

THE PICTURE OF THE TAOIST GENII PRINTED ON THE COVER of this book is part of a painted temple scroll, recent but traditional, given to Mr Brian Harland in Szechuan province (1946). Concerning these four divinities, of respectable rank in the Taoist bureaucracy, the following particulars have been handed down. The title of the first of the four signifies 'Heavenly Prince', that of the other three 'Mysterious Commander'.

At the top, on the left, is Liu *Thien Chün*, Comptroller-General of Crops and Weather. Before his deification (so it was said) he was a rain-making magician and weather forecaster named Liu Chün, born in the Chin dynasty about +340. Among his attributes may be seen the sun and moon, and a measuring-rod or carpenter's square. The two great luminaries imply the making of the calendar, so important for a primarily agricultural society, the efforts, ever renewed, to reconcile celestial periodicities. The carpenter's square is no ordinary tool, but the gnomon for measuring the lengths of the sun's solstitial shadows. The Comptroller-General also carries a bell because in ancient and medieval times there was thought to be a close connection between calendrical calculations and the arithmetical acoustics of bells and pitch-pipes.

At the top, on the right, is Wên *Yuan Shuai*, Intendant of the Spiritual Officials of the Sacred Mountain, Thai Shan. He was taken to be an incarnation of one of the Hour-Presidents (*Chia Shen*), i.e. tutelary deities of the twelve cyclical characters (see p. 262). During his earthly pilgrimage his name was Huan Tzu-Yü and he was a scholar and astronomer in the Later Han (b. +142). He is seen holding an armillary ring.

Below, on the left, is Kou *Yuan Shuai*, Assistant Secretary of State in the Ministry of Thunder. He is therefore a late emanation of a very ancient god, Lei Kung. Before he became deified he was Hsin Hsing, a poor woodcutter, but no doubt an incarnation of the spirit of the constellation Kou-Chhen (the Angular Arranger), part of the group of stars which we know as Ursa Minor. He is equipped with hammer and chisel.

Below, on the right, is Pi *Yuan Shuai*, Commander of the Lightning, with his flashing sword, a deity with distinct alchemical and cosmological interests. According to tradition, in his earthly life he was a countryman whose name was Thien Hua. Together with the colleague on his right, he controlled the Spirits of the Five Directions.

Such is the legendary folklore of common men canonised by popular acclamation. An interesting scroll, of no great artistic merit, destined to decorate a temple wall, to be looked upon by humble people, it symbolises something which this book has to say. Chinese art and literature have been so profuse, Chinese mythological imagery so fertile, that the West has often missed other aspects, perhaps more important, of Chinese civilisation. Here the graduated scale of Liu Chün, at first sight unexpected in this setting, reminds us of the ever-present theme of quantitative measurement in Chinese culture; there were rain-gauges already in the Sung (+12th century) and sliding calipers in the Han (+1st). The armillary ring of Huan Tzu-Yü bears witness that Naburiannu and Hipparchus, al-Naqqās and Tycho, had worthy counterparts in China. The tools of Hsin Hsing symbolise that great empirical tradition which informed the work of Chinese artisans and technicians all through the ages.

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李約瑟著

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JOSEPH NEEDHAM

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TECHNOLOGY

PART I: PAPER AND PRINTING

BY

TSIEN TSUEN-HSUIN, PH.D.

PROFESSOR EMERITUS OF CHINESE LITERATURE AND
LIBRARY SCIENCE AND CURATOR EMERITUS
OF THE FAR EASTERN LIBRARY AT THE
UNIVERSITY OF CHICAGO



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To
three eminent scholars who have contributed to
our knowledge of the History of Printing

L. CARRINGTON GOODRICH

*Dean Lung Professor Emeritus of Chinese
Columbia University*

HOWARD W. WINGER

*Professor Emeritus of Library Science
The University of Chicago*

and

KWANG-TSING WU

*Former Head, Chinese and Korean Section
The Library of Congress
Washington, D. C.*

this volume is dedicated

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FOREWORD

It was in 1948, some thirty-six years ago, that the writing of this series of volumes began, after I came back from China and from Unesco. My first collaborator was Wang Ling¹ (Wang Ching-Ning²); and then eight years later Lu Gwei-Djen³ came over from Paris to occupy the same position of Adjutant-General of the Project which she still fills. While Wang Ling's background was rather mathematical and chemical, Lu Gwei-Djen's is more medical and biological. Then, some fifteen years ago, we found ourselves faced with a great dilemma, whether to peg away alone for the rest of our lives, or whether to associate with ourselves a group of collaborators, who would bring us nearer to seeing the conclusion in our own lifetime. We decided on the latter course. It was a veritable turning-point.

Now, with the present Volume, we see the first-fruits of this plan. We were able to persuade our dear friend Professor T. H. Tsien (Chhien Tshun-Hsün⁴), of the University of Chicago, and one of the world's most eminent authorities on the subject, to accomplish this task in our series. We greatly admire what he has done. Of course, the book of T. F. Carter (1) has long been a classic, but it is now quite old, having seen the light first in 1925 and not revised since 1955; since then many archaeological finds, and many literary perspectives, have intervened, so that a new synthesis was urgently necessary.

We expect that in due course other Volumes not written personally by us will be appearing in our series; notably next Vol. 6, pt. 2, on the 'History of Agriculture in China', which has been written by Ms. Francesca Bray. This again deals with a subject of the highest importance for the general theme of the history of science and technology in China, and we feel fortunate that her work for some ten years past on our staff has proved so successful. We now anticipate that still further Volumes will be contributed by our collaborators.

I suppose that no theme could be more important for the history of all human civilisation than the development of paper and printing. Francis Bacon, 'the bell that call'd the wits together', fully recognised this.^a In the present Volume readers will be able to follow all the vicissitudes of paper and printing during those Chinese centuries when Europe knew nothing of such arts. I always suspected that the Chinese Buddhists may have had something to do with the technique of documentary reproduction, because of their mania for the infinite replication of images, as I had plenty of opportunity to observe on the walls of the Thang cave-temples at Chhien-fo-tung⁵ (Tunhuang⁶).^b

^a Cf. Vol. 1, p. 19.^b Vol. 1, p. 126.¹ 王鈴² 王靜寧³ 魯桂珍⁴ 錢存訓⁵ 千佛洞⁶ 敦煌

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Volume 5

Joseph Needham

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FOREWORD

It has always been extremely hard to believe that Johann Gutenberg about +1454 knew nothing (even by hearsay) of the Chinese printed books which had been circulating in large numbers in China for five previous centuries—and there are some sources fairly contemporary which aver that he did.^a It seems perhaps less likely that he ever knew of his predecessor Pi Shêng¹, the artisan who had anticipated him as the inventor of movable type by some four centuries. We have already alluded to the celebrated passage about Pi Shêng in the *Mêng Chhi Pi Than*², and we have illustrated a rotating ‘case’ for the type sorts depicted by Wang Chen³ later.^b Many printers in Korea as well as China, subsequently made use of this invention, but of course it was much more inviting to use movable type for the alphabetic languages needing only twenty-six letters, than for the ideographic ones where as many as 53,500 characters, with some 400 radicals, would be involved.

Be that as it may, however, there is plenty of evidence that Chinese printing and book-production were the envy of the whole world that knew about them before Gutenberg’s time.^c Even long afterwards we have Jesuit relations which show their great admiration for the books of China, which enshrined so much of human learning and knowledge.^d True it is that, as Francis Bacon again said: ‘The wits and knowledges of men remain in books, exempted from the wrong of time, and capable of perpetual renovation.’ Let us pray that no evil fire-storm will be let loose upon the world to destroy in an instant much, if not all, of the accumulated culture of the ages, and put an end to that most glorious of human achievements, printing and the paper on which it may be done. So let us wish all success to this story told by Tsien Tsuen-Hsue.

JOSEPH NEEDHAM

Cambridge
January 1984

^a Cf. Vol. 1, p. 244 (*b*).

^b Vol. 4, pt. 2, pp. 33, 533 (Fig. 685). We also came across Pi Shêng in the context of chemical industry; Vol. 5, pt. 3, p. 187.

^c For example the Arabic scholar Dāwūd al-Banākī in +1317; Needham (88) repr. in (64), pp. 22–4.

^d See vol. 4, pt. 2, p. 439. The words were those of Matteo Ricci himself.

¹ 畢昇

² 夢溪筆談

³ 王禎

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Volume 5

Joseph Needham

Frontmatter

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AUTHOR'S NOTE

This volume is devoted to the study of the origin and development of papermaking and printing in Chinese culture from their earliest known beginnings to the end of the 19th century, when both handicrafts had gradually been replaced by modern technology. It is intended to be a comprehensive study, covering all periods in their history and all aspects of their techniques, aesthetics, applications, and worldwide spread and influence, based on extensive investigation of literary records, archaeological discoveries, scientific reports, as well as artifacts available for examination. Previous contributions to the field are either limited in scope or outdated in many respects. Numerous Chinese documents concerning paper had not been explored and many important topics had not been covered in Western scholarship. Details of printing, on the other hand, are rarely documented in Chinese literature, but hundreds and thousands of items printed from the +8th century onward are available for investigation. The present work tries to bring up to date or fill gaps in previous studies; it also offers new interpretations based on fresh data and new evidence. An attempt in this direction is briefly explained at the end of the Introduction.

The project started in late 1968 at the request of Dr Joseph Needham to contribute a section on 'Paper and Printing' to his great series of volumes *Science and Civilisation in China*. His proposal actually suggested a sequel to my previous work on pre-paper and pre-printing records of China.^a A travel grant from the American Council of Learned Societies for 1968–9 enabled me to visit Cambridge and many libraries and museums in Europe and America for a preliminary exploration of opportunities. During the next few years, basic sources were collected and screened, a series of lecture-discussion sessions was held on several university campuses, and three sections on paper were then drafted. To pursue further the study of printing, a seminar was set up at the University of Chicago in 1972 and again in 1974 for a systematic examination of the sources and a discussion of various problems involved. But the actual writing of subsequent sections was interrupted by the increasing load of my duties at the University. With the generous support of the U. S. National Science Foundation and National Endowment for the Humanities from 1977 to 1980, I was relieved of part of my teaching and administrative responsibilities at the University. This allowed me to devote more time to research. Additional support from the East Asian History of Science Trust in Cambridge made it possible for me to complete the entire work by the end of 1982. The original plan was to write a section of about 100 pages, but subsequent studies

^a *Written on Bamboo and Silk: The Beginnings of Chinese Books and Inscriptions*. University of Chicago Press, Chicago, 1962.

went deeply into the sources, and this resulted in a volume much broader in scope and size and one which consumed more time than originally planned.

The present work consists of ten sections, with a bibliography of nearly 2000 entries and about 200 plates and figures for illustration. Three sections each deal separately with paper, printing (including inkmaking and bookbinding), and their worldwide spread and influence, in addition to an Introduction as a summary and orientation. The last section on the contributions of paper and printing to world civilisation serves as a conclusion. Each part on paper and printing is treated both chronologically and topically. Special attention is given to technical and artistic aspects of each subject as well as to their role in society. Where previous studies are available, a brief description of the topic or events is usually given; where gaps exist in earlier scholarship, fuller discussion is provided. For special editions of works in Chinese and Japanese cited in this volume, their publisher, date, or inclusion in a series are given in parentheses following the specific title in the footnotes and bibliographies. Abbreviations for titles of journals, large collections, symposia, and *tshung-shu* are found in a list preceding the bibliography.

In the preparation of this volume, many of my friends, colleagues, and former students have contributed significantly. I am especially indebted to three eminent scholars and specialists in the field who served as consultants of the project, Professor L. Carrington Goodrich, Professor Howard W. Winger, and Dr K. T. Wu¹, for their constant advice, reading and criticism of the entire manuscript. Professor and Mrs H. G. Creel also gave generously of their time to read over the final draft. All their comments from different perspectives have been most useful in improving this work. I wish also to express my gratitude for the valuable help in many ways from Dr Poon Ming-Sun², Mr James K. M. Cheng³, Mr Ma Tai-Loi⁴, Mr John Grobowski, Dr Michael Finegan, and Miss June Work, who served at one time or another as research assistants in the project.

To all my colleagues at the University of Chicago, especially in the Center for Far Eastern Studies, the Department of Far Eastern Languages and Civilisations, the Graduate Library School, and the University Library, I am grateful for advice and continuing support. In the course of my writing, I made use of several excellent papers and theses developed in my seminars by Miss Constance Miller, Mr Edward Martinique, Mrs Lily Chia-Jen Kecskes, and Dr Poon Ming-Sun, whose contributions are acknowledged at various points in the book with reference to their respective works in the bibliography.

For supply of materials for my study and photographs for illustrations, I am indebted to the librarians and curators of the British Museum and British Library, the Cambridge and Oxford University Libraries, the Bibliothèque Nationale, the Musée Guimet, the Austrian National Library, the Museum für Völkerkunde, the Royal Ontario Museum, the Dard Hunter Paper Museum, the Field Museum of Natural History, the Metropolitan Museum of Art, the Fogg Art Museum, the

¹ 吳光清² 潘銘榮³ 鄭燭文⁴ 馬泰來

D

AUTHOR'S NOTE

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Printing Department of Newbery Library, the Asian Division of the Library of Congress, the Spencer Collection of New York Public Library, the Harvard-Yenching Library, and the East Asian Library of Columbia University. However, the basic sources of information for my study were drawn largely from the Far Eastern Library of the University of Chicago. All credits to figures in this volume are acknowledged.

During my travel to the Far East in 1979, I benefited greatly from visiting libraries and museums, meeting and discussing with specialists, and collecting additional materials for my final revision of the draft. Certain old paper specimens and samples of rare printing were examined in China and Japan. Valuable experience was gained by my visits to the printing shops of Jung-Pao-Chai¹ in Peking and Tuo-Yün-Hsien² in Shanghai, where woodblock cutters and printers were interviewed and tools and accessories collected. I am grateful to Mr Ku Thing-Lung³, Director of Shanghai Library, for his advice and cooperation in making a series of photographs and drawings, based on my interviews, showing step-by-step procedures for carving and printing. My thanks are also due to Mr Phan Chi-Hsing⁴ of the Institute of the History of Science, Academia Sinica, for his expert advice and reading of the three sections on paper; to Mr Chang Hsiu-Min⁵ formerly of the Peking Library and Mr Hu Tao-Ching⁶ of Shanghai, for their counsel and information; and to Mr Chhang Pi-Te⁷ of the Palace Museum in Taipei for his generous assistance in sending me many photographs of old and rare samples of printing now kept in Taiwan.

I feel particularly fortunate to have been associated with the East Asian History of Science Library in the Needham Research Institute at Cambridge, where my hardworking friends have been patiently watching the slow progress of my study. My gratitude goes to Dr Lu Gwei-Djen for her gracious advice, Dr Michael Salt for sending me useful materials, Dr Colin Ronan for his skilled editing of the manuscript, and Mr Peter Burbidge and the staff of the Cambridge University Press for their helpful advice in the publication of this volume. My deepest debt is due to the architect of the project, Dr Joseph Needham, who provided timely help and advice on many problems in the process of my writing. Without his inspiration, guidance, and constant support, this enterprise would not have been accomplished.

Finally, I owe a debt of gratitude to my wife, Hsü Wen-Chin⁸, who has not only given her encouragement and support to my study over many long years, but also contributed a piece of her calligraphy for the oldest poem on 'Paper' appearing in Figure 1230, which adds a special feature to this volume. To many others who cannot be named here, I wish to offer my thanks for help of various kinds.

The University of Chicago
October 1983

T. H. TSIEN

¹ 榮寶齋
⁶ 胡道靜

² 朵雲軒
⁷ 昌彼得

³ 顧廷龍
⁸ 許文錦

⁴ 潘吉星

⁵ 張秀民