

方勵之先生物理、天體物理、宇宙學類文獻：  
目錄，整理、編訂說明和初步探討

—— 為中國科技大學科學技術史專業建立三十週年呈獻

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A：引言

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C：整理和編輯說明

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## A：引言

本文的產生緣于下列諸因素：

1. 方勵之先生(1936-2012)逝世后，美國亞利桑那大學(UofA)物理系系主任 Sumit Mazumdar 教授委託本系的謝克強教授為 *Physics Today*（《今日物理學》）撰寫長篇訃告。先生的學術文獻目錄是該項工作的一個基礎。因筆者剛整理編輯出他的非物理學類的文章目錄<sup>[1]</sup>，故而受謝教授并物理系的支持，榮幸地承擔了本目錄的蒐輯与整合任務；
2. 中國科技大學科學技術史專業成立至今三十週年。方先生不僅是其奠基人之一，而且還繼錢臨照先生后擔任第二屆研究室主任，開辦過學術講座、研討會并且指導和培養了多位研究生；此外，他身體力行地發表了一定數量的科學史、科學方法与哲學、科學社會學方面的學術文章，這類文章有不少是離開科學史教職后完成，可見他對於這個領域的興趣和喜好。本文一方面是代表科大科學史學人、學生向先生致以的敬意和謝意，另一方面可視為“借花獻佛”而呈給科大科學技術史專業的三十週年紀念論文；
3. 目前，國外和國內網絡上公開及半公開地流傳一個學術文章目錄，其來源是論文作者在 UofA 物理系網頁相連的一個個人主頁，僅僅限於 1989 年之後的文獻 180 余篇。本目錄力求完備；
4. 附上簡要說明和初步探討，試圖為將來深入、全面地考察和研究他的學術成就提供一個起始點；
5. 在國外的一些中文網站上，見到少數非物理學、非科學、非專業的“筆桿”對於方先生學術水平的非議和妄議達到匪夷所思、可悲可嘆的境地<sup>[2]</sup>，謬種流傳至國內，因而有必要公開這個論文目錄，以正視聽。

本文的形成限於時間、囿於資源，漏失与錯誤在所難免，希請專家讀者予以補充和指正，以期得到充實完善。

在目錄蒐輯、整理和研究以及本文的完成過程中，得以下各位師友的支持、討論、指點和教正：李淑嫻、謝克強、蘇淑芳、方克、程福臻、鄭偉、畢紅光、馮瓏瓏、高煜、王力帆、熊偉、李競、向守平、劉志峰、施蘊渝，在此一併致以感謝！

**B: 目錄正文**

**Scientific Articles of Li-Zhi Fang (Fang Lizhi)**

**方勵之先生物理、天體物理、宇宙學類論文目錄**

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本目錄所列的是方勵之先生所發表過的物理、天體物理和宇宙學類的學術論文和文章，他的學術著作將另行開列；除此之外的學術論文如科學史、科學哲學方面的和其它方面的文章也將另行開列<sup>[1]</sup>。

整理所依據的資料有兩個主要來源：

- 亞利桑那大學(University of Arizona)物理系保存的作者的英文履歷表(CURRICULUM VITA)，其中覆蓋 1961-2008 的論文題目；
- 論文作者的個人網頁所載：“Scientific Articles of Li-Zhi Fang (Fang Lizhi) Since 1989”：[www.physics.arizona.edu/~fanglz/publication/publication.html](http://www.physics.arizona.edu/~fanglz/publication/publication.html)

並盡力檢索和對照部份在線期刊。在上面的目錄中，已發現缺失了個別較早期的論文(3)、(79)、(105)、(128)，估計還可能不止這幾個遺漏。2012 年(以及 2011 年末)的論文，由於出版和付印的週期因素不及統計，可能會有所遺漏。

有三篇登載在《科學通報》的論文：(54)、(59)、(63)的頁碼，履歷表上所列的與《科學通報》網站檢索出的不符，在未查看到原文的情況下，按照網站標出的頁數錄入。(10)合作者原為 M.Wang，根據中科院“科技期刊開放獲取平台”(CAS-OAJ)上的信息改為 S.J.Gu(顧世傑)。

論文作者 1961 年發表的處女作(1)，CURRICULUM VITA 中僅寫出 L.Z.Fang 為作者，今根據其敘述<sup>[3]</sup>更改為：Y.R.Wang (L.Z.Fang)。

所有在中國學術刊物和著作中的論文題目和期刊名稱，限於資料和時間，均採納原件的格式以英文輸入(如：《物理學報》寫為 *Acta Physica Sinica*)，有待查核、並須按照原文編目。

## D: 關於論文的初步探討

### I. 有關論文數量的觀察

方勵之先生發表的物理學、天體物理學、宇宙學類的學術文章總數不少於 346 篇，所覆蓋的年代是 1961 年至 2012 年初。每年的平均數約估為 6.8 篇；如果將 1967-1971 整 5 年無法從事科研和發表文章、以及 1966 年只能計入半年來精算，每年的平均數則為 7.6 篇。

1961 年之前未發表過論文。其原因如他所述：“1955 年一百個物理大學生被調集到北京大學得一個祕密單位——我也在其中——當局告訴我們，任務是學核物理，準備發展中國的核項目……一年之後，我 20 歲，成為近代物理研究所的一名實習研究員”<sup>[4]</sup>，

“1959年，我已二十三歲，還沒發表過論文。以前從事機密的核項目研究，不能發表論文”<sup>[5]</sup>。這段時間是論文作者的“禁產期”。

1967至1971年的五年間，發表的論文數是零，原因眾所週知。方先生的說明是：No publications due to the trouble of the Cultural Revolution in China.（“由于在中國的文化革命的困擾，無論文發表”）；No publications也可理解為：“無（學術）出版物”。事實上，中國物理類學術期刊之首席《物理學報》從1967年初至1973年底整七年都處於停刊狀態，受害之久更超過了先前它最長的1941至1943年的三年停刊。這五年即是方（和全體中國科學家）的“零產期”。

不過，文革後期（1972年）學術出版物甫回潮，方緊接著就發表一篇（14）在《物理》雜誌上，系單獨作者。由此可看出他在過去“再教育”的幾年中沒有懈怠<sup>[6]</sup>。《物理》于1972年創刊，當時因傳統的《物理學報》等尚未解禁，也近於國內物理學期刊的頂峰。之後的三年內，發表的論文數目是：3（1973年），4（1974年），4（1975年），4（1976年），從數量上看似乎穩，但遠不是先生作學問的真實水平（見下段）。值得一提的是，1973年的那篇（15）關於雙星(binary)的工作，成了他與摯友許良英先生相識的楔子<sup>[7]</sup>。

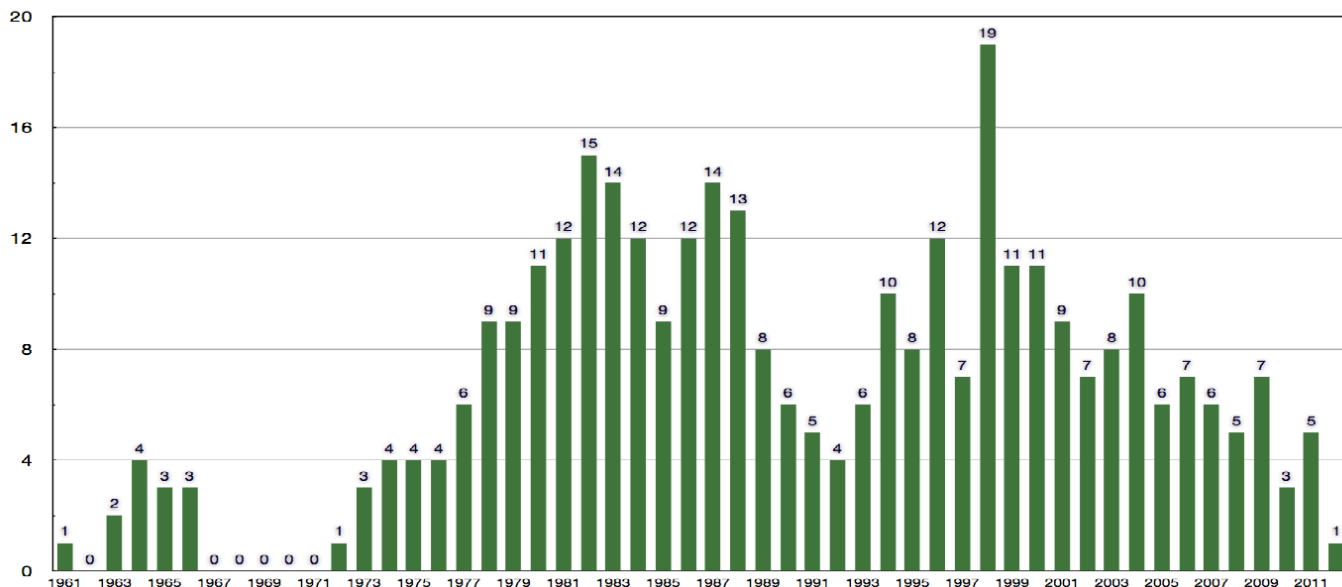
從數量來考察，文革結束後1977年的有6篇，1978年的有9篇，自此論文的年發數目便更上一層樓，之後的年份基本保持在該水平（~10篇/年）。對比他從1978到2000年的23年平均10.3篇/年的發表速率來看，文革後期（1972-1977）的3.5篇/年顯而易見是處於“壓抑期”，因為三十六至四十一歲理應是物理學家一生中最高產的期間。或者從現實角度來評論，那段的工作也等效於“準備期”：找到研究方向、建立學術影響、構架人際關係、打通發表渠道等等。

方勵之先生的文章發表最豐產（數量達到12篇/年）的年份是以下各年：

[論文年份 - 數目]

- 1998 (19)
- 1982 (15)
- 1983 (14)
- 1987 (14)
- 1988 (13)
- 1981 (12)
- 1984 (12)
- 1986 (12)
- 1996 (12)





年發論文的數目（馮瓏瓏製作）

可以觀察到，方的文章發表速率在八十年代中期和九十年代末期有兩個峰值，之間也是以較高的數目啣接。1991-1992 是後期論文數目較少的兩年(9 篇)，當然這裡純粹考慮數量、不論質量，而那正值他一生中的大動盪：北京、劍橋、普林斯頓、圖桑，也是他重入大學(UofA)執教、帶領研究生的一段時期，對於寫、發論文都多少產生一些影響？實際上，他在 1989 年6月初至1990 年 6月底的十三個月里，仍完成並發表了三篇天體物理學論文：(175)、(181)、(待查)。

他晚年的論文也是持之以恆的高產、穩產，在年逾七十的最後的六個整年度(2006-2011)，每年的科學論文平均數仍達到 5.5。

長期任職於美國物理學會的 Edward Gerjuoy 教授對此的評價是：“方有超過 300 篇文章，這是個令人印象深刻的數量（Fang had over 300 papers, a very impressive number [8]）”。

值得強調的是，方勵之先生還完成和發表過非物理類——在科學史、科學哲學與和涉及科學與社會的社會學方面——的科學論文，數量達數十篇；其它的散文、隨筆、報告、評論等更有近兩百篇<sup>[1]</sup>，不在本文討論之內。

## II. 有關論文重要性的幾個論點

判斷科研論文的重要性和學術價值，應該是同行評議的範疇。應 UofA 主持方勵之先生紀念活動的謝克強教授的要求，筆者曾向方先生的天體物理學同行(合作者、同事、

學生)徵詢過，提請他們指出各自認為的其中最有價值和最有影響的文章若干(十篇左右)，得到下述回覆：

- 高煜研究員(原科大天體物理中心研究生)向 ADS(SAO/NASA Astrophysics Data System)索得一份 Fang, L. 的引文目錄，最多被引用的 16 篇論文如下：

[論文#(年份) - 引用數目]

- 217 (1996) - 159.00
- 253 (1999) - 145.00
- 241 (1998) - 109.00
- 206 (1995) - 109.00
- 236 (1998) - 80.00
- 252 (1999) - 79.00
- 209 (1995) - 74.00
- 244 (1998) - 59.00
- 199 (1994) - 59.00
- 200 (1994) - 56.00
- 225 (1997) - 55.00
- 267 (2000) - 50.00
- 208 (1995) - 47.00
- 213 (1996) - 45.00
- 195 (1994) - 42.00
- 190 (1993) - 42.00

(時間的因素，近期的工作的重要性往往不能從被引用數上很快反映出來)

- 程福臻先生(原科大天體物理教授、七十年代起的論文合作者)和鄭偉教授(論文合作者)建議的重要論文如下(按年代順序)：

[論文# (年份)]

- 1 (1961)
- 14 (1972)
- 18 (1974)
- 46 (1979)
- 48 (1979)
- 78 (1982)
- 121 (1985)
- 185 (1992)
- 186 (1992)
- 232 (1998)
- 263 (2000)
- 275 (2001)
- 276 (2001)
- 304 (2004)
- 327 (2008)

- 馮瓏瓏研究員(原在科大天體物理師從方先生、長期的論文合作者)對於方的重要論文的建議是：

- 武向平、景益鵬、莫厚俊和畢紅光与方教授有許多高引用率的文章，更好讓他們對合作文章作評估。
  - 方的(14)是中國現代宇宙學的首篇(發表)文章。
  - 1973年方与張(家鋁)發表了中國有關相對論天體物理的論文(15)，之後，他同科大天體物理中心的同事們做了一系列有關吸積盤(結構、幅射機制、SS433模型等)的工作；不幸的是，其中的大部發表在中國國內期刊上，有些要早於國外類似的工作十年以上。
  - 從1978年起，方教授和陸(焱)、羅(遼復)、曲(欽岳)和汪(珍如)在中國期刊上發表過一些反常中子星的文章[案：(36)、(38)、(46)]。据我所知，這項工作是受到李政道的關於核物質反常態的工作(1976年?)，是該領域內的早期工作之一。
  - 方教授同科大天體物理中心的同事們提交的一份關於他們的工作的全面回顧(90)。
  - (120)獲得國際引力研究基金會的頭獎。
  - 方的小組是最早認識到成團在多分量宇宙中的重要性的三個小組之一，它實際就是宇宙結構形成的冷-熱暗物質模型中的基本，見(114)。
  - 將小波(wavelet)技術引入大尺度宇宙結構的統計研究，方幾乎是最早的。自從1997年起，他和同事合作發表了許多這個課題的論文，超過了60篇。
- 畢紅光先生(原在科大天體物理師從方先生、論文合作者)，根據他了解的領域，建議是(按年代順序)：
  - [ 論文#      (年份) ]
  - 184      (1991)
  - 185      (1992)
  - 191      (1993)
  - 208      (1995)
  - 225      (1997)
  - 232      (1998)
  - 264      (2000)
  - 282      (2002)
  - 300      (2004)
  - 311      (2005)
- 王樹軍(筆者，原在科大科學史師從方先生)1984年曾以“雙光子吸收研究的綜述”為大學畢業實習論文。發現方-區在1965年合作發表的關於雙光子吸收的論文(8)、(9)在中國大陸是具開創性的，文革之前雙(多)光子的極少數几篇占其二。考慮到當時國內外科學信息流通的狀況，Kaiser等在1961年用激光所作的雙光子實驗觀察<sup>[9]</sup>以及所引起的理論文章潮，很可能遲至1962年(或之後)才傳到國內(當時科學刊物的進口、審查、複製和發放有大

約一年的週期)，接著方和區(智)開始他們的工作並做出成果，在發表這個環節上又有一年到兩年的週期<sup>[10]</sup>。盡管如此，(8)、(9)在國際上橫向比較不算落後。

(29)是中國科大歷史上的一篇重要論文。據 *Nature* 在 1977 年的報導：“該文章的作者是方勵之、周又元、程福臻和褚耀泉，他們來自於一所很不為西方所知的中國科學技術大學。”<sup>[11]</sup> 它可以視為中國科大(USTC)和科大天體物理中心(CFA)走向世界的一個里程碑。

我們大致可從以上的評議看出，方先生的論文質量是持續地高水準，其中有重要地位和有長期影響的比例遠超過 10%。

### III. 有關合作者的數據

作為單獨作者的文章的統計是 73 篇，占總數的 21.1%，餘下的為合作文章。合作的 273 篇中有 113 篇方為第一作者。他的合作者分佈十分廣泛，除去曾經工作過的單位：科大、北台、UofA，國內的合作者還有：南大、北大、北師大、紫台、物理所、雲南台等等。國外的合作者來自不少的國家和地區：意大利、美國、日本、台灣、印度、英國等等。

方勵之先生的第二篇學術論文(2)發表在 1963 年，是關於鐵磁體的研究。該文章的第一作者是李蔭遠先生(Y.Y.Li)，時為中科院物理所副所長，是他的第一個合作者，也來自工作單位(科大)之外；對此，方曾作過說明<sup>[12]</sup>。

他的第一個外國合作者是羅馬大學魯菲尼(R.Ruffini)教授，論文是 1979 年發表在 *Phys. Lett.* 上的(50)。猜測魯菲尼還可能是他的最後一位論文合作者，因方在逝世前不久正在與他在 SKYPE 商談十三屆格羅茲曼會議(Marcel Grossmann Meeting on General Relativity)的組織和論文。

同方先生合作發表論文最多的是褚耀泉先生，共有 38 篇；年代跨越(1976-2010)也最長，此外他們還合作過一本高級科普著作<sup>[13]</sup>。以下諸物理學家也和方合作過 10 篇以上的論文：馮瓏瓏(30 篇)、武向平(19 篇)、莫厚俊(17 篇)、Pando(16 篇)、朱杏芬(13 篇)、程福臻(12 篇)、向守平(12 篇)、景益鵬(12 篇)、張家鋁(11 篇)、畢紅光(11 篇)。

他和夫人李淑嫻教授(當時為北大物理系副教授)的第一篇合作論文發表於 1983 年，直到 1986 年底，兩人共合作發表過五篇物理學文章：(97)、(114)、(119)、(122)、(138)。早在文革前，他們就合譯出席夫的《量子力學》(文革后出版)，很有影響；1984 年合寫了教科書《力學概論》，在國內物理學生中口碑甚佳；之後還有著作《宇宙的創生》以多種文本出版<sup>[14]</sup>，具廣泛和持久的影響，並深獲好評<sup>[15]</sup>。

除了合作的文章之外，方与同行的討論以及幫助過的論文<sup>[11]</sup>也是難以統計的。

#### IV. 有關登載刊物、著作的數據

1961-1979 年的前 49 篇物理類學術論文都在國內發表，其中的大多數是重要期刊、學報，如：《物理學報》、《科學通報》、《天文學報》、《物理》和《中國科技大學學報》。与魯菲尼合作的(50)是他在國際上發表的第一篇文章，所載 *Phys. Lett.* 就是物理學領域中的最高水準的刊物之一，它不僅是當年國內少有能登上 *Phys. Lett.* 的文章，也能夠排進中國在文革結束後物理研究走向世界的先行者之列。

1985 年及之前，方的論文主要是發表在中國的學術刊物上。據統計，在《物理學報》、《科學通報》、《中國科學》、《天文學報》這樣國內頂級刊物上有 63 篇，占 50% (國內刊物所佔有比例約 75% 或更高)；在 *Phys. Lett.*, *Astr. Astrophys.* 這樣國際頂級刊物上有 6 篇，占 5%。此外在不少較高級別的學刊 (如 *Astrophys. Space Sci*) 和會議錄上登載 (如 *Proceedings of the nth Marcel Grossmann Meeting on General Relativity*)。1985 年之後，他的論文發表在國際刊物或英文著作上的比例迅速升高，1986 年: 75%，1987 年: 50%，1988 年: 50%，1989 年: 63%。這個轉型對於他在 1989 年之後的論文發表至關重要，因為自 1990 年起，方先生的學術論文就与中國刊物基本絕緣。能夠確定他的最後兩篇國內刊發的物理類文章“高能天體物理前沿鳥瞰(上)(下)” (169)，是在 1989 年 1-2 月和 3-4 月。

可以發現，自 1990 年起，方勵之先生的文章大多發表在 *Phys. Rev.*, *Phys. Rev. Lett.*, *Astrophys. J.*, *Mod. Phys. Lett.*, *Astr. & Astrophys.* 這樣有很高水準的國際物理學-天文學刊物上。

文章登載的期刊、專著和會議錄所屬的國別，計有：中國、美國、意大利、荷蘭、新加坡、日本、韓國、愛爾蘭等。

茲引用《宇宙大尺度結構的形成》<sup>[16]</sup>一書序言中的一段作為結語：

兩位作者還想利用本書出版的機會，向我們就讀研究生時期的導師——Prof. L.Z. Fang, University of Arizona, USA, 表示最誠摯的敬意和謝意！Prof. Fang 是現代宇宙學在中國的最早傳播者和拓荒者。他曾用極大的熱情和努力，在這片古老的熱土上普及廣義相對論和現代宇宙學知識，培養了一批至今仍活躍在科研第一線的中青年科學工作者。他在學術研究中展現出來的熱情、敏銳、嚴謹以及孜孜不倦的治學精神，使本書作者以及每個曾受過他教誨的人終生受益。

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備註：

[1] “方勵之先生非物理學、天體物理學文獻目錄”，筆者所整理，同時公開。

[2] 例：

方勵之的學術水平大概就是一本他和一美國教授合著的《相對論》了。我當時買了所有與相對論有關的書，當然也包括方勵之這本。讀後連呼上當。”  
(馬悲鳴)

案：1)《相對論天體物理的基本概念》的主旨並非相對論，而是天體物理學(如同《物理化學》的核心是化學而非物理學)；2)該著作所涉的“相對論”系指“廣義相對論”、或愛因斯坦引力理論，而不是公眾認知的“相對論”——“狹義相對論”；3)合著者魯菲尼不是“美國教授”，而是意大利教授(生於法國)；4)該書非高中生、本科生的教材，更非科普讀物。還有無需一駁的，也立此存照：

在方感興趣的“天體物理”領域里，他做了些啥呢？我記得八十年代初曾有報道說他發表了一兩篇論文，然後報章就大吹特吹。八十年代國內的科研水平可以想象的，方勵之能有什麼東西值得驕傲的？(“金筆”)

[3] “吃刺蝟的年代——科大的第一創世紀”(來源參見[1])：

1960年初冬……在當時，發表論文已違規。筆名或可蒙混過關。這是錢臨照先生援我的一招。我干脆就請錢先生代我隨便取一筆名就是了。他答應了。

1961年第一期《中國物理學報》，17卷57頁，刊登了我的論文，作者名字赫然是“王允然”。心想，錢臨照先生厲害，這個筆名可不是隨便取的。它暗示，在中國發表物理學論文，除了同行的审稿外，還必須有 His (her) Majesty “允然”才行啊！

[4] 引自“‘紙老虎’研究五十年”(來源參見[1])。

[5] “吃刺蝟的年代——科大的第一創世紀”(來源參見[1])。

[6] “八公山下的再教育——文化大革命中的1969—1970年”(來源參見[1])：

很巧，在謝三鈞的混亂批鬥中，我居然成功夾帶了一本朗道(L.Landau)的《場論》(Classical Theory of Fields)……。那時，為防蚊子，每個人都有一頂帳子，放下帳子來，儘可放心地看書。就這樣，在淮南的幾月中，朗道這本書成了我的勞動之後的最心愛的，也是唯一的讀物。

[7] “許良英先生九秩賀”(來源參見[1])。

[8] Edward Gerjuoy 的電子郵件，有關為 Physics Today 所擬方勵之先生訃告的草稿。

[9] Kaiser, W. and C.G.B. Garret, Two-photon excitation in  $\text{CaF}_2:\text{Eu}^{2+}$ , *Phys. Rev. Lett.*, **7**, 229-231, 1961.

[10] More evidence for a closed universe from QSOs, *Nature*, **270**, 17, Nov. 1977.

[11] 參見“強光与自由電子的相互作用——半導體中載流子的多光子過程”，霍裕平，《物理學報》，第21卷第1期，1965年1月。注明“1963年7月26日收到。”

另外，論文末尾的有：

作者對李蔭遠先生、于淥、方勵之、李鐵城等同志在工作中的有益討論和幫助表示感謝。

[12] “我經歷的1989—1990中美互動(A)”（來源參見[1]）：

2010年圣诞节前，收到李荫远先生的e-短信。云：“多年不通音信。钱先生辞世不觉已十一年了，我手边只有他指导的科学史学生早年写的传略。我在网上读到过你的两篇回忆散文，都是关于大学刚毕业时期的，也许你真该动笔写回忆录了，不是写你正确与否，而是可以给二、三十年后治史学者之采择与评论。”

这里钱先生是指钱临照。李荫远先生曾任中国科学院物理研究所副所长，1962-1965年间，我一边在科技大学教书，一边在李先生门下作研究。李先生现年已92岁，已洗手物理，也不参加院士活动，转而研究新诗，2006年有“当代新诗读本”出版。

[13] 《從牛頓定律到愛因斯坦相對論》，方勵之、褚耀泉著，科學出版社，1981年第一版。

[14] 《宇宙的創生》，方勵之、李淑嫻著，科學出版社，1987年7月第一版，1988年10月第二次印刷。

《宇宙的創生》，台灣亞東書局，方勵之、李淑嫻著，1988年8月初版。

《宇宙的創生》，方勵之、李淑嫻著，香港南粵出版社，1989年5月第一版。

《方勵之が語る宇宙のはじまり：最初に何が起こったか？》，方勵之，李淑嫻著；佐藤文隆，青木薫訳，講談社，1990年3月第一版。

《宇宙的創生》，方勵之、李淑嫻著，台灣曉園出版社，1990年10月第一版。

《宇宙的創生》，方勵之、李淑嫻著，台灣正中書局，1990年4月第一版。

*La creazione dell'universo*, Fang Li Zhi, Li Shu Xian, Garzanti Libri, 1990.

*Creation of the Universe*, Fang Li Zhi, Li Shu Xian, World Scientific Publishing Company, November 1993.

*La naissance de l'univers*, Lizhi Fang et Shuxian Li, Dunod, 1ere édition, décembre 1997.

《宇宙的創生》，方勵之、李淑嫻著，台灣凡異出版社，2002年5月初版。

[15] Amazon上所引的專業人士評語：

".. is a worthwhile elementary treatment of the cosmology of the early Universe written with a liveliness and simplicity that will surely encourage students to pursue the subject further."

John D Barrow, *Nature*, 1989

.. a superb guide to what is known about cosmology....The authors also leave you with a sense of anticipation and excitement."

David Hughes, *New Scientist*, 1989

"The book is well written and interesting, particularly in its use of Chinese stories throughout ... The book contains all the standard material found in such texts. The chapters on the thermodynamics of the Universe are particularly good ... this is a first-rate book of its genre and is heartily recommended."

Kenneth Dunn, *Mathematical Reviews*, 1993

"The best popular account of the science that explains how the universe can be friendly to life is a book, 'Creation of the Universe', by the Chinese astronomers, Fang Li Zhi and Li Shu Xian. The book was translated into English and published by World Scientific Publishing in 1989. Fang Li Zhi is the famous dissident astronomer now living in exile in the United States. I particularly recommend Chapter 6, with the title 'How Order Was Born of Chaos'. This tells the same story that I am telling you today, but with more detail and more depth."

Freeman J Dyson, Oppenheimer lecture at University of California, Berkeley, Mar 2000

[16] 《宇宙大尺度結構的形成》，向守平、馮瓏瓏著，中國科學技術出版社，2010年1月第一版。