved in $Et_2O$. The solution was washed with $H_2O$ and saturated sodium chloride and dried over anhydrous magnesium sulfate. Chromatography on silica

gel (Hexane) gave 1-phenyl-2-(phenylseleno) ethyne (64.0 mg, 83%) as a colorless oil.

**1-Phenyl-2-(phenylseleno) ethyne (Table 2, entry 13)**[8a]: $^1$H NMR ($CDCl_3$) δ 7.23–7.35 (m, 6H), 7.48–7.51 (m, 2H), 7.57–7.60 (m, 2H); $^{13}$C NMR ($CDCl_3$) δ 69.2, 103.5, 123.2, 127.1, 128.3, 128.6, 128.9, 129.0, 129.5, 131.7; IR (neat) 3057, 2159, 1576, 1476 cm$^{-1}$; elemental analysis calcd for $C_{14}H_{10}Se$ (257.19): C, 65.38; H, 3.92; found: C, 65.40; H, 4.17.

**1-Phenyl-2-(benzylseleno) ethyne (Table 2, entry 14)**: $^1$H NMR ($CDCl_3$) δ 4.10 (s, 2H), 7.25–7.37 (m, 10H); $^{13}$C NMR ($CDCl_3$) δ 32.6, 33.0, 101.2, 123.5, 127.5, 128.1, 128.2, 128.6, 129.0, 131.4, 137.5; IR (neat) 3060, 3028, 2156, 1599, 1493 cm$^{-1}$; elemental analysis calcd for $C_{15}H_{12}Se$ (271.22): C, 66.43; H, 4.46; found: C, 66.15; H, 4.67.

**1-(4-tolyl)-2-(phenylseleno) ethyne (Table 2, entry 15)**[16]: m.p. 43.8-44.0 °C; $^1$H NMR ($CDCl_3$) δ 2.35 (s, 3H), 7.13 (d, *J* = 7.9 Hz, 2H), 7.23–7.34 (m, 3H), 7.39 (d, *J* = 8.2 Hz, 2H) 7.57 (d, *J* = 7.9 Hz, 2H); $^{13}$C NMR ($CDCl_3$) δ 21.5, 103.1, 120.1, 126.9, 128.9, 129.0, 129.1, 129.5, 131.5, 131.7, 138.8; IR ($CHCl_3$) 3017, 2159, 1577, 1567, 1477 cm$^{-1}$; elemental analysis calcd for $C_{15}H_{12}Se$ (271.22): C, 66.43; H, 4.46; found: C, 66.39; H, 4.59.

**1-(Phenylseleno)-1-octyne (Table 2, entry 16)**[8a]: $^1$H NMR ($CDCl_3$) δ 0.89 (t, *J* = 6.8 Hz, 3H), 1.25–1.38 (m, 4H), 1.40–1.48 (m, 2H), 1.52–1.64 (m, 2H), 2.45 (t, *J* = 6.9 Hz, 2H), 7.21–7.32 (m, 3H), 7.51 (d, *J* = 7.9 Hz, 2H); $^{13}$C NMR ($CDCl_3$) δ 14.0, 20.5, 22.5, 28.5, 28.6, 31.2, 57.3, 104.7, 126.6, 128.5, 129.3, 129.4; IR (neat) 2929, 2857, 1578, 1477 cm$^{-1}$; elemental analysis calcd for $C_{14}H_{18}Se$ (265.25): C, 63.39; H, 6.84; found: C, 63.56; H, 6.93.

**1-(Benzylseleno)1-octyne (Table 2, entry 17)**: $^1$H NMR ($CDCl_3$) δ 0.89 (t, *J* = 6.8 Hz, 3H), 1.24–1.39 (m, 6H), 1.40–1.53 (m, 2H), 2.32 (t, *J* = 6.9 Hz, 2H), 3.99 (s, 2H), 7.21–7.33 (m, 5H); $^{13}$C NMR ($CDCl_3$) δ 14.0, 20.4, 22.5, 28.5, 28.7, 31.3, 32.4, 58.9, 102.4, 127.3, 128.4, 128.9, 137.9; IR (neat) 2929, 2160, 1494, 1453 cm$^{-1}$; elemental analysis calcd for $C_{15}H_{20}Se$ (279.28): C, 64.51; H, 7.22; found: C, 64.21; H, 7.32.

**1-(Phenylseleno)but-1-yn-3-ol (Table 2, entry 18)**: $^1$H NMR ($CDCl_3$) δ 1.52 (d, *J* = 6.6 Hz, 3H), 2.08 (br, 1H), 4.72 (q, *J* = 6.6 Hz, 1H), 7.25–7.34 (m, 3H), 7.51 (d, *J* = 7.2 Hz, 2H); $^{13}$C NMR ($CDCl_3$) δ 24.3, 59.4, 64.4, 105.5, 127.2, 128.3, 129.1, 129.5; IR (neat) 3369, 3057, 2940, 2180, 1577, 1476 cm$^{-1}$; elemental analysis calcd for $C_{10}H_{10}OSe$ (225.15): C, 53.35; H, 4.48; found: C, 53.07; H, 4.45.

**1-[(Phenylseleno)ethynyl]-1-cyclohexenol (Table 2, entry 19)**: $^1$H NMR ($CDCl_3$) δ 1.25–1.31 (m, 1H), 1.53–1.76 (m, 7H), 1.97–2.01 (m, 2H), 2.14 (s, 1H), 7.21–2.34 (m, 3H), 7.51 (d, *J* = 6.6 Hz, 2H); $^{13}$C NMR ($CDCl_3$) δ 23.2, 25.1, 39.9, 63.8, 69.8, 107.5, 126.9, 128.7, 128.8, 129.5; IR (neat) 3377, 2935, 2166, 1577, 1477 cm$^{-1}$; elemental analysis calcd (%) for $C_{14}H_{16}OSe$ (279.24): C, 60.22; H, 5.78; found: C, 60.24; H, 5.89.

**1-(Phenylseleno)-3-dimethylaminopropyne (Table 2, entry 20)**: $^1$H NMR ($CDCl_3$) δ 2.34 (s, 6H), 3.50 (s, 2H), 7.24–7.33 (m, 3H), 7.53 (d, *J* = 8.2 Hz, 2H); $^{13}$C NMR ($CDCl_3$) δ 44.1, 49.4, 63.7, 99.1, 126.9, 128.8, 128.9, 129.4; IR (neat) ν = 2939, 2773, 2775, 1577, 1476 cm$^{-1}$; elemental analysis calcd for $C_{11}H_{13}NSe$ (238.19): C, 55.47; H, 5.50; found: C, 55.30; H, 5.64.

**1-[(Phenylseleno)ethynyl] cyclohexene (Table 2, Entry 21)**[3c,3i]: $^1$H NMR ($CDCl_3$) δ 1.56–1.69 (m, 4H), 2.10–2.22 (m, 4H), 6.17–6.20 (m, 1H), 7.24 (t, *J* = 7.9 Hz, 1H), 7.30 (dd, *J* = 8.2 and 7.9 Hz, 2H), 7.51 (d, *J* = 8.2 Hz, 2H); $^{13}$C NMR ($CDCl_3$) δ 21.4, 22.2, 25.7, 29.1, 65.4, 105.1, 120.9, 126.8, 128.6, 129.1, 129.4, 135.9; IR (neat) 2929, 2147, 1577, 1475 cm$^{-1}$; elemental analysis calcd for $C_{14}H_{14}Se$ (261.23): C, 64.37; H, 5.40; found: C, 64.29; H, 5.51.

**1-(Phenylseleno)-2-(tri-isopropylsilyl) ethyne (Table 2, entry 22)**: $^1$H NMR ($CDCl_3$) δ 1.11 (s, 21H), 7.25 (t, *J* = 7.2 Hz, 1H), 7.29 (dd, *J* = 7.9 and 7.2 Hz, 2H), 7.53 (d, *J* = 7.9 Hz, 2H); $^{13}$C NMR ($CDCl_3$) δ 11.4, 18.6, 85.1, 108.3, 126.8, 128.6, 128.9, 129.4; IR (neat) 2942, 2865, 2087, 1578, 1477, 1461 cm$^{-1}$; elemental analysis calcd for $C_{17}H_{26}SeSi$ (337.44): C, 60.51; H, 7.77; found: C, 60.56; H, 7.71.

**Preparation of the alkynyl tellurides from terminal alkynes with ditellurides**

A typical procedure is given for the reaction of ethynylbenzene with diphenyl ditelluride **2f** giving phenylethynyl phenyl telluride (entry 1 in Table 4): To the mixture of Cu(I)Cl (1.5 mg, 0.015 mmol), diphenyl ditelluride (61.4 mg, 0.15 mmol), *n*$Bu_4NBr$ (19.3 mg, 0.06 mmol) and *N*,*N*'-dimethylethylenediamine **8b** (2.6 mg, 0.03 mmol) in dioxane (0.5 mL), ethynylbenzene (30.6 mg, 0.3 mmol) were added under a nitrogen atmosphere using the balloon. The mixture was stirred at 100 °C for 24 h. After the solvent was cooled to room temperature, the reaction mixture was dissolved in $Et_2O$. The solution was washed with $H_2O$ and saturated sodium chloride and dried over anhydrous magnesium sulfate. Chromatography on silica gel (Hexane) gave 1-phenyl-2-(phenyltelluro) ethyne (75.2 mg, 82%) as a pale yellow oil.

**1-Phenyl-2-(phenyltelluro) ethyne (Table 4, entry 1)**[8a,13]: $^1$H NMR ($CDCl_3$) δ 7.24–7.34 (m, 6H), 7.44–7.48 (m, 2H), 7.73–7.75 (m, 2H); $^{13}$C NMR ($CDCl_3$) δ 47.2, 113.1, 114.2, 123.3, 127.9, 128.2, 128.6, 129.7, 131.9, 135.1; IR (neat) 2140, 1574, 1487 cm$^{-1}$; elemental analysis calcd for $C_{14}H_{10}Te$ (305.83): C, 54.98; H, 3.30; found: C, 54.94; H, 3.21.

**1-(4-Tolyl)-2-(phenyltelluro) ethyne (Table 4, entry 2)**[13]: m.p. 73.6–74.0 ºC; $^1$H NMR ($CDCl_3$) δ 2.35 (s, 3H), 7.12 (d, *J* = 8.5 Hz, 2H), 7.26–7.28 (m, 3H), 7.36 (d, *J* = 8.5 Hz, 2H), 7.70–7.73 (m, 2H); $^{13}$C NMR ($CDCl_3$) δ 21.4, 46.1, 113.2, 114.4, 120.3, 127.8, 129.7, 131.8, 134.7, 134.9, 138.8; IR ($CHCl_3$) 3019, 1574, 1507 cm$^{-1}$; elemental analysis calcd for $C_{15}H_{12}Te$ (319.86): C, 56.33; H, 3.78; found: C, 56.22; H, 3.93.

**1-(Phenyltelluro)-1-octyne (Table 4, entry 3)**[8a]: $^1$H NMR ($CDCl_3$) δ 0.88 (t, *J* = 6.8 Hz, 3H), 1.26–1.31 (m,

4H), 1.35–1.45 (m, 2H), 1.51–1.59 (m, 2H), 2.56 (t, $J$ = 6.9 Hz, 2H), 7.20–7.26 (m, 3H), 7.64–7.70 (m, 2H); $^{13}$C NMR ($CDCl_3$) δ 14.0, 21.1, 22.5, 28.5, 28.8, 31.2, 34.6, 113.1, 116.1, 127.5, 129.5, 134.6; IR (neat) 2928, 2856, 2158, 1574, 1474 cm$^{-1}$; elemental analysis calcd for $C_{14}H_{18}Te$ (313.89): C, 53.57; H, 5.78; found: C, 53.58; H, 5.88.

**1-(Phenyltelluro)but-1-yn-3-ol (Table 4, entry 4)**: $^1$H NMR ($CDCl_3$) δ 1.50 (d, $J$ = 6.6 Hz, 3H), 2.04 (br, 1H), 4.75 (q, $J$ = 6.6 Hz, 1H), 7.21–7.31 (m, 3H), 7.66–7.70 (m, 2H); $^{13}$C NMR ($CDCl_3$) δ 24.3, 42.2, 59.5, 112.3, 116.8, 128.0, 129.7, 135.3; IR (neat) 3369, 2155, 1572, 1474 cm$^{-1}$; elemental analysis calcd for $C_{10}H_{10}OTe$ (273.79): C, 43.87; H, 3.68; found: C, 43.92; H, 3.84.

**1-[(Phenyltelluro)ethynyl]-1-cyclohexanol (Table 4, entry 5)**: $^1$H NMR ($CDCl_3$) δ 1.24–1.28 (m, 1H), 1.51–1.73 (m, 7H), 1.90–1.98 (m, 2H), 2.15 (s, 1H), 7.23–7.27 (m, 3H), 7.64–7.68 (m, 2H); $^{13}$C NMR ($CDCl_3$) δ 23.2, 25.1, 39.9, 69.9, 112.8, 116.9, 118.9, 127.7, 129.6, 134.7; IR (neat) ν = 3390, 2931, 2149, 1574 cm$^{-1}$; elemental analysis calcd for $C_{14}H_{16}OTe$ (327.88): C, 51.28; H, 4.92; found: C, 51.31; H, 5.08.

**1-(Phenyltelluro)but-1-yn-4-ol (Table 4, entry 6)**: $^1$H NMR ($CDCl_3$) δ 1.90 (br, 1H), 2.82 (d, $J$ = 6.2 Hz, 2H), 3.75 (br, 2H), 7.22–7.28 (m, 3H), 7.64–7.71 (m, 2H); $^{13}$C NMR ($CDCl_3$) δ 25.3, 37.8, 61.2, 111.8, 112.6, 127.8, 129.6, 135.1; IR (neat) 3368, 2159, 1573 cm$^{-1}$; elemental analysis calcd for $C_{10}H_{10}OTe$ (273.79): C, 43.87; H, 3.68; found: C, 43.83; H, 3.82.

**1-(Phenyltelluro)-3-dimethylamino propyne (Table 4, entry 7)**: m.p. 64.0–64.8 ºC; $^1$H NMR ($CDCl_3$) δ 2.32 (s, 6H), 3.58 (s, 2H), 7.22–7.27 (m, 3H), 7.67–7.71 (m, 2H); $^{13}$C NMR ($CDCl_3$) δ 41.3, 44.0, 49.7, 110.5, 112.7, 127.7, 129.6, 135.0; IR ($CHCl_3$) 3019, 2400, 1574, 1574, 1475 cm$^{-1}$; elemental analysis calcd for $C_{11}H_{13}NTe$ (286.83): C, 46.06; H, 4.57; found: C, 45.84; H, 4.69.

**1-[(Phenyltelluro)ethynyl] cyclohexene (Table 4, entry 8)**: $^1$H NMR ($CDCl_3$) δ 1.52–1.68 (m, 4H), 2.12–2.20 (m, 4H), 6.14–6.16 (m, 1H), 7.17–7.27 (m, 3H), 7.63–7.70 (m, 2H); $^{13}$C NMR ($CDCl_3$) δ 21.4, 22.2, 25.5, 29.2, 43.2, 113.5, 116.5, 121.2, 127.6, 129.6, 134.6, 137.9; IR (neat) 3051, 2928, 1573, 1474, 1434 cm$^{-1}$; elemental analysis calcd for $C_{14}H_{14}Te$ (309.86): C, 54.27; H, 4.55; found: C, 54.03; H, 4.64.

**1-(Phenyltelluro)-2-(tri-isopropylsilyl) ethyne (Table 4, entry 9)**: $^1$H NMR ($CDCl_3$) δ 1.09 (s, 21H), 7.23–7.25 (m, 3H), 7.65–7.69 (m, 2H); $^{13}$C NMR ($CDCl_3$) δ 11.4, 18.5, 64.7, 113.1, 121.4, 127.5, 129.5, 134.4; IR (neat) 2942, 2864, 2073, 1574, 1462 cm$^{-1}$; elemental analysis calcd for $C_{17}H_{26}TeSi$ (386.08): C, 52.89; H, 6.79; found: C, 52.97; H, 7.00.

**1-(Phenylthio)-2-(ethyl carboxylate) ethyne (Table 4, entry 10)**: $^1$H NMR ($CDCl_3$) δ 1.29 (t, $J$ = 7.1 Hz, 3H), 4.24 (dd, $J$ = 7.1 and 14.2 Hz, 2H), 7.25–7.34 (m, 3H), 7.72–7.75 (m, 2H); $^{13}$C NMR ($CDCl_3$) δ 14.0, 61.9, 77.2, 107.3, 110.8, 128.8, 130.0, 136.4, 152.1; IR (neat) 3019, 2137, 1700 cm$^{-1}$; elemental analysis calcd for $C_{11}H_{10}O_2Te$ (301.80): C, 43.78; H, 3.34; found: C, 43.53; H, 3.54.

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# 総合科学研究会報告

## これまでに開催した総合科学研究会プログラム

(1) 「生命倫理」映画上映会「熊笹の尾根の生涯人間・砑雄二　ハンセン病とともに生きる」
（企画：国立療養所栗生楽泉園入所者自治会、制作：岩波映像株式会社）
第 47 回総合科学研究会
2018 年 12 月 20 日（木）17 時から 18 時
福島県立医科大学 5 号館 2 階第 8 講義室

(2) 妊娠と育児と地域：　記述統計から参加型研究へ
後藤あや　先生　（本学総合科学教育研究センター　自然科学系領域）
第 48 回総合科学研究会　（研究連携セミナー2019 との合同開催）
2019 年 2 月 14 日（木）17 時～18 時
福島県立医科大学 6 号館 2 階第 3 講義室

(3) 福島の酒造り　ー 地域と大学の連携を通して ー
斎藤　美幸　氏〔(有)金水晶酒造店代表取締役〕
第 49 回総合科学研究会
2019 年 3 月 14 日（木）17 時～18 時
福島県立医科大学 5 号館 2 階第 8 講義室

(4) 低温物理学と超伝導の話
開 康一　先生（本学総合科学教育研究センター 自然科学系領域）
第 50 回総合科学研究会
2019 年 3 月 19 日（火）17 時～18 時
福島県立医科大学 6 号館 2 階第 3 講義室

**福島県立医科大学総合科学教育研究センター紀要 Vol.8 2019**
2019 年 10月15 日発行

# 福島県立医科大学総合科学教育研究センター紀要投稿規定

2012.2.29　提示
2012.10.31 承認
2014.10.16 一部改訂

## １．方針・趣旨

本紀要では、センターメンバーの研究活動、および、センターの活動を紹介することを主な目的とする。また、その内容は、本学の理念およびポリシーに則ったものを掲載する。

## ２．名称及び発行

福島県立医科大学総合科学教育研究センター紀要
英文名称：The Bulletin of the Center for Integrated Sciences and Humanities
年１回、１１月に発行する。

## ３．投稿資格

[1]　本紀要へ投稿できる者は、本学教職員および非常勤教職員であることを原則とする。
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## ５．倫理規定

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## 11．投稿規定の施行

本投稿規定は、2012年4月1日に遡る。

福島県立医科大学総合科学教育研究センター紀要

The Bulletin of the Center for Integrated Sciences and Humanities

2019 年10 月 15 日発行

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