



纺织科技史导论

周启澄 屠恒贤 程文红 编著



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北宋王居正纺车图

INTRODUCTORY HISTORY OF TEXTILE SCIENCE AND TECHNOLOGY

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Zhou Qicheng Tu Hengxian Cheng Wenhong



宋耕织图中的花楼机

唐代捣练图

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内 容 提 要

本书简明介绍了纺织科学和纺织技术的发展历史。分总论、通史、专史和附录四部分。总论叙述纺织科学的总貌和纺织生产的发展历史;通史包括中国纺织史和海外纺织史,侧重纺织科技从原始到现代的演变规律;专史包括丝绸、麻纺织、毛纺织、棉纺织、印染、刺绣、针织、化纤、服装等的发展史。附录包括若干论文,涉及英语称中国为 China 的由来、提花机发展史及当代棉、毛纺织工业发展大趋势等。

本书可作中专以上学校相关专业的选修教材,特别是大学本科高年级及研究生的选修课教材,也可供纺织系统各级管理干部、纺织企业科技人员和社会各界对纺织有兴趣的人们阅读。

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前言

纺织是一项关系到亿万人民生活的生产活动。狭义的纺织指纺纱和织布,广义的纺织(大纺织)则包括化学纤维生产、原料初步加工、缫丝、针织、染整,以及最终的衣装、装饰、各类产业用纺织品的生产在内。解决纺织生产实践问题的方法和技艺就是纺织技术,在现代构成纺织工程;而人们在此基础上所掌握的基本规律体系,则构成纺织科学。

如今我国纺织生产,不仅保证了 13 亿人民舒适且优美的衣装,以及家居装饰、工农业生产、文化旅游、医疗、国防等等部门所需的纺织品,而且在 2000 年出口超过 520 亿美元,占世界同类出口总额的 13% 以上。棉纱布、毛纱呢绒、丝绸、化学纤维、服装等生产量,稳居世界首位。同时还创造了 1 000 多万个劳动就业岗位。

纺织科技在今天,正在吸收各方面高新技术,使纺织生产逐步从劳动密集型生产向智能化、信息化生产发展。回顾在人类历史上,纺织生产曾经发生过两次飞跃:第一次飞跃大约在 2 500 年前首先发生于中国,从此开始了手工业的时代。在这次飞跃中,我们的祖先做出了十分辉煌的贡献,我们把它归纳为“十大发明”,几乎可以和众所周知的“四大发明”相媲美。其中,最为突出的是育蚕取丝。蚕本来是桑树上的“害虫”,吃其叶,伤其树。蚕多桑必不繁,桑繁蚕必难多。这是一对矛盾。我们的先人把蚕和桑分离开来,实行适度采叶喂蚕,使蚕桑两旺,我国由此获得“丝国”的美誉,“适度”体现了中国哲学原理“中庸之道”。第二次飞跃大约在 250 年前发生在西欧,从此开始了大工业的时代。在这次飞跃中,我国的贡献则几乎微不足道。这中间,有许多问题值得我们去思考。现在正面临第三次飞跃,急需大量培养科技人才。

为了发扬我国上代人勤奋创造的优良传统,吸取上代人的创造思维经验,启迪年轻一代奋发向上,成长为纺织生产第三次飞跃的骨干力量,我们建议在各类相关学校,特别是大学本科高年级和研究生中,开设“纺织科技史导论”课程。为此,我们编写了这本教材。

本书主要取材于《中国大百科全书·纺织》中纺织史学科有关条目和《中国近代纺织史》的有关内容。《总论》是本人起草,经《中国大百科全书·纺织》分科主编会议审议,最后由陈维稷同志亲自修改定稿,并且署名刊用;《通史》是由我改写;《专史》则采自纺织史学科所约请的各分支行业权威专家们所写的条目;《附录》是本人近年来所撰写的有关期刊论文。成稿时,根据新近纺织科技的发展,作了增删和修改。为了使学有练习专业英语的更多机会,原来用英文发表的论文,仍保持用英文,附图也都加了英文图名。屠恒贤副教授结合教学实际对书稿提出了宝贵的修改意见。博士生程文红也对书稿录入和插图加工等方面做了许多工作,并由此对纺织科技史产生了极其浓厚的兴趣。我衷心希望,纺织史学科能有更多年轻的志愿者加入,使学科得到进一步发展。

本书着眼于普及纺织科学,行文深入浅出,图文并茂。但因时间及经费限制,还比较粗糙,衷心希望读者指正。

周启澄

2002 年 10 月

INTRODUCTORY HISTORY OF TEXTILE SCIENCE AND TECHNOLOGY

China is one of the few birth places of textile production in the world. Spindle whorls of 5200 B. C. were unearthed in Hebei Province. Textile handcraft industry was formed in China before 500 B. C. , since then a lot of innovations were made in China. In this book, main Chinese textile inventions and chief regularities of textile science and technology are simply described. Following are typical examples.

Silkworm breeding

The first and most important innovation made in China is silk production. Silkworms originally were harmful to the mulberry tree, which would be hardly to maintain living, if the silkworms were prosperous. How can the silkworm be abundant without any harm to the mulberry tree? Chinese forefathers discovered a clever method: to separate the silkworm from the mulberry tree. They picked all the silkworms down the trees, setting them in special baskets in a room and fed them with mulberry leaves moderately taken before (see Fig. 1 - 2). Thus the mulberry tree might be maintaining prosperous and large scale silk production became possible. Here Chinese forefathers realized the Chinese philosophy “**Moderation**”, avoiding any extremity. China was called by European nations “Serice”, meaning “country of silk”. The English term “China” was derived from French word “Chine”, the origin of which is “Sinae” in Latin, a variation of Chinese character “Si (丝 silk)”.

Opening through vibration

Before spinning, fibers must be opened. Chinese discovered vibration method by sound frequency, i. e. through vibration of the cord of a big bow (see Fig. 1 - 3, 1 - 4). Since the response of fibers with different lengths and weights to the vibration is different, the fibrous mass can be scattered and separated to single fibers without any damage.

Multi-spindle twisting frame

In spinning, a series of spindle wheels was discovered: from single-spindle (see Fig. 2 - 12) to three-spindle operated by hand; from three-spindle by foot (see Fig. 2 - 13) to multi-spindle (up to 32 spindles) operated by running water (see Fig. 2 - 15). Since there

was no drafting mechanism, this kind instrument in present sense, should be called the twisting frame.

Twist determination by contraction

Yarn twisting intensity is hardly determined without fine instruments. Chinese forefathers discovered quantitatively twist determining method: to judge the twist intensity through yarn contraction (see Fig. 1 - 6). To-day we know, that yarn contraction after twisting is positively correlated to the yarn twist (turns per unit length). The bigger the contraction, the larger the yarn twist.

Harnesses (healds) lifting by multi-pedals (treadles)

A series of looms was discovered also one after another: plain looms — from breast loom (see Fig. 2 - 10) to inclined loom (see Fig. 2 - 17, 2 - 18); patterned ones from multi-heald (multi-harness) multi-treadle (multi-pedal) type (see Fig. 2 - 20) to pattern sheet type (see Fig. 1 - 8).

For multi-heald multi-treadle looms, Chinese made two inventions: the **Dingqiao** (treadles with an array of scattered pegs) method (see Fig. 2 - 22) and the **combinatorial** method (see Fig. 2 - 21). In order to weave fabrics having big patterns, a large number of healds (up to 120) are needed. Since every heald is driven by a special treadle, the same number of treadles is necessary. But how can so many treadles (up to 120) be arranged within the loom frame? (If the width of treadle is 5 cm, 120 treadles will be 6 meters wide!) Chinese forefathers invented treadle only 1 cm wide, and 120 treadles may be arranged in the loom frame with a width slightly more than 120 cm. But how can the weaver pedal so narrow treadle without interfering neighboring treadles? A clever method was found: put pegs one on each treadle, arranging the pegs in an scattered array. The treadle is pedaled through the peg, thus avoiding any interference on neighboring ones.

To pedal dozens of treadles is quite troublesome. Mr. Ma Jun in the Three Kingdoms Period invented combinatorial method: let every heald be driven not by one treadle, but simultaneously by two treadles. Thus using only 12 treadles may drive 66 different healds, since $C_{12}^2 = 66$ (see Fig. 1 - 7).

Manual programming

When very large patterns (such as dragons) are required to be woven, 120 healds are not enough. New method is to drive every warp yarn individually. A set of vertical threads are added onto the warp (see Fig. 1 - 8), every vertical thread being connected to one warp yarn correspondingly. The information of “lift” or “no” of every warp yarn during

shedding is “recorded” on the corresponding vertical thread by putting a horizontal thread going ahead or behind the vertical thread. The set of vertical threads with intersected horizontal threads is called the “**pattern sheet**”, which forming a pattern recorder; thus a manual programming system is formed.

Dyeing and finishing arts

In the field of dyeing and finishing, a lot of innovations appeared also in ancient China. At present these arts are still existing in districts of minor nationalities and surprising to visitors both domestic and from abroad. Typical examples are: batik dyeing, tie dyeing (see Fig. 1 - 9), warp tie dyeing, simultaneous dyeing and finishing — shu-liang finishing etc. (see colored figures)

Miscellaneous fabrics

Miscellaneous kinds of fabrics are firstly appeared in ancient China, typical examples being: **satin**, **crepe**, **kesi** (fabric with thorough warps and zigzag colored wefts for simulating drawings and paintings). (see colored figures)

Piece goods standards

Governmental standards of fabrics appeared in China about 1000 B. C. (the Zhou Dynasty). A piece of cloth was required to be 40 Chinese feet (9.24 meters) in length and 2.2 Chinese feet (50.8 cm) in width, fitting for making 1 set of adult clothing at that time. Any fabric having dimensions not satisfying the standard was strictly forbidden in the market.

Organized labor

Since the Zhou Dynasty (1100 ~ 770 B. C.), textile labors were divided into specializations. In the Tang Dynasty, the governmental textile organization had 10 weaving workshops, each producing one kind of fabrics, 6 dyeing and finishing workshops, each dyeing one color.

This book consists of 4 parts: part I is general discussions; part II — general histories of China and of the other part of the world with discussions of development regularities and trends; part III — blench histories of Chinese textile production: silk, bast fibers, wools, cotton, dyeing and finishing, embroidery, knitting, chemical fibers, apparel; part IV appendixes — papers dealing with some important topics, containing 2 papers written in English.

This book may be useful for readers, who wish to understand Chinese apparel culture, and to know, how were the textile arts yesterday and what will be the future of the textile production.

致 谢

本书引用了《中国大百科全书*纺织》中纺织史学科多位专家的条目稿,特此致谢。

饮水思源

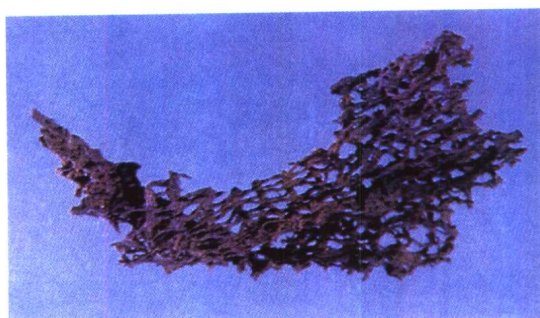
谨将本书献给:

创导和组织纺织科技史研究的前辈陈维稷老师和朱新予老师,以及为研究和推广纺织科技史耗尽后半生的老友高汉玉同志和赵文榜同志。

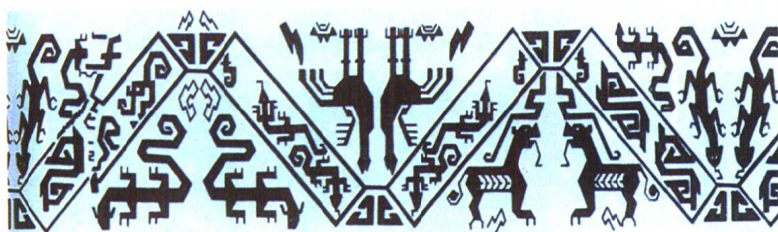
周启澄



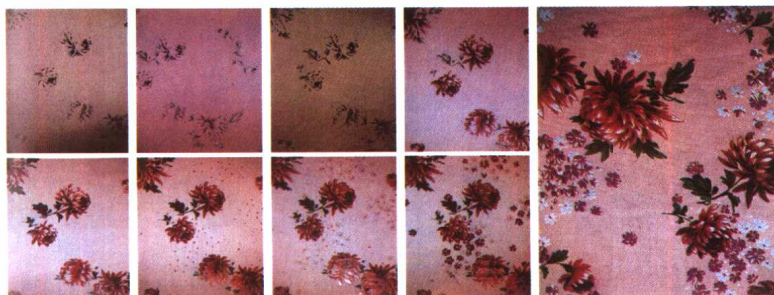
C1 6000 年前草鞋山葛织物
Kudzu cloth 4000 B.C. unearthed in Caoxieshan



C2 5500 年前浅绛色罗 (河南青台出土)
Purple silk leno unearthed in Qingtai
Henan Province (3500 B.C.)



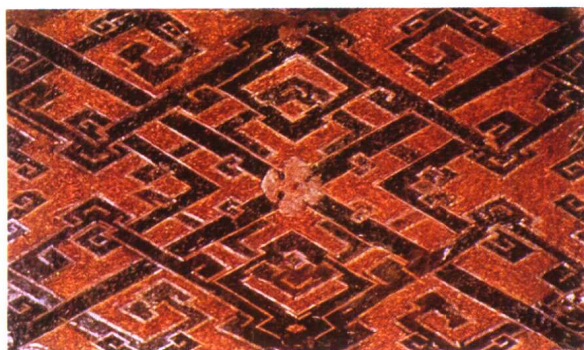
C5 战国舞人动物锦纹样复原图
A sketch of "dancers and animals" pattern (Warring States Period)



C14 现代八套色印花 Contemporary progressive printing with eight colors



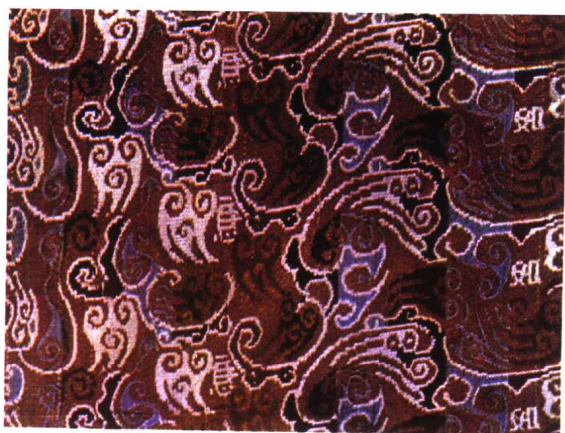
C15 战国六边形纹织成锦
Brocade with
hexagonal pattern
(Warring States Period)



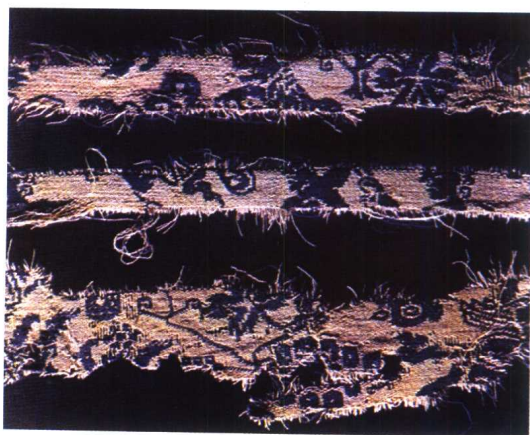
C17 西汉菱花贴毛锦
Brocade with lozenge pattern
(Western Han Dynasty)



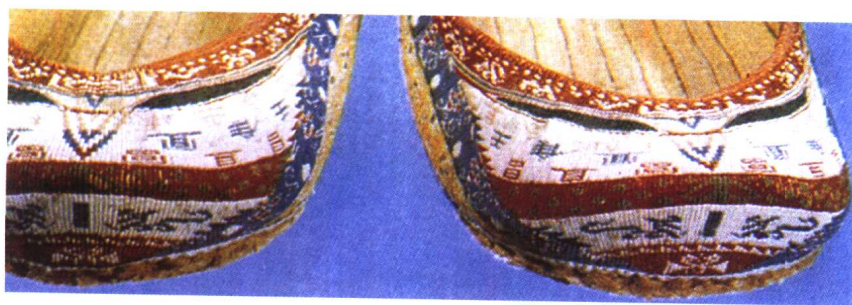
C16 战国印花布
Printed cotton cloth
(Warring States period)



C20 东汉万事如意锦
Brocade with Chinese characters
(Eastern Han Dynasty)



C21 东汉人兽葡萄纹毛织品
Patterned wool fabric of the Eastern Han Dynasty
with men-animal-grape pattern



C22 东晋织成鞋 Pattern woven shoes of the Eastern Jin Dynasty

C18 尼雅出土犍毛 “Kemao” unearthed in Niya Xinjiang



C19 新疆尼雅 2000 年前
男尸上的彩色毛料衣服



C23 北朝树纹锦

C23 Brocade with tree figures (Northern Dynasties)



C24 北朝扎染绢

C24 Tie-dyed silk of the Northern Dynasties



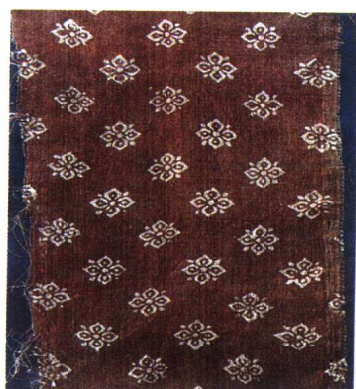
C25 北朝蜡染棉布

C25 Batik dyed cotton cloth (Northern Dynasties)

C19 Remains years 2000 ago unearthed in Niya Xinjiang District, showing colored wool apparels



C26 唐代扎染绢
Tie-dyed silk of
the Tang Dynasty



C27 唐代蜡染绢
Batik dyed silk of
the Tang Dynasty



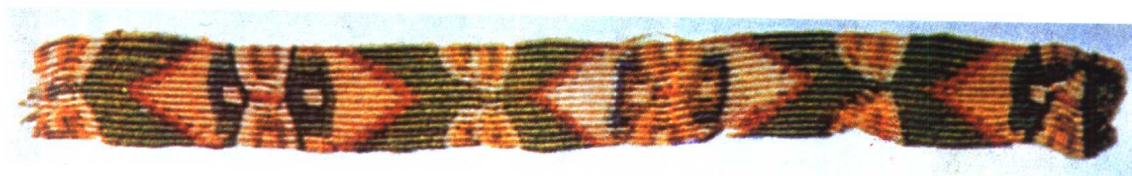
C29 唐印花绢
Printed silk of
the Tang Dynasty



C28 唐扎染罗
Tie-dyed leno of the Tang Dynasty



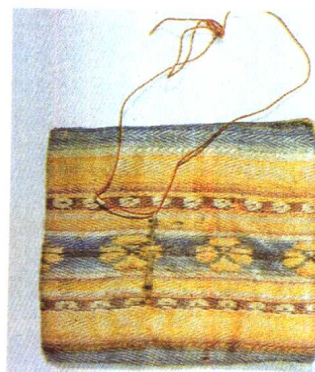
C30 唐代青容
Gauze with gold-painted figures on sky blue ground
(Tang Dynasty)



C31 唐代绛丝带
Kesi band of the Tang Dynasty



C32 唐代麻布



C33 唐代晕绡纹锦



C34 唐方棋纹锦

C32 Ramie cloth of the Tang Dynasty
C33 Brocade with muted stripes of the Tang Dynasty
C34 Brocade with chess figures of the Tang Dynasty



C35 北宋灵鹫纹锦



C37 宋锦八角回龙

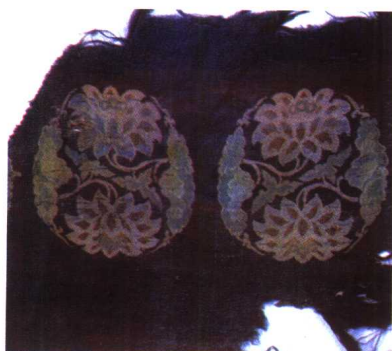


C38 南宋花綾

C35 Brocade with eagle figure (Northern Song Dynasty)

C37 Brocade with octagon and dragons (Song Dynasty)

C38 Patterned ghatpot of the Southern Song Dynasty



C36 北宋蓝地重莲锦



C40 南宋印金花边



C41 南宋罗镶花边单衣

C36 Brocade with double lotus patterns on blue ground (Northern Song Dynasty)

C40 Gold-printed lace of the Southern Song Dynasty

C41 Leno unlined clothing with patterned lace (Southern Song Dynasty)



C47 (上)清光绪龙袍局部 A part of the dragon gown of the Qing Dynasty

C39 (左)南宋朱克柔缣丝莲塘乳鸭图

Kesi "infant ducks in lotus pool" by Zhu Kerou (Southern Song Dynasty)



C44 明织金罗

Leno with gold-coated yarns (Ming Dynasty)



C45 (上)明代加金缎

C42a (左)元团龙凤龟子纹纳石失

C42a Patterned fabric with gold-coated yarns (Yuan Dynasty)

C45 Satin with Chinese characters woven with gold-coated yarns (Ming Dynasty)



C42b 元纳石失放大图



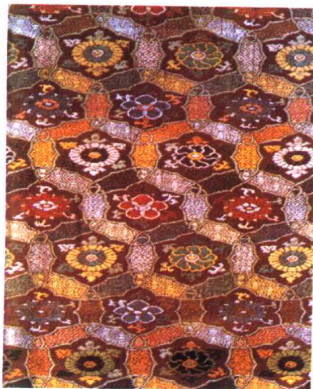
C42c 元纳石失放大图



C48 清代缂丝靠垫

C42b,c Enlarged parts of patterned fabric with gold-coated yarns (Yuan Dynasty)

C48 Kesi surface of a cushion (Qing Dynasty)



C43 明盘缘纹锦



C46 清妆花缎



C49 清代缎绣

C43 Brocade with spiral bands pattern of the Ming Dynasty

C46 Satin Zuang Hua of the Qing Dynasty

C49 Embroidery on satin ground (Qing Dynasty)



C50 4~5世纪埃及提花毯
Patterned blanket of Egypt in 4~5th century



C52 14世纪西班牙织物
Spanish fabric in 14th century



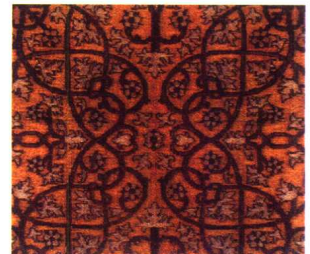
C53 15世纪意大利织物
Italian fabric in 15th century



C51 7~8世纪埃及织物
Egyptian fabric (7~8th century)



C54 15~16世纪意大利织金天鹅绒
Velour with gold-coated yarns
of Italy in 15~16th century



C55 16世纪西班牙织物
Spanish fabric in 16th century



C56 17世纪波斯天鹅绒
Persian velour in 17th century



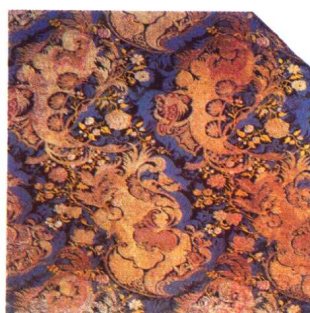
C57 17世纪土耳其阿拉伯文字织物
C57 Turkish fabric with Arabian characters in 17th century



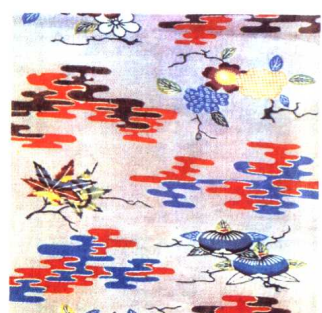
C58 17世纪印度印花布
C58 Indian printed cloth in 17th century



C59 17世纪小亚细亚织锦
C59 Minor Asian brocade in 17th century



C60 18世纪意大利提花织物
C60 Italian patterned fabric in 18th century



C61 19世纪日本花布
C61 Japanese printed cloth in 19th century



C62 清藏族睡垫

Sleeping cushion of Tibet nationality
(Qing Dynasty)



C64 清维吾尔族和田绸

Tied-warp dyed Hetian silk of Uygur
nationality (Qing Dynasty)



C63 苗族蜡染

Batik dyed cloth of Miao nationality



C65 清苗族双鹤锦

Brocade with figures of double cranes by Miao
nationality (Qing Dynasty)



C67 清傣族锦 Thai Brocade (Qing Dynasty)



C66 清哈尼族锦

Brocade of Hani nationality (Qing Dynasty)



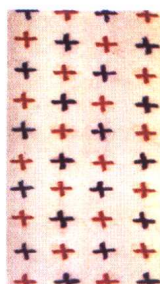
C68 清长城艺毯缉毛

Kemao (tapestry) of the Qing Dynasty



C69 西藏毛织物氍毹

C69 Pulu (a kind of wool fabric) of Tibet District



C71 贵州蜡染

C71 Batik dyed fabric in Guizhou Province



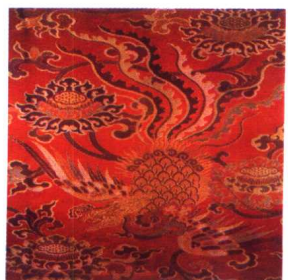
C70 台湾高山布

Cloth made by the natives of
Taiwan Province



C72 维吾尔族爱得丽斯绸

Adelis silk by Uygur nationality



C75 云锦妆花缎

Satin Zhuanghua



C73 (左)苗锦
Brocade of Miao
nationality
(left)



C74 (上)壮锦 Brocade of Zhuang nationality

C76 (右)现代缙丝
Contemporary
Kesi (right)



C77 战国锦绵袍 Floss gown
(Warring States Period)



C81 唐代女服
Woman clothing of the Tang Dynasty

C80 (右) 唐女俑
Maiden figurine
of the Tang
Dynasty
(right)



C78 (上)西汉绵袍 Floss gown (Western Han Dynasty)



C82 (左)台湾贝珠衣
Apparel with shell and pearl sets in
Taiwan Province (left)



C79 东汉锦袍



C83 黎族服装

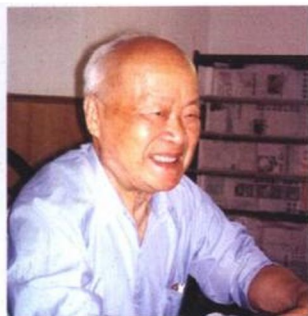
C79 Gown with brocade face (Eastern Han Dynasty)

C83 Apparel of Li nationality in Hainan Province

C84 Dragon gown of the Qing Dynasty



C84 清代龙袍



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*已在电子数字图书馆上网,网址:<http://www.pdg.com.cn>

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