Seeking Originality: An Analysis of Physics Elementary School Textbook *Shōgakkō Seitoyō Butsurisho* by Makita Gotō et al.

Toyomi Tamaki, Jun Shozawa, Hiroshi Takahashi and Akira Akabane

Abstract

In the early 2000, we uncovered more than 3000 school textbooks published in the Meiji Era (1868-1914) in the archives of the Gunma University Library. We created booklists for 276 Japanese-style school science textbooks in 2004. The *Shōgakkō Seitoyō Butsurisho*, Physics Textbook for elementary school students, was of greatest interest, because the writers had a strong affiliation to Gunma Prefectural Normal School, one of the predecessors of the present Gunma University where we are now responsible for science education. This paper provides a preliminary analysis of this textbook.

Keywords: Meiji Era, Elementary school physics textbook, Gunma Prefectural Normal School, Gunma University Library

1 Introduction

The year 1868 marks the beginning of Meiji Era, ushering in a period of rapid national modernization and transition from feudal to industrial Japan. The fundamental motivation of the new government was to gain parity with the West and be accepted as an equal among then advanced nations. Pursuit of science was encouraged by the authorities. As elementary school education was formally established in 1872, science classes became an integral part of the curriculum. At first, translations of textbooks originally published in Europe or US were used. For example, *Butsuri Kaitei* published in 1875, was used for the study of elementary physics. It is basically a translated version of *First Lessons in Natural Philosophy* written by R. G. Parker and published in 1842 in the United States. However, *Shōgakkō Seitoyō Butsurisho* (*Physics Textbook for Elementary School Students*) published in 1885 is very different: it is an original textbook, written in an easy-to-understand style and based on the description and interpretation of simple physics experiments.

We found more than 3000 Meiji Era textbooks in the Gunma University Library in 2001. They had been left with small paper attachments that showed the original organization to which they had belonged. Stamps on the books also helped us locate the first and successive owners. We found that the books were the heritage of Gunma Prefectural Normal School and Gunma Prefectural Girls Normal School. Among them, 276 school science textbooks were listed in a science report in 2004 [1]. There were eight

copies of *Shōgakkō Seitoyō Butsurisho* then. Three of them had been bought by Gunma Prefectural Normal School and the remaining 5 were the collection of the Hometown Laboratory of Gunma Prefectural Girls Normal School in 1931. We wanted to explore how these textbooks had been used in Gunma Prefecture and how *Shōgakkō Seitoyō Butsurisho* had been edited by the authors.

2 School Science Textbooks

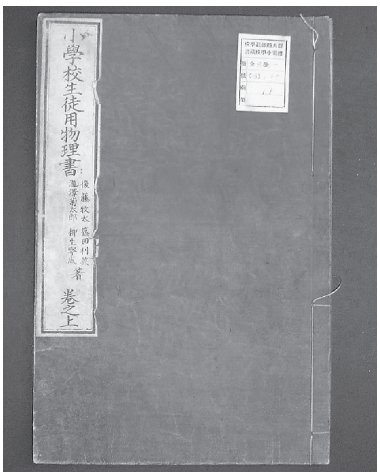
We collected 276 Japanese-style school science textbooks from 3000 Meiji Era textbooks and created booklists for them [2]. The books were classified into the following six subject areas: physics, chemistry, natural history, physiology, general science and physiography. The number of books in each subject area were 55, 58, 26, 44, 91 and 2, respectively. A few of physics textbooks are shown in Fig. 1.

3 *Shōgakkō Seitoyō Butsurisho*

The first author, Makita Gotō, was born in 1853 and passed away in 1930. He was a physics teacher at Tokyo Normal School in his thirties when he wrote this textbook. Later, he became a professor at Tokyo Higher Normal School (Now Tsukuba University), established in 1886 [3]. The other authors, Shinoda, Takizawa and Yagyū, were all physics teachers in Gunma Prefectural Normal School. The years they worked at Gunma Prefectural Normal School were 1882–1886, 1883–1892 and 1884–1886, respectively.

Makita Gotō's thoughts about elementary physics education are clearly described in the preface of the textbook. We consider it to be representative of his educational philosophy. To be precise, the preface was co-authored by: M. Gotō, K. Takizawa, T. Shinoda, and Y. Yagyū. We, however, judged that Makita Gotō wrote the preface based on the fact that this section was written using only "Hiragana" (Japanese

Fig. 1 A few of Physics textbooks. *Butsuri Kaitei* is shown in the center group.



(a)

(b)

Fig. 2 (a) The cover of the textbook *Shōgakkō Seitoyō Butsurisho* published in 1885. (b) A portrait of Makita Gotō copied from the homepage of the Archives of Keio University.

phonetic syllabary), style particular to M. Gotō. Below is the translation of the preface.

3.1 Preface of *Shōgakkō Seitoyō Butsurisho*

This book avoids material considered unnecessary or too difficult for students even though it may be useful for class purpose.

This work is written briefly and does not go into in-depth explanation. The style lends itself to oral instruction and effort was made to avoid subject matter more suitable to independent learning.

The reason why this book is titled *Shōgakkō Seitoyō Butsurisho* is that we intend to make another textbook for teachers soon. It will be based on the present book and will illustrate how to teach, conduct experiments, make and use equipment, sample questions to ask students, and will include explanations of difficult parts in this book.

Experiments shown in this book are very simple therefore they can be conducted by teachers and/or students using original equipments. For those interested in learning other procedures of simple experiments we would like to recommend *Kan'i Kikai Rikagaku Shikenhō* (*Methods of Simple Experiments in Physics and Chemistry Using Easy Equipment*) co-authored by Gotō and Miyake.

This book is written in a language very accessible to students because there is little point in spending valuable time on vocabulary and language aspects.

In this book, there are places where printed text is smaller. These parts denote more complex sections which are to be skipped if teachers deem them inappropriate in the light of students' level.

The equipment for conducting experiments shown in this book are all for sale at Seirensya shop in Shitaya Takechō, Tokyo for 25 yen per set.

September, Meiji 18 (1885), Tokyo,
written by the authors

3.2 Contents of the textbook

Shōgakkō Seitoyō Butsurisho comprises three volumes. Volume 1 contains Part 1: Movement and Force, Part 2: Liquid, and Part 3: Gas. Volume 2 contains Part 4: Sound, Part 5: Heat, and Part 6: Light. Volume 3 contains Part 7: Magnets and Part 8: Electricity [3].

Every part contains several sections. Each section is clearly and analytically explained in the following sequence: Example, Experiment, Definition, Fact, Determination, Reason and/or Application.

There are many figures in the textbook. For example, Volume 1 is composed of 3 parts, 26 sections and 47 experiments, containing 39 figures. They are mostly simply drawn figures. But there are a few which are artistic and more complex, as shown in Fig. 3. Both types of figures are effective in explaining concepts of the fundamental physics.

In order to examine the aforementioned

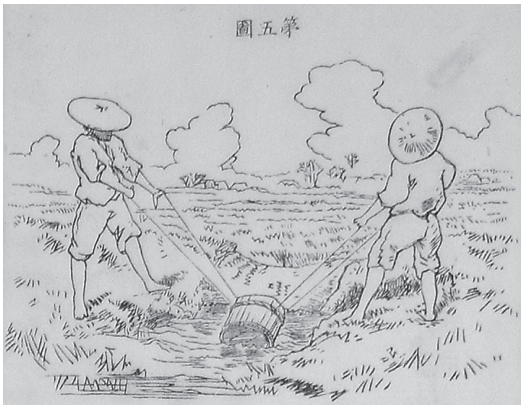


Fig. 3 Figure No. 5 in Section 5: Work of Two Forces in Part 1: Movement and Force

style, we refer to a translation of Section 7: Action and Reaction in Part 1: Movement and Force.

3.3 Section 7: Action and Reaction in Part1: Movement and Force

EXAMPLE

As shown in Fig.4 (Figure No. 10 in Section 7), when a child on the left sitting on a swing is going to draw a child on the right towards him, the child on the left also approaches the child on the right. Moreover, when someone on a boat pushes another boat with a pole, his own boat will also move backwards. Furthermore, if someone draws another boat towards him, his own boat can also be drawn towards the other.

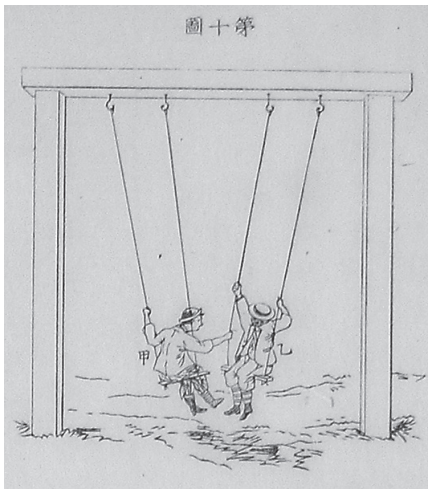


Fig. 4 Figure No. 10 in Section 7: Action and Reaction in Part 1: Movement and Force

EXPERIMENT No. 13

A thin strip of bamboo was bent like a hair pin as shown in the freehand drawing of Fig. 5 (b) (Figure No. 11 in Section 7). One end of it was bound to the outside of a teacup or a glass. The other end was put inside the cup. Halfway down each end, the bent bamboo was tied with a thread. This apparatus was floated on water. When the thread was burned, the teacup doesn't move anywhere but the free end of the bamboo hits the edge of the cup.

DETERMINATION

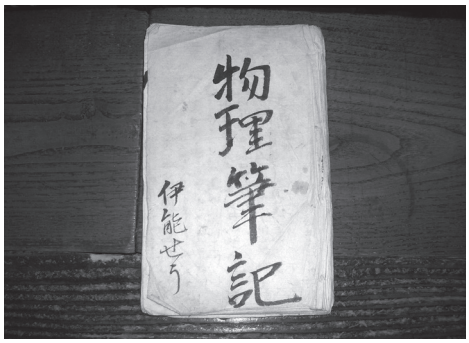
For every action, there is an equal and opposite reaction.

FACT

When a bird flies, its feathers hit the air. When one swims, it paddles in the water. When you fire a gun, it backkicks and pushes against your shoulder. Even if you push a car when you are inside it, the car will not move at all.

3.4 Particular study of the textbook

Fig.5 shows *Butsuri Hikki*, (*Physics Notebook*) written by Ms. Shō Iyoku in the Meiji Era. We found it at Nakanojō Museum of Folk



(a)

(b)

Fig. 5 The physics notebook written by Ms. Shō Iyoku about 125 years ago. (a) The title *Butsuri Hikki* and her name. (b) Figure No. 11 used for Experiment No. 13 described in Section 7 is seen on the right-hand page.

and History in Nakanojō, in Agatsuma District of Gunma Prefecture, Japan, when we visited the place in 2006.

Since our discovery, physics notebooks or notebooks for other subjects written by students during the Meiji Era have been found in many places in Japan. Therefore, we think it was a popular practice to make *Hikki* (*study notebooks*), when students studied several subjects. *Hikki* would thus be a good resource to help us understand how students studied science in the Meiji Era. Through our research, we found that the *Butsuri Hikki* of Ms. Shō Iyoku was a handwritten copy of *Shōgakkō Seitoyō Butsurisho*.

Fig. 6 is a parallel that shows a printed figure (left) and the student's hand-drawn one (right) of Figure No. 29 in Section 21: Air Pressure in Part 3: Gas. She traced the figure on a semi-transparent paper. Almost half of 39 figures of *Shōgakkō Seitoyō Butsurisho* in Volume 1, 21 figurers accurately, have been drawn in this way.

3.5 Application of simple experiments in our time

Experiment No. 13 was included in our repertory of simple experiments for a science show for kids and was introduced in our previous paper [4]. Here we show another simple experiment. It is Experiment No. 10, which is described in Section 6: Balance in Part 1: Movement and Force. In Fig. 7 we show a handmade balance with a scale made of bamboo. A 1-yen Japanese coin is used as an accurate one gram weight. Fig 7 (a) shows a balanced state and (b) shows an oblique state caused by the 1-yen coin. The latter suggests the accuracy of the balance. This apparatus is popular with elementary school students attending Science Festivals, which are held in Gunma Prefecture during the summer vacations.

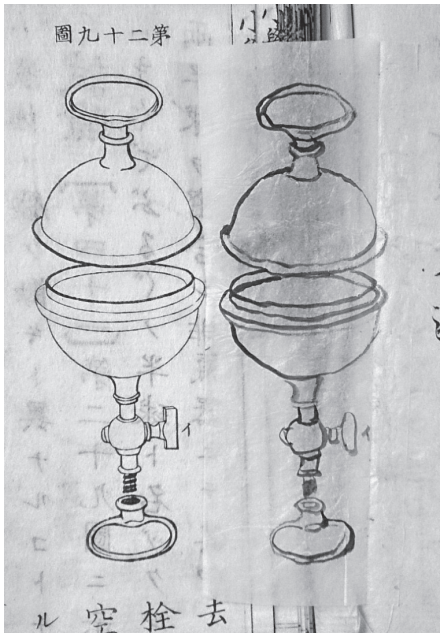
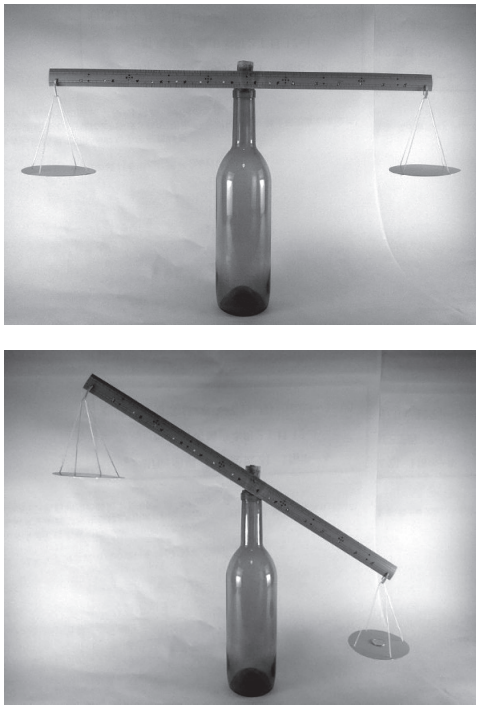


Fig. 6 Figure No. 29 in Section 21: Air Pressure in Part 3: Gas. One the left is a printed figure in the textbook and on the right is a hand-traced copy of it by Ms. Shō Iyoku.



(a)

(b)

Fig. 7 A handmade balance with a bamboo scale. (a) The balanced state. (b) The oblique state caused by a 1 yen coin.

4 Conclusions

Shōgakkō Seitoyō Butsurisho was regularly used in Gunma Prefectural schools as a physics textbook since its publication.

We now assume that the textbook was written after the local experimentation trials which were conducted in many places around Gunma Prefecture.

The material presented in the textbook inspired interellectual curiosity in a girl who went on to make notes with many hand-drawn figures.

Even nowadays, simple experiments taken from the textbook give pupils the motivation to study science.

This article was originally prepared for the proceedings of the International Conference on Physics Education held in Beijing, China, 2015 (ICPE 2015). The proceedings haven't been published and we have already informed the Japanese secretariat ICPE 2015 that we intend to withdraw our paper from publication. The format has been changed from the official submission rules establised by ICPE 2015 and several new sections were added.

Acknowledgment

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(たまき　とよみ) 株式会社数理設計研究所
(しょざわ　じゅん) 東京未来大学
(たかはし　ひろし) 群馬大学
(あかばね　あきら) 埼玉医科大学