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Some notes on translations of the *Physics Primer* and physical terminology in late Imperial China

Iwo Amelung

1880 年至 1903 年之间，Balfour Stewart 著的 Physics Primer（初版 1872）曾三次译成中文，在中国出版。关于物理学翻译，以及物理学术语研究有待于加强的今天，考察这三种中译本将给我们有益的启示。通过原著与三种译本的比较，不仅可以了解译本的翻译质量，还可以廓清物理学领域术语成立的某些问题。

The reception of Western knowledge related to the different sciences in China and the problems of terminological accommodation closely related to it, have since the middle of the 19th century, when this process started in earnest received a high degree of attention. Bibliographical and especially terminological problems of course were of great relevance for persons actively engaged in the different enterprises related to the transmission and reception of Western scientific knowledge. While this topic always was somehow on the list of practitioners and researchers (we should note for example that the journal of the Chinese Science Society *Kexue* 科學 during the 10s and the 20s of the 20th century contained a regular column devoted to terminological problems), it during the last ten or so years, has been subjected to scrutiny in a more systematic way. Researchers dealing with the problem, however, have very different goals and employ widely differing methods.

While during the first phase of this recent interest, researchers tried to give a broad picture of the transmission in general, as for example Xiong Yuezhi 熊月之 in his pioneering book from 1994[1] or focused on terminological change in a likewise general way,

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[1] Cf. Xiong Yuezhi 熊月之. 1994. *Xixue dongjian yu wan Qing shehui* 西學東漸與晚清社會 (The dissemination of Western knowledge and late Qing society). Shanghai: Shanghai renmin chubanshe,

terms[3], analyze important books or newspapers[4], and more recently are devoted to the interaction of the reception of Western knowledge and the establishment of modern academic disciplines in early 20th China.[5] Depth and quality of this research, however, are anything but uniform. While we have several studies on Chemistry–at least partially due to the intriguing and particular interesting problems, which coining of Chinese characters for the elements posed[6]–and other fields, like Geography etc. are rather well researched,[7] research on the transmission of physical knowledge and on physical terminology is still lagging behind. Although Wang Bing 王冰 recently has published a book on Sino-foreign exchange related to physics[8], the parts relevant for the late 19th and the early 20th century are almost completely based on her valuable, but by now not in all cases up-to-date articles from the 80s and the 90s. In the field of the reception and transmission of physics, we consequently are still in a phase of research, in which a larger number of case studies could contribute considerably to our understanding of some of the problems involved and might be useful for laying the foundation for more systematic and more

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[3] We should note that W. Lippert's work on the creation of Marxist terminology pre-dates the recent wave of research for more than 15 years, cf. Lippert, Wolfgang. 1979. *Entstehung und Funktion einiger chinesischer marxistischer Termini. Der lexikalisch-begriffliche Aspekt der Rezeption des Marxismus in Japan und China* (Münchner Ostasiatische Studien 19), Wiesbaden: Steiner.

[4] Cf. for example Shen Guowei 沈國威 (ed.). 1999. *Rokugo sodan no gakusaiteke kenkyu* 六合叢談の学際的研究 (Studies on the academic aspects of the Shanghae Serial). Tokyo: Hakuteisha.

[5] Cf. especially Kurtz, Joachim. 2003. "The Discovery of Chinese Logic. Genealogy of a Twentieth-Century Discourse", unpublished PhD.-Dissertation, University of Erlangen–Nuremberg.

[6] Cf. Reardon-Anderson, James. 1991. *The Study of Change. Chemistry in China 1840-1949*, Cambridge/Mass: Harvard University Press, Wright, David. 2000. *Translating Science. The Transmission of Western Chemistry into Late Imperial China, 1840-1900* (Sinica Leidensia), Brill. There is a large number of relevant articles in Chinese, the most substantial written by Wang Yangzong 王揚宗. Cf. for example "Guanyu Huaxue jianyuan he Huaxue chujie"關於化學鑒原和化學初階 (On *Hua xue jian yuan* and *Huaxue chujie*), *Zhongguo keji shiliao* 11:1 (1990), pp. 84-88 and "A new inquiry into the translation of chemical terms by John Fryer and Xu Shou", in: Michael Lackner, Iwo Amelung, Joachim Kurtz (eds.). *New Terms for New Ideas. Western Knowledge and Lexical Change in Late Imperial China*. Leiden: Brill, pp. 272-283.

[7] Cf. for example Guo Shuanglin 郭雙林. 2000. *Xichao jidang xia de wan Qing dilixue* 西潮激蕩下的晚清地理學 (Late Qing geography under the impact of the Western Wave), Beijing: Beijing daxue chubanshe., Zou Zhenhuan 鄒振環. 2000. *Wan Qing xifang dilixue zai Zhongguo* 晚清西方地理學在中國 (Western geography in China during the late Qing period), *Shanghai*: Shanghai guji chubanshe.

[8] Cf. Wang Bing, Dai Nianzu 王冰，戴年祖. 2000. *Zhongguo wulixue shi daxi - Zhongwai wuli jiaoliu shi* 中國物理學史大系- 中外物理交流史, Changsha: Hunan jiaoyu chubanshe.

definite work. In this brief article, I will attempt to undertake such a case study–or rather mainly provide "documentation"–based on an analysis of three Chinese translations of an English textbook on Physics.

Some Bibliographical Notes

The *Science Primer Series* was one of the most popular series of textbooks related to the sciences of the 19th century. The series, conceived, edited and partial written by well-known English scientists as A. Huxley, H. Roscoe and Balfour Stewart originally was printed in London by Macmillan starting in 1872. An American edition printed by Appleton in New York appeared already in 1873. Due to its popularity the series saw several editions still in the 70s, revised editions were published in Britain and the US since 1879. The book not only was tremendously successful on the English-language market (even in Japan at least two English versions of some of the original books were published) but also was translated into almost all major languages of the world.

It thus is not particular surprising that the series was translated into Chinese as well. The first partial translation of the series was done by the missionary and translator Young J. Allen (Lin Lezhi 林樂知, 1836-1907) in collaboration with the Chinese translator Zheng Changyan 鄭昌棪(?-1902) and was published, probably in 1880 at the Jiangnan arsenal in Shanghai. This publication only consisted of translations of four books of the original *Science Primer Series*, namely the *Chemistry Primer*, written by H. Rosoe, the *Physics Primer*, written by Balfour Stewart, the *Primer on Physical Geography* written by Archibald Geikie and the *Astronomy Primer* written by Normam Lockyer. This series was published under the title *Gezhi qimeng* 格致啟蒙 (Introduction into the sciences), with the respective sub-titles *Huaxue* 化學 (Chemistry), *Gewuxue* 格物學 (Physics), *Dilixue* 地理學 (Physical Geography), and *Tianwenxue* 天文學 (Astronomy). The *Introductory Primer* written by Huxley, was translated separately by Henry Loch (Luo Hengli 羅亨利 1827-1900) and Qu Anglai 瞿昂來 as *Gezhi xiaoyin* 格致小引 and only published at the Jiangnan Arsenal in 1886. As far as I am aware all these books were included in unchanged form in the *Sequel to the great Collection of Western learning* (*Xu xixue dacheng* 續西學大成), which was edited by Sun Jia'nai 孫家鼐 and published in 1897.

A second Chinese translation was published in 1886 by the Imperial Customs. It had been suggested by the Inspector General Robert Hart and apparently was carried out single-handed by the missionary-turned-translator Joseph Edkins (Ai Yuese 艾約瑟, 1823-1905). According to the preface of the *Introductory Primer*, he had worked on the translation for five years. Except for the five books mentioned above it contained other books from the *Science Primer Series* as well as a *Brief description of Western learning* (*Xixue lüeshu* 西學略述) written by Edkins himself. The series was published under the title *Gezhi qimeng* 格致啟蒙 as well. While multiple translations of the same work by different translators are not exactly unknown in late Imperial China, it is impossible to say for what reason Edkins decided to embark on a complete new translation of the books just published by Allen and Zheng. It is very unlikely that he was not aware of their translation. It might be that he thought that some of the shortenings, which were done by Allen and Zheng, were inacceptable, so that a new fuller translation was necessary. Most likely, however, he was not really satisfied with the terminology employed by Allen and Zheng and for this reason decided on compiling a complete new translation, employing a uniform terminology throughout the series, however not completely successful in all cases. As far as I can see by now, Edkins' translation saw at least two reprints, one published by the *Zhuyitang shuju* 著易堂書局 in Shanghai in 1896, a second one published by Yingji shuzhuang 盈記書莊 also in Shanghai in 1898. Parts of the collection apparently were published by the Tushu jicheng yinshuju 書集成印書局 also in 1898.

As I have stressed elsewhere the translation of the *Physics Primer* is of considerable interest for the reception of Western physics in late Imperial China since Allen's and Zheng's translation can be considered as the first physics-book drawing together the single disciplines of physics, hitherto introduced into China in a piece-meal fashion in one book. I have noted as well that already the fact that Allen called the physics-part of his introduction *gewuxue* 格物學 while Edkins opted for *gezhi zhixue* 格致質學 to a certain extent can be used as an indicator to the terminological confusion prevalent in China during this particular period.[9]

Before addressing this issue in more detail, we need to take a brief look on some of the bibliographical details of the third Chinese translation, alluded to above. How difficult bibliographical research on translations of textbooks during the very late Imperial era is can be seen by the fact that former research has almost completely failed to note the book at all. It was

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[9] Cf. Amelung, Iwo. 2004. "Naming Physics. The Strife to Delineate a Field of Modern Science in Late Imperial China", in: Lackner, Michael, Vittinghoff, Natascha (eds.), *Mapping Meanings: Translating Western Knowledge into Late Imperial China*, Leiden: Brill, pp. 381-422.

published as *Wulixue xin shu* 物理學新書 (A new book on physics) as part of the *Translated encyclopedia of normal education* (*Bianyi putong jiaoyu baike quanshu* 編譯普通教育百科全書) by the Huiwen xueshe in Shanghai 上海 in 1903. This encyclopedia was translated by the extremely productive but enigmatic Fan Diji 范迪吉.[10] The book, however, was not translated from the English original but, as apparently most of the books of this series, from a Japanese book published at Fuzanbō in 1891.[11] This book is largely based on Stewart's English original. It for example employs the same illustrations as the English book. It is, however, to a certain extent re-organized and shortened–in contrast to the two books introduced above the order of the chapters and sections was not retained. However, as we will see in a moment, it is close enough to the original to be considered as a translation of the book. It is impossible to say, whether Fan Diji was aware of the two earlier Chinese translations. It is clear, however, that even if he was, he could not have cared less, since his book is completely based on the Japanese edition, not only in respect to the terminology employed but at times visible even in the phrasing and structure of the sentences in the translation.

However this may be, the fact important for our research here is, that we are in the favorable situation of having access to three translations of the same book, which were published in China within the comparatively short period of 24 years. Since these years were marked by a high degree of instability in respect to scientific terminology, a closer look into these translations may be of some help of gaining a better understanding of some of the issues involved.

A closer look into the translations

On the following pages I compare some passages from the original *Physics Primer* with the three Chinese translations.

English Original	Translation by Allen and Zheng	Translation by Edkins	Translation by Fan Diji
3. Definition of Force. – Now what is it that	第三 論力 物本不動因何者使	第三節 何為力 有人來前致問物靜	第三節 力之定義 使運動靜止之物體

[10] On Fan Diji's translations cf. Reynolds, Douglas. 1993. *China, 1898-1912. The Xinzheng Revolution and Japan*, Cambridge: Harvard University Press (Harvard East Asian Monographs 160), p. 114.

[11] A list of the books is included into Xiong 1994, p. 647-651. Xiong, however, somehow surprisingly does not list the book under review here.

sets in motion anything that was previously at rest? Or what is it that brings to rest a thing that was previously in motion? It is force that does this. It is force that sets a body in motion and it is force (only applied in an opposite direction) that brings it again to rest. Nay, more, if it requires a strong force to set a body in motion, it requires also a strong force to bring it to rest. You can set a cricket- ball in motion by the blow of your hand, and you can stop it by a blow, but a massive body like a railway train needs a strong force to set it in motion, and a strong force to stop it.	之動物本動因何者使之不動無他力也力在一邊推之則行力在兩邊相拒則止有大力使之行必得有大力使之止炮彈一推即行手即以推之力擋住汽車有若干力可駛行亦必有若干力使勤住	而使之動者為何或云物動而使之靜者為何則將應之曰即力也力能令動物止而靜并能令靜物起而動令靜物動之力令動物靜之力同為力也惟方向相對矣令靜物動時設加以大力欲靜其物不使動亦必加以大力二力之理相同也有以皮球於此欲弄之行動手力即能勝其任欲皮球中止反手即可成功載中車行於達衢非手力所能輓之動而拽之靜必以大力方可使之行必以大力方可使之止也蓋易施力使動之物亦為易施力使靜之物難施力使動之物亦為難施力使靜之物耳由是觀之是力之為用不惟可使靜物動兼可使動物靜無論物靜時使動動時使靜皆力為之	又使靜止運動之物體若變其速度或變其方向者力也而以小力使運物體靜止之亦以小力為充分而以大力運行者使靜止之亦須大力例如時計之垂球使運動之又使靜止之以小力為多反之如使汽車運動又使靜止即須大力
39. Energy in repose. – It is very easy to see that a body moving	第三十九 論物力靜存 最容易見者物動快	三十九節 物靜作工之力 人見物動之迅速也	第四十三節 潛勢 有甚速運動之物體為多量之働具有力

very fast has the power of doing a great deal of work, but besides this we haven often energy in a quite state.	速即是有力做功可照前計算有若干功物有時不動而靜存非不能動蓋其力仍在也	即謂其作工之力大且成功甚易外此亦知物靜不動亦非無力也	雖最易了知然其外靜止之情形尚有存在之勢
75. Nature of Heat. – We have already compared heat to sound, and told you that a heated body is an energetic body. Let us now take up this comparison once more. In sound we have two things to study: first, the body which vibrates; and secondly, the impulses which this body sends out through the air to our ear, and which make us hear a sound. Now you were told that a heated body is one in which the small particles are in a very rapid vibration, and that just as a vibrating body gives out sound, which strikes the ear, so a heated body gives	第七十五　論力生熱熱生力 前經比較熱與聲見熱之有力今仍申論音聲有二理一須講究擺搖動之物為何質一須講究擺搖擊空氣傳於耳而成聲至於熱即其微渺質點急迅震慄故擺搖之動耳得之而成聲震慄之動目遇之而成光夫物非自為擺搖也必有重物擊之乃為擺搖即如敲鐘有杵當杵將敲到鐘時空中杵行有力杵到鐘時力果何往蓋杵力到鐘鐘受其力而擺搖譬之鐵匠將軟鉛置鐵墩上而以鎚擊之軟鉛無他響聲鎚擊之力即變為熱鉛之微渺質點震慄成熱倘屢擊之鉛亦能化試以銅鈕在木上磨之其磨擦之	七十五節　何為熱 上數節中已將聲與熱兩相對較並云熱有能力之物矣於茲時也可復於其事加意揣之聲之中可留心揣度者有二一為經聲撞顫動之物其一即物發聲顫動鼓盪風氣風氣與風氣授受遞續相傳鼓蕩入我耳使我聞聲也 前乎此時諸生不聆有云人之所謂熱物即內含有若許微點顫動之物乎或物作速顫動發有聲入人耳或物經火熱發有光入人目均為物中微細點從速顫動而然也惟其物何以即能如是之動乎鼓聲淵淵鐘鳴鏘鏘皆屬有擊扣者方然耳鐘膛內木舌向四圍鐘體擊撞即顫動發聲擊鐘之器無論為木	第八十節　熱之性質 前節既陳述熱與音響之比較今再就音響而言之則一為其震動體次為其震動體與空氣而使吾人之耳達音響之打激是也如受熱物體之分子以非常速度運動發光而打擊目恰如震動體起音韻而打擊耳且如一物體例如鐸又大鼓有震動只因打擊之甚故聞鐵鎚鐘瓣向鐸之一邊運動即打無論初震動即此時鐵鎚又鐘瓣速有運動物體之勢故得為働作打鐸之後其勢在鐸故鐸震動而震動之物體不有體勢其故在鐸所打擊之勢不消滅卻從鎚移轉於鐸今冶工於鐵砧上置鉛之一片以重錐打之則聞鈍音不如

out light, which strikes the eye. But how is a body made to vibrate; a bell or a drum, for instance? – only by giving it a blow, You bring the heavy hammer or tongue quickly against the side of the bell, and the bell begins to vibrate; now this hammer or tongue before it strikes the bell is a body in rapid motion, and therefore possesses energy, or can do work. Well, what becomes of its energy after it strikes the bell? It has, in truth, given up its own energy to the bell, for the bell is now vibrating, and you have already been told that a vibrating body is one with energy in it. Thus the energy of the blow given to the bell has not been lost, but has only been transferred from the	力即可成熱	舌為木棒當夫尚未擊鐘之先其舌棒要為能速行物具有大力能工作者其力向鐘施去實效即於鐘昭顯諸生亦聞夫物之顫動皆有力隱寓於中乎鐘經擊觸而鼓盪擊鐘之力原非失喪也惟有離卻擊鐘之器而傳與鐘體內耳臂猶鑪匠之鍛煉金品也安一鉛塊於砧上屢舉鎚加力擊打每有一次鎚煉諸生耳中即聞丁丁之聲不似鐘被擊之若等顫動聲試為思之擊鐘之若等力於何歸去乎則將告以擊鐘顫動之力已變為熱鉛被擊時鉛之個點具顫動第不同於入耳來之鐘聲若等動別有一種動式耳 鑪匠頻頻加力錘煉夫鉛並能變其鉛為他等式也即液質 持紐扣於木面擦磨即可將紐扣磨至極亮固為諸生所共知	鐸之震動此時此勢如鐸之震動非變化耳所打擊之震動然則此勢果為何變化耶曰蓋為熱之變化也因此打激熱此鉛片凡震動其分子而其激動僅與鐸之震動異若充分打擊鉛片則必至最終鉛可鎔解

hammer to the bell. Now let us suppose a blacksmith places a piece of lead upon its anvil and brings down his hammer upon it with a heavy blow. You hear a dull thud, but there is no vibration like that of the bell. What becomes therefore of the energy of the blow? It is not transformed into vibrations like those of the bell, which can strike the ear – into what therefore is it changed? or is it changed into anything? We reply that it is changed into heat. The blow has heated the lead and set all its particles vibrating, although not in the same way as those of the bell; and if the blacksmith strikes the piece of lead long enough, I dare say he will even		所乎誠告諸生力已變為熱也試將其紐扣置於手背或置於同人之手背即知其已變為熱矣	

melt the lead. No doubt some of you have spent much energy in rubbing a bright button on a piece of wood. Now what has become of all the energy you have spent upon the button? We reply, it has been transformed into heat, as you will easily find out by putting the button quickly on the back of your own hand or on the back of your neighbour's.			
85: Energetic nature of electrified bodies. – From what has been said you must now be convinced that electricity is something which has energy in it. You see that the two opposite eletricities of the jar rush together and unite, and that the union is accompanied by a flash and a	第八十五 論電力 今觀電氣大有力量陰陽二電之路一通即跳發火星計其明亮火光一閃之速率即一秒工夫分作二萬四千分內之一分工夫其迅無比即成有多許熱氣夫熱氣即力也蓄一瓶電氣於此其電發有力乃能變化而顯其熱與光又電為有力之物須用力乃能發電旋	第八十五節 含電氣物其力如何 諸生曾觀上文業知電氣為有力物蓄電瓶內外相觀望之陰電陽電互趨就合而為一既有火星迸出兼聞有聲響矣此火星發時極明雖為時甚暫不能踰判一秒為二萬四千分之一分猶可謂其為發有多熱也有熱即屬有力當蓄氣瓶向外放	第九十節 蓄電體之勢 依以上所論知電氣乃是有勢者也蓄電器內外相反對之電氣在合體平均時則發電火及音固人所目擊也此電火從二萬四千分之一秒時間長繼續尚有光且起著熱而熱即勢故蓄電器放電之電氣只稱電氣一種之勢為變光及熱之勢而

report. This flash is very bright while it lasts; and although it does not last longer than the twenty-fourth thousandth part of a second, it nevertheless implies considerable heat. Now heat means energy, and we thus see that when jar is discharged that kind of energy, which we call electricity is changed into that other form of energy which we call heat and light. Again since electricity is an energetic thing, it requires labour or work to produce it; you do so by turning the electric machine, but such a machine is particularly hard to turn on account of the electricity. You thus see that there is nothing for nothing; if you wish to obtain an energetic agent, you must spend work in	轉摩擦覺頗不輕鬆以有電力相帶也惟一摩擦即生電不摩擦即不生電以摩擦之力得電氣之力電力何在即變為熱於光是也	電時電氣力乃變為光力熱力也 電氣既為有力之物亦必外加有力方能發出電氣也當旋轉電氣機時費有若許力緣電氣有阻力儻於旋轉電氣機時不出力不能得何功效也惟旋力方可得力則且還而論之相觀望之陰陽二電氣相合時非不見力力原未嘗失去毫末只緣其形勢已變電力變為光於熱力而已	已 又電氣一有勢故起之必須以力即欲起電氣必先回轉起電器起電器者以起電氣重在回轉若依是見之則知不有原因不有結果欲以其勢於物體則為之須以勞力又從他點云則陰陽兩電氣雖合體平均然勢不消滅但因電氣之態變熱態而已

doing so. On the other hand, there is no disappearance of energy when the two electricities combine, but only a change from the form of electricity into that of heat.			

At the outset we can make the observation, that the translations to a certain extent are faithful to the original. It is clear as well, that the translation by Allen and Zheng is considerably shortened. The *Wulixue xinshu* in the first passage goes beyond the original by drawing attention to the fact that force not only is important for getting something to move or stop it but for changing the direction as well.

The translation of Edkins is the longest; this is visible not only in the passages given here, but throughout the book. It is interesting to see, how the translators in these examples struggled to translate the illustrations originally provided by Stewart. A cricket-ball certainly was not something known to Chinese readers at the time the earlier translations originally were made. Even later it probably would not have constituted the ideal example for illustrating physical laws. However that may be, it seems questionable whether the Chinese readership could imagine what the "leather ball" (*piqiu*) employed by Edkins was. Even less intelligible probably was the idea that a "cannonball" or "projectile" (*paodan*) used by Allen could be thrown and caught by hand. We should note here of course, that such problems were rather common during this earliest phase of translation and can be observed in other translations as well.[12]

Reading through Edkins' translation, one almost can get the impression, that Edkins did not have very much trust in his own ability of transmitting new knowledge in physics to his readers. He often repeats himself or reiterates points only raised once in the original, so that his translation, acquires a certain degree of clumsiness, and certainly not was fun to read for

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[12] In his translation of Jevons's *Logic* for example, Edkins several times referred to "things (and men) Chinese" instead of the Western ones employed in the Original work. Cf. Kurtz 2003, p. 96.

everybody. Wang Yangzong in his comparison of the translations of the *Introductory Primer* has suggested, and I would agree with him, that this tendency probably was due to the fact that Edkins' translated the *Science Primer Series* on his own.[13] Collaboration with a Chinese scholar certainly could greatly enhance the readability of a text. Although Edkins' command of the Chinese language is said to have been excellent, it apparently did not suffice for the task of translating even rather basic scientific texts into Chinese. This is particularly obvious if one compares his translation of the *Physics primer* with his translation of Whewell's *Mechanics*, which he had undertaken together with the mathematician Li Shanlan 李善蘭 (1810–1882), 30 years earlier and which not only was lucidly written and understandable (especially to mathematicians) but remained the best Chinese introduction to mechanics until the beginning of the 20th century.[14]

Looking in more detail into the passages cited here in full, a point of interest is the terminological treatment of the energy concept. The energy concept in Western physics, of course, was rather new and contested and in its full form only developed since the early 50s of the 19th century. The law of the conservation of energy, was however first suggested in the 40s of the 19th century. At this time most scientists referred to energy as force, being aware, that this force was not the same as the forces of Newton. Helmholtz himself at the outset referred to the conservation of "force" ("Die Erhaltung der Kraft").[15] It was Thomson, who insisted on the concept of energy, exactly because he wanted to draw a clearer line between force and energy. It is well known that Thomson for his crusade for 'energy' enlisted support from a large number of north-British scientists. One of these scientists was Balfour Stewart[16], who briefly after his

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[13] Cf. Wang Yangzong 王揚宗. 2000, "Hexuli 'kexue daolun' de liang ge zhongyi ben- jian tan Qingmo kexue yizhu de zhunquexing" 赫胥黎科學導論的兩個中譯本- 兼談清末科學譯著的準確性(The two Chinese translations of Huxley's Introductory Science Primer in Comparison), *Zhongguo keji shiliao* 2000:3, pp. 207-221.

[14] Cf. Amelung, Iwo. 2001a. "Weights and Forces: The Reception of Western Mechanics in Late Imperial China", in: Michael Lackner, Iwo Amelung, Joachim Kurtz (eds.). *New Terms for New Ideas. Western Knowledge and Lexical Change in Late Imperial China*. Leiden: Brill, pp. 197-232

[15] Interestingly the first translation of his seminal paper into Chinese was done by nobody else than Wang Guowei in 1902. For energy Wang used the term *shili*.

[16] Cf. Smith, Crosbie. 1998, *The Science of Energy. A Cultural History of Energy Physics in Victiorian Britain*, London: The Athlone Press, p. 253-255, 280.

Physics Primer published a popular book on the conservation of energy.[17] Balfour's emphasis on the energy concept is already clearly visible in the *Physics Primer*. As we can easily see Fan Diji, on the basis of the Japanese adoption of Stewart's work distinguished rather carefully between force *li* and energy, which he called *shi*. *Shi* for energy (sometimes as *shili*) was used in Japan latest since the late 70s of the 19th century and actually constitutes a rather nice translation, of course based on Chinese classical texts in which it often denotes something like an 'advantage of position' and thus is not too far from 'kinetic energy'. As we see from the passages listed here, the term was consistently applied in the Japanese translation, with the exception of section 43 (39 in the original), which however seems to constitute an oversight rather than conscious usage. It is puzzling, however, that neither Allen and Zheng nor Edkins offered a convincing terminological solution for the problem. Edkins was close, at least, since he once uses the term *nengli*, which during the early 20th century was to become one possible translation for 'energy'. Except for this, however, he either employs *li*, which he uses for 'force' as well, or clumsy descriptive terms. The same is true for the translation by Allen and Zheng. But why did they fail to provide a satisfying translation for 'energy'? Since a conclusive answer to this question would require more systematic research into the complete corpus on books on physics translated into Chinese during the late Qing and better biographical information on the translators[18], I here only can offer some suggestions. Of importance was surely that the energy-concept was a rather recent development, so that neither Allen, nor Edkins had been confronted with it, when they went to college in the US and England. It moreover was, as suggested above, highly contested in England at that time.

It has been shown that rejection of the energy concept by Faraday was related to his religious outlook. Faraday preferred to view god as a god of power rather than as a divine architect as Thomson and Stewart who were connected to religious ideas prevalent in the north of England and had more materialistic views. [19].

While neither Allen nor Edkins were Sandemanians as Faraday, his view certainly

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[17] Stewart, Balfour. 1874, *The Conservation of Energy. Being an Elementary Treatise on Energy and ist Laws*, London: Longmans, Green.

[18] For a biography of Allen see, Bennett, Adrian A. 1983, *Missionary Journalist in China, Young J. Allen and His Magazines, 1860-1883*, Atlanta: University of Georgia Press. Unfortunately there is no biography of the even more productive and certainly rather influential Edkins.

[19] Cf. Smith. 1998, p. 7.

was more palatable to men with Baptist or Congregationalist background like Allen and Edkins. In fact, it is clear, that Edkins' highly estimated Faraday, not only as a scientist but as a Christian as well. As late as 1874 he had given a Chinese introduction of Faraday's concept of the "unity of forces"[20], or to be more exact of Faraday's assumption that "all forces are convertible forms of a single basic, and universal power".[21] Even though I am not able to provide a conclusive answer on this problem here, it may serve as a reminder, that the question of terminological choices during the period in question requires a close look into the conditions in the country of origin and may even need to take ideological considerations into account.[22]

Technical Terms

In the appendix I present a list of the technical terms used in the three Chinese translations of the *Physics Primer*. In order to faciliate comparisons it is supplemented by the technical terms found in the first Japanese translation of the *Physics Primer* published in 1880[23], the Japanese translation Fan Diji's translation was based on and the respective terms found in the first Japanese and the first Chinese dictionary of physical terms[24], published in 1888[25] and 1908[26] respectively. Since the number of physical terms in the strict sense employed in the book and the translations is rather limited, I included a number of terms from adjacent disciplines as well. The Japanese particle *no* の in the Japanese terms in the lists was replaced by its Chinese equivalent *zhi* 之.

The table clearly attests to the terminological confusion in the field of physics in China during the late 19th and the early 20th century. There are only very few terms employed in

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[20] Edkins, Joseph (Ai Yuese) 艾約瑟. 1874/75. "Guang re dian xi xinxue kao" 光熱電吸新學考 (Research into the new science of light, heat, electricity and attraction),*Zhong Xi Wenjianlu* 28 and 29.

[21] Gooding, David. 1980. "Metaphysics versus Measurement: the Conversion and Conversation of Force in Faraday's Physics", *Annals of Science* 37 (1980), pp. 1-29, 10.

[22] We should note here, that an imaginary re-translator not being aware of the original book almost certainly would not have translated *li* as 'energy'.

[23] Stewart, Balfour. 1880. *Shi-shi butsuri shôgaku* 士氏物理小學, Tokyo.

[24] On these dictionaries see Amelung, Iwo 2001b. "Notes on Late Qing Dictionaries of Physics", *Wakumon* III, pp. 11-16.

[25] Butsurigaku yakugo kai (comp.). 1888. *Butsurigaku jutsugo Wa-Ei-Futsu-Doku taiyaku jisho* 物理學術語和漢英佛獨對譯字書 (Japanese-English-French-German dictionary of physical terms).

[26] Cf. Xuebu shendingke 學部審定科. 1908. *Wulixue yuhui* 物理學語彙 (A dictionary of physics), Shanghai: Shangwu yinshuguan.

all three translations. While *li* for force certainly is a natural choice, the term *yali* uniformly employed for pressure deserves some more attentention. As we can see from the table it was employed in Japan and in China. This apparently was due to the fact, that it had been used by W.A.P. Martin (Ding Weiliang 丁韙良 1827-1916) in his *Gewu rumen* 格物入門 (and maybe even had been coined by him) and that this book was transmitted to Japan.[27] When the term "returned" to China during the wave of translations from Japanese books around the turn of the century, it thus was well established in China.

Except for these few instances, the table shows that the tree translations in respect to terminology had very few points in common. It is striking, however, that, as briefly hinted above, the terminology employed in the *Wulixue xinshu* was almost completely identical with the one used in the Japanese translation of 1891. There are however a number of differences between the terminology employed in this book (and thus in its Chinese translation) and the terminology employed in the first translation of Stewart's book into Japanese and the vocabulary proposed in the first Dictionary of Physical terms in Japan, published in 1888. Somehow surprisingly the terminology employed in the *Wulixue xinshu* is quite different from the terms suggested in the first Chinese dictionary of physical terms, which was published in 1908. This shows, that even the certainly great impact of terminology reaching China from Japan around and shortly after the turn of the century did not result in an immediate terminological standardization. Although terms from the Japanese clearly became extremely important, the terminological situation remained "volatile" for quite some time. While this phenomenon clearly would deserve a more systematic analysis than I can offer here, I would suggest that one of the reasons for it was that during the wave of translation from Japan, terminological ambiguities existing in Japan were exported to China as well. It is quite clear that at least in some cases, translators either did not care or where in no position to solve such problems. While some of the Western translators were very conscious about the problem, and at least in their own translations tried to employ a consistent terminology[28], this clearly was not the case with some of the translators from the Japanese. The most spectacular example in this respect is again Fan Diji. In the same year he translated the

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[27] Cf. Martin, W.A.P. 丁韙良. 1869. *Gewu rumen* 格物入門 (An Introduction into the Sciences), Beijing: Tongwenguan.

[28] Cf. for example John Fryer. 1890. "Chinese Scientific Terminology its Present Discrepancies, and Means of Securing Uniformity", *Records of the General Conference of the Protestant Missionaries of China Held at Shanghai, May7-20, 1890*, Shanghai, pp. 531-549.

Wulixue xinshu he rendered another book on physics called *Wulixue wenda* 物理學問答 (Questions and answers on physics) into Chinese, probably based on a Japanese book with the same title (*Butsurigaku mendō*) also published at Fuzanbō in 1903. The terminology employed in this book at times differs considerably from the terminology used in the *Wulixue xinshu*, which must have been translated at roughly the same time. For 'energy' for example, which as we have seen above, was translated as *shi* in the *Wulixue xinshu*, the *Wulixue wenda* offers a phonetic transcription, written–without doubt mistakenly–even with different characters (both pronounced *ainaluoji* 哀訥洛基 and 哀訥羅基). While the *Wulixue xinshu* employs the term *dong* for 'work', the *Wulixue wenda* uses *shishi* 仕事. It would be easy to give many more examples, the point, I want to stress here is that the "terminological shortcut" provided by translations from Japan was not without its problems either.

The question, to what extent terminological problems in the field of the natural sciences influenced the successful transmission of sciences to China is contested. I by no means want to suggest that it was the crucial factor for establishing physics as an academic discipline in late 19th and early 20th century China. It certainly was of considerable importance, however, for education, especially on the middle-school level and it thus is not by accident that terminological issues up to the middle of the 20th century remained high on the list of priorities of physicists and educators. More systematic research on the question of the establishment and the changes of the technical terms used in physics during the formative phase of the establishment of disciplines will help us to gain a better understanding of some of the problems, these men were confronted with and which option to resolve such problems were feasible.

Appendix

Table of physical terms used in translations of the *Physics Primer* and early dictionaries of physics.

Original English term	Allen, Zheng Changyan 1880	Edkins 1886	*Wulixue xinshu* 1903	*Shi-shi butsuri shôgaku* 1880	*Butsurigaku shin sho* 1891	*Wulixue yuhui* 1908	*Butsurigaku ni mochiyuru* 1888	Modern Chinese term
absorption	消受	減去	吸收	吸收	吸收	吸收	吸收	吸收
air-pump	抽氣筩，吸氣筩	撤氣筒	排氣器	排氣機	排氣器		排氣器	空氣，唧筒
architect		築室者	建築家		建築家			建築師
astronomer	天文館師	天文家	天文學者	星學家	天文學者			天文學家
atmosphere	氣	風氣	空氣	大氣	空氣	大氣	大氣	大氣
attraction of the earth	地心吸力	地球攝力	引力		引力			萬有引力
balance	天平，權衡	天平	天秤	天秤	天秤	天平，游絲	秤，天秤	天平，稱
balloon		氣球	輕氣球	風船	輕氣球	氣球	風船	氣球
barometer	空氣壓力表，風雨表	風雨表	氣壓計，晴雨計	風雨針	氣壓計	氣壓表，風雨表	晴雨針	氣壓計，氣壓表
body	物體	物	物體	物體	物體		體	物體
boiling point	沸度	沸水度	沸湯點，沸騰點	沸點	沸點	沸騰點，沸點	沸騰點	沸點
buoyancy	浮力	倒壓托力，托力	浮力	浮泛力	浮力	浮力，浮度		浮力
capillarity	微管翕水	滲力	毛細管引力	細管力	毛細管引力		毛管現象	毛細作用，毛細現象
carbonic acid gas	炭氣煤	炭強氣	炭素瓦斯	炭酸氣	炭酸瓦斯			碳酸氣
cause	緣由	原由	原因	原因	原因		原因	原因
centigrade	百度	百度	百刻度	百度規	百度規	百度表	百分度	百分度
centre of gravity	重心	重心	重心	重力之中心	重心	重心	重心	重心

Original English term	Allen, Zheng Changyan 1880	Edkins 1886	*Wulixue xinshu* 1903	*Shi-shi butsuri shôgaku* 1880	*Butsurigaku shin sho* 1891	*Wulixue yuhui* 1908	*Butsurigaku ni mochiyuru* 1888	Modern Chinese term
change of state	化變		狀態之變化	三態之變化	狀態之變化			物態變化
chemical attraction	化學愛力	異性物相合立	原子力	化學親和力	原子力			化學吸引
chemistry	化學	化學	化學	化學	化學	化學		化學
cohesion	結力	物質各點連合之力	分子力	凝聚力	分子力	凝聚力	凝聚	內聚力
compass	指南針	羅經		羅盤鍼				羅盤，指南針
compound	雜質	雜質	複體		複體		合成，組立	化合物
concave mirror	凹光鏡	凹鏡	凹鏡	凹鏡	凹鏡	凹面鏡	凹鏡，中低鏡	凹鏡，凹面鏡
conduction of heat	引傳	傳熱	熱之依傳導	熱之傳導	傳導		傳導	傳導
conductor	通電	傳電	導體	導體	導體	良導體，易傳體	傳導物，傳導體	導體
convection of heat	凸傳	移熱	熱之流導	熱之交代	熱之流導		對流	對流，運流
definition			定義		定義		定義	定義
density				密度		密度	密度	密度，濃度，比重
direction	向	方向	方向	方向	方向		方向	方向
discharge	放電	放電	放電	電氣之放泄	放電	放電		放電
ebullition	水沸成汽	騰空	蒸發	沸發	蒸發	沸騰	沸騰	沸騰
echo	回應	回聲	音響之反射 音響反射，反響	反響	音響之反射	回聲	山彥	回聲，回音
effect	功	功效	結果	作用	結果	效果	效果	效果
electric current	電氣流通	電氣溜	電流	電氣之流通	電流			電流
electric spark	電發火	電氣火星	電火	電花	電火	電氣火花		電火花
electrical machine	發電器	電氣機	起電器	電氣機	起電器			電機

Original English term	Allen, Zheng Changyan 1880	Edkins 1886	*Wulixue xinshu* 1903	*Shi-shi butsuri shôgaku* 1880	*Butsurigaku shin sho* 1891	*Wulixue yuhui* 1908	*Butsurigaku ni mochiyuru* 1888	Modern Chinese term
electricity	電氣，電學，電	電氣	電氣	電氣	電氣	電氣	越力，電氣	電，電學
electroscope	電擺	探電器	驗電器	驗電器	驗電器	驗電器	越歷驗	驗電器
elementary substance	原質	原行一質物	單體	原質	單體			單質
energy	物動之力	力，能力	勢	勢力	勢	能力		能量
energy in repose [latent energy]	物力靜存	物靜作工之力	潛勢	靜勢力	潛勢	[位置之能力]		勢能
engineer		營造事務者	機械師		機械師			工程師
evaporation	水烘曬成汽	化氣	氣發	蒸發	氣發	蒸發	蒸發	蒸發
expansion	漲伸	漲	膨脹	膨脹	膨脹	漲大	膨脹	膨脹
experiment	試驗，試驗工夫	測驗	試驗		試驗	實驗	試驗	實驗，試驗
focus	聚光處	聚熱點	燒點	燒點	燒點		焦點	焦點
force	力	力	力	力	力	力	力	力
freezing point	凝結度	凝冰之點	冰點	冰點	冰點	凝固點 冰點	凝固點 冰點	凝固點，凍結點
friction	摩擦黏力 摩擦	面阻力	摩擦	摩擦	摩擦	摩擦	摩擦	摩擦
gas	氣質	氣質物	瓦斯體	氣體	瓦斯體	氣體，加斯	氣體，瓦斯	煤氣
geometry	弧三角法	幾何原本	幾何學	幾何學	幾何學			幾何學
gravity	地之吸力，吸力，地心吸力	萬物互相吸引之力	重力	重力	重力	重力	重力	重力
heat	熱學，熱，熱氣	熱	熱	熱	熱	熱	熱學，熱	熱
hydrogen	輕氣	輕氣	水素瓦斯	水素	水素瓦斯			氫氣
image	影	影	肖像	影		像	像	圖象，象，映

Original English term	Allen, Zheng Changyan 1880	Edkins 1886	*Wulixue xinshu* 1903	*Shi-shi butsuri shôgaku* 1880	*Butsurigaku shin sho* 1891	*Wulixue yuhui* 1908	*Butsurigaku ni mochiyuru* 1888	Modern Chinese term
induction	引分電氣法		感應	電氣之導引	感應	感應作用 感應圈	感應	感應，影響
latent heat	隱熱，暗熱	藏熱	潛熱	潛熱	潛熱	潛熱	潛熱	潛熱
lens	透鏡，鏡	透凸鏡	凸凹鏡	透光鏡	凸凹鏡	透鏡		透鏡
leyden jar	蓄電瓶	蓄電瓶	蓄電器	雷電罈	蓄電器	來頓瓶		萊頓瓶
liquid	流質	液質物	液體	流體	液體	液體	液體	液體，流體
locomotive		火輪車		汽車		機關車		機車
machine	機器		機械	機械	器械		器械，機關	機械
magnet	指南針	吸鐵石	磁石	磁石	磁石	磁石	磁石	磁鐵
magnifying glass	顯微鏡	映大鏡	寫像鏡	顯微鏡	寫像鏡			放大鏡
matter	物質	質體		物質		物質	物質	物質
mercury	水銀	水銀	水銀	水銀	水銀			汞，水銀
motion	動	動	運動	運動	運動	運動	運動	運動
moving body	物動	動物	運動之物體	動體	運動之物體			動體
music	音韻	樂響	樂音	調音	樂音		音樂	音樂
negative	陰電	陰電	陰電氣	陰電氣	陰電氣	陰晝	負	負
nitric acid	硝強水	硝強水	消酸	硝酸	消酸			硝酸
noise	響聲	聲響	噪音	不調音	噪音	噪音	操音	噪音
non-conductor	不通電	不傳電	不導體	不良導體	不導體		不傳導物，不傳導體	非道體
oxygen gas	養氣		酸素	酸素	酸素			氧氣
particle	微粒	質點	分子	分子	分子	質點	質點	粒子
philosopher	格致師			理學者				哲學家
photographer		照像家						攝影家
physics	格物學	質學	物理學	物理學	物理學	物理學	物理學	物理學
piston	活塞	活塞	活塞	活塞	活塞	活塞		活塞
pitch	音韻		音調		音調	高		音高

Original English term	Allen, Zheng Changyan 1880	Edkins 1886	*Wulixue xinshu* 1903	*Shi-shi butsuri shôgaku* 1880	*Butsurigaku shin sho* 1891	*Wulixue yuhui* 1908	*Butsurigaku ni mochiyuru* 1888	Modern Chinese term
planet	行星	行星						行星
platinum	白金	伯拉低農	白金	白金	白金			白金
positive	陽電	陽電	陽電氣	陽電氣	陽電氣	正，陽	正	正
pressure	壓力	壓力	壓力	壓力	壓力	壓力	壓力	壓力
pressure of air	空氣壓力	風氣壓力	空氣之壓力	空氣 m 壓力	空氣之壓力			氣壓
principle	法	理	理	理	理	原則，原理	原理，原則	原理
prism	三棱玻璃	三邊稜玻璃	三稜鏡，三角稜	三稜鏡	三稜鏡	三稜鏡		稜鏡
proportional			比例	比例	比例			比例
pure alcohol	酒醇	酒精	酒精		酒精			酒精
radiant heat	熱之暈射	光熱外射		線射熱				輻射熱
radiation	暉射	外射	放射	線射	放射	輻射		輻射
radiation of heat	射熱	射熱	熱之反射	熱之線射	熱之反射		輻射	熱輻射
railway	鐵路			鐵道				鐵路
railway train	汽車	火輪車	氣車	汽車	氣車			火車
ray	光線	光照	光線	光線	光線	放射線	光線	光線
reflection	回光，反射	回光返照，反射	反射	反射	反射	返射		返射
reflector	回光鏡	凹面圓鏡	反射鏡	反射鏡	反射鏡			反射鏡
refraction	斜折	光折	屈折	屈折	屈折	屈折	屈折	折射，撓曲，光的折射
satellite		小星	衛星	衛星	衛星			衛星
solid	定質	定質物	固體	固极	固體	固體	固极	固體
sound	音聲，聲音	聲	音響	響	音響	音	音	聲音
specific gravity	重數	等體輕重互較率	比重	比較疏密	比重	比重	比重	比重
specific heat	熱度	容熱之量	比熱	比較熱	比熱	比熱	比熱	比熱

Original English term	Allen, Zheng Changyan 1880	Edkins 1886	*Wulixue xinshu* 1903	*Shi-shi butsuri shôgaku* 1880	*Butsurigaku shin sho* 1891	*Wulixue yuhui* 1908	*Butsurigaku ni mochiyuru* 1888	Modern Chinese term
spectrum	光分七色圖	諸色象	廣光帶，光紐 光帶		光帶	分散帶 光帶		光譜
spirit-level	酒平測	酒準		酒秤				氣泡，水平儀
steam-engine	汽機	氣機	蒸氣機關	蒸氣機關	蒸汽機關			蒸氣機
sulphur	硫黃	硫磺	硫黃	硫黃	硫黃			硫
syphon	虹吸	酒撤吸水	吸液管	撤液器	吸液管			虹吸管
telegraph	電線報 電報	電氣通信	電信機	電信機	電信機		電信機	電報
telescope	千里鏡，遠鏡	千里鏡	望遠鏡	千里鏡	望遠鏡		望遠鏡	望遠鏡
temperature	熱度	熱	溫度	溫度	溫度		溫度	溫度
thermometer	寒暑表	寒暑表	寒暑表，驗溫器	寒暑針	寒暑表	空氣寒署表	寒暖計	溫度表
trade winds	貿易風	貿易風	貿易風	貿易風	貿易風			貿易風
vacuum	空缺處	空虛處	真空	真空	真空	真空	真空	真空
velocity	速率	速率，遲速	速度	速力	速度	速，速度	速度	速度　，速率
velocity of light	光行之速	光行速	光之速度	光之速力	光之速度			光速
vibrating body		蟬動物	震動體，振動體	震動體	震動體			振動體
vibration	擺搖之動	顫動	震動數	震動	震動	擺動，顫動	振動	振動
voltaic battery		佛爾塔氏電池	電池	電池	電池			電池
volume	體積		容積，積	體積	容積	體積，容積	立積	體積
water-level	水平測	水平	水平器	水秤	水平器			水準儀
wave	浪	波浪				波，浪	波	波
weight	權衡	輕重	重量，量	重量	重量	砝碼，重		重　重量
work	功	操作	働	動作	働	工作	仕事	功，作用，活動
zinc	鋅	倭鉛	亞鉛	亞鉛	亞鉛			鋅