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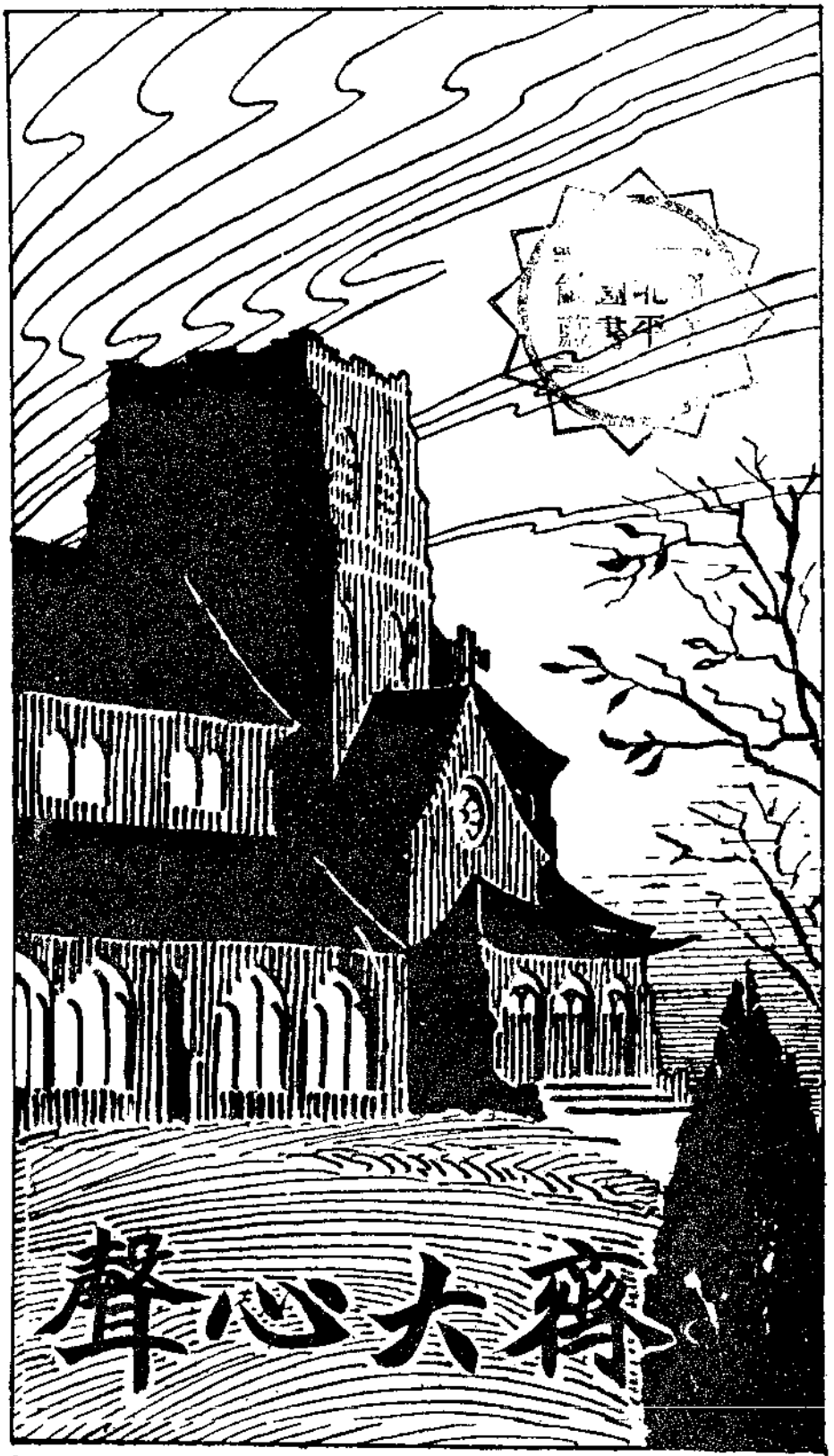

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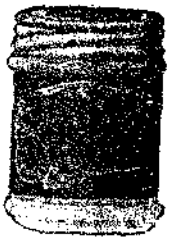

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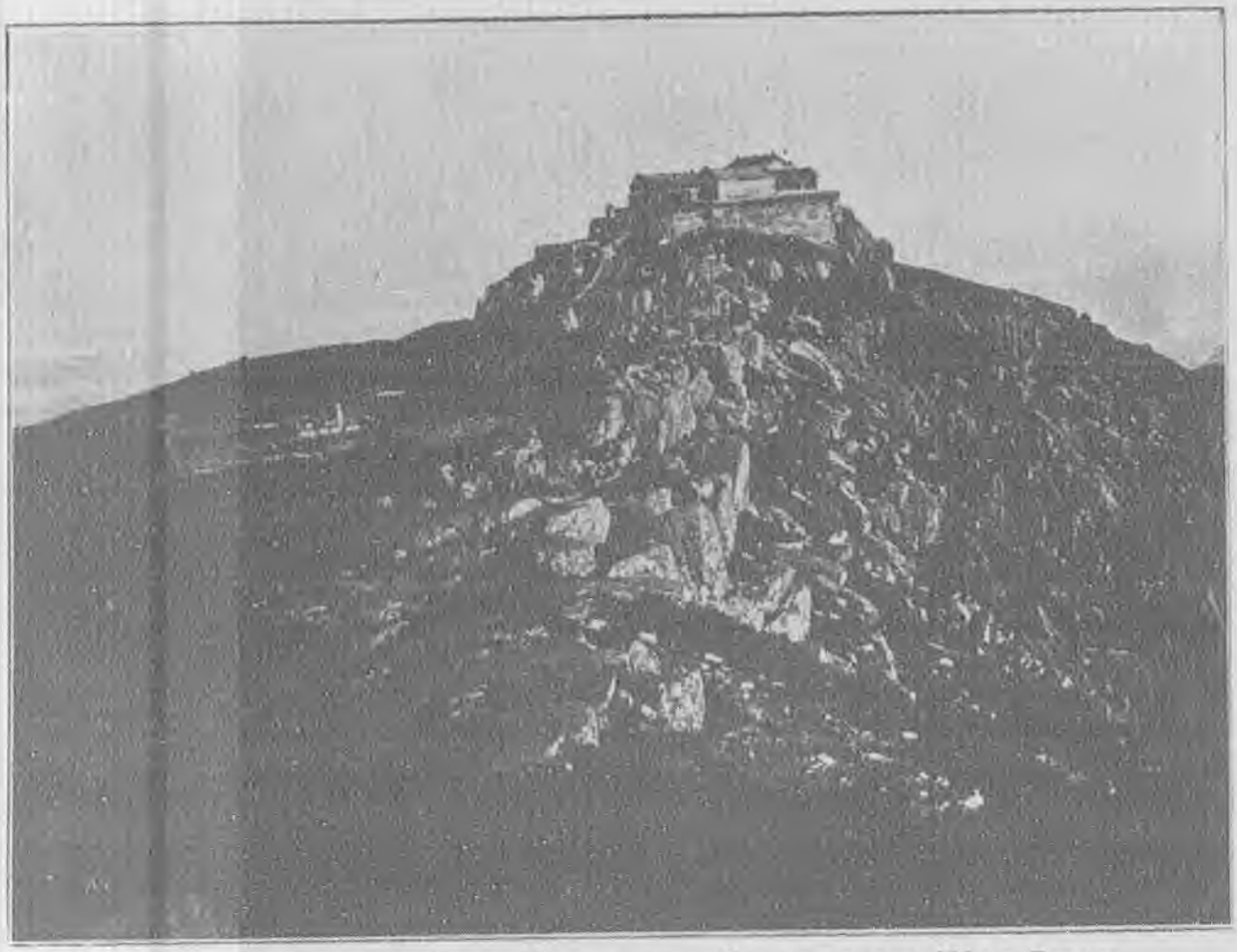
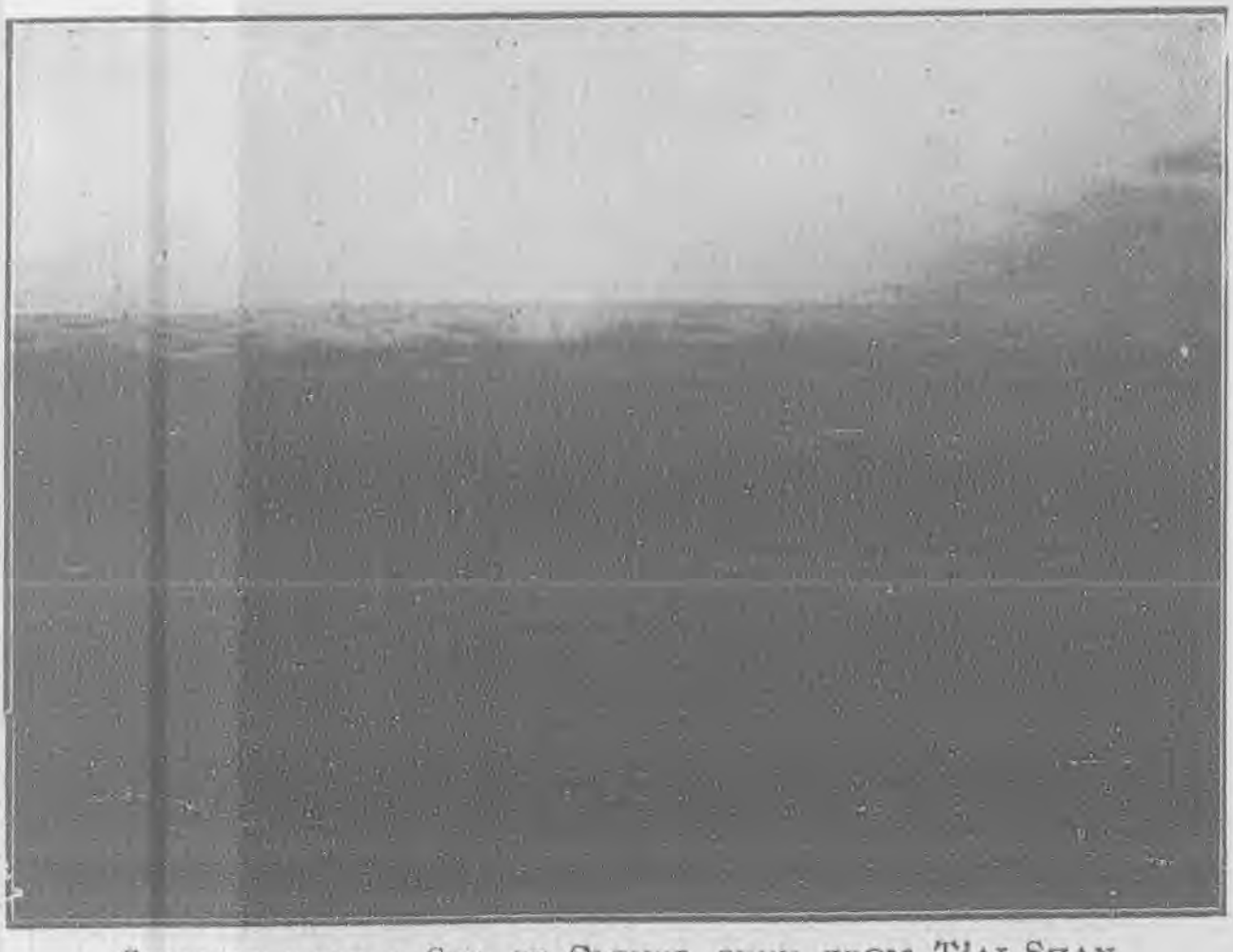


TEMPLE OF THE JADE EMPEROR—SUMMIT OF T'AI SHAN

泰山玉皇頂



SUNRISE FROM A SEA OF CLOUDS, SEEN FROM T'AI SHAN

泰山頂觀日出

齊大心聲

編輯委員會

開篇話——公開的一個答覆

承校友的盛情有賜函本報，指教一切的。感激之餘，聊作一公開的答覆。事雖煩瑣，或亦爲讀者所樂聞。因取便利，於未答覆之前，僅將原函錄後（來函頗多，此只其中之一，取代表其餘之意耳。）

原函：

心聲主筆台電敬啓者貴報裝訂華美內容豐富而定價一元廉矣然吾輩同學覩此一元猶未必甘心何哉每年如此外加匯費貧者實不能不如此計算試以向後訂報之數徵之當知吾言不謬然則何以推廣曰紙張無須如此精美內容不必如此豐富蓋同學所關心者校內之實情箇人之現況並非如讀中常報紙之長篇大論也至於英文方面愈少愈好畸實未嘗盡閱也再者刊費大減何妨贈送而每年捐助一次當無不可愚直之言或有推廣之價值也　校友王錫疇敬陳

覆函：

王錫疇先生大鑑：來函敬悉，曷勝感激！對於先生之提議，本報曾一再招集委員會費長時間的討論，無解決之良方。蓋人心不同，各如其面，至終須服從多數之意見也。

（一）紙張：本報經理高思德先生，在委員會議席上，曾將各種紙樣及價目，與同人等詳爲參較，煞費斟酌。現所用之紙，較次一等者，每期多費七或八元上下之數。而於美觀方面，却大受影響——爲數不止七或八元。且『齊魯』——大學也，『心聲』——大學之定期最高出版物也，以一大學中之最高出版物，而用粗劣暗淡之紙張，正如一偉壯丈夫，衣敝縕袍，事惡乎可？尤有進者，每期印刷費，至少須超二百四十元，再加寄費運費，統共將及三百元，以之與七或八元相較，當嫌其微。故大家表決，終究用現所用之紙。

（二）內容：有好些校友，各用不同的眼光，來看心聲。有的嫌科學材料太少，他種學術太多，有以爲校聞一欄，可以取消的；也有主持凡關於文藝的作品，當多登載一些；更有的說法完全和上邊相反的。這就叫編報的人作了難了。所以委員會決定，嚴叫材料適中些——較普通一點兒，庶幾不至於太離奇了。

（三）英文：本報除校友訂看外，還要寄與各地外國朋友。大凡與本校有直接或間接重要關係的人，都要看報的。他們有一些——簡直是全數，都是慣念英字。所以同人等議決，要中字材料佔三分之二，洋字佔三分之一；這正是與讀報的漢洋比例數相當。

（四）勸捐：往年校友會在濟開大會，當時關於校友看報的事，曾經議決，採用勸捐方法，替校友包辦一總代訂，如先生所言。但結果此種計畫，是失敗了（此事校友會當有詳細的報告，無庸多贅。）以此，向後，才用了這各人自己直接訂閱的新法子，也是一種沒法兒不如此辦的事呢。

以上所言，或未有當，希不時賜教，藉作南針，本報幸甚！同人幸甚！此覆，即頌

大安。

家

吳金鼎

家之一字考之泰西諸國文字其語根大率相同。蓋皆導源於拉丁文之 Familia 一字也。按歐洲諸國之家字：

荷蘭文	Familie
德文	Familie
法文	Famille
西班牙文	Familia
葡國文	Familia
意大利文	Famiglia
瑞士文	Familj
英文	Family
丹麥文	Familie

考拉丁文之 Familia 乃源於奧斯幹語 (Oscan) 之 Famel 蓋麗屬之意，或服從者之謂也。或云，Familia 乃指家中一切之奴隸也。(The servants in a household.) 故稱家人爲 Familus。

總之，諸國文字中之家字所含蓄之意義，絕無現代家庭二字所代表之組織及意味。其家字之本意乃指家長以下之一羣奴隸而已。而其所謂「奴隸」之範圍又極廣泛。舉凡妻子兒女以及傭人寄客，對家長而言，無一不列入奴隸之類也。然則我國之家字其眞詮當何如乎？吾人不治文字源流之學姑以之質諸小學家之著作而求解焉。惟以我國字學而證社會學中之某種事實往往有兩個問題阻難其間。勢必先行解決之，以免除其障礙，然後再按字學所與之資料以解明某字之眞義。不然者非流諸穿鑿附會之境，即誤於委曲解釋之途。此社會學者所當愼之又愼者也。所謂兩個先決之問題者：第一，斷定字之今古。按我國文字之源流而論，自倉頡創文字(？)以迄於今已越四千七百餘年之久，於斯久遠之期間每因時代之急需而有新字之增添或變古字之形式而作新字之應用。以致今之談字學者常困於古今混雜之難，深感明

家

辨之非易。偶一疏忽，遂致以古詮今，或以今詮古，其謬誤殆有甚於「宋版康熙字典」或標有民國前五千年之骨董者。

第二，辨明字之種類。我國文字，以其書寫之法而分類，常概曰六書，蓋言字之種類凡六。一曰象形，如日月之類，象其形也。二曰會意，如忠信之類，中心爲忠，人言爲信，會合其意也。三曰轉注，如考老之類，起筆一首，左右相注也。四曰指事，如上下之類，人在一上爲上，人在一下爲下。五曰假借，如令長之類，一字兩用也。六曰形聲，如江河之類，以水爲形，以工爲聲也。然則斯六類之區劃，果能概括一切之字而無遺類乎？果然，則字類之界限既判然分明，則某字之當歸諸何類，誠非難事。其實，不然也。六書之說，僅浮汎之理論耳，在實際上何嘗能概括一切耶？依嚴格的精詳的考查，不完全屬乎六書的某一類之字，實屬極多。例如中正，夫立諸字，是象形兼指事者也。世，葬，或，恆諸字，是會意兼指事者也。朮氏，肩，音諸字，是形聲兼指事者也。齒，函，兢氏諸字，是形聲兼象形者也。牢，牢，登，器諸字，是會意兼象形者也。穴，身，金，禽諸字，是會意形聲，又兼象形者也。禮，珥，碧，返諸字，是形聲兼會意者也。由此觀之，六書之外，又有七書焉。安知七書之外，即無若干種類爲吾人所未發現耶？字類之繁賾如是，苟欲依六書分類之慣技，作老生長談之解釋，固不難也。不然，吾人若以實事求是之態度而辨明某字究竟所屬之種類，則戛戛乎其難哉。

所謂兩個先決之問題者，大意如此。今按二問題之次第，先行決定家字之性質與種類，然後再行解釋家字究竟之意義。

一，家字是否爲古字？欲證明家字之是否爲古字，自當證之於古籍。我國古籍中之最古者，厥爲易經與書經。今取二經信手拈閱之，則見：

易經家人卦載「家人利女貞。彖曰，家人女正位乎內，男正位乎外。男女正，天地之大義也。家有嚴君焉，父母之謂也。父父，子子，兄兄，弟弟，夫夫，婦婦，而家道正。正家道而天下定矣……」

書經載「……克儉于家……家用平康……家用不富……

不能厥家人……若作室家……輯寧爾邦家……惟爾王家我適……在家不知用勘相我國家……」

按二經中家人，家道，家用，室家及他諸詞句之用法與其所含之語義與吾人現在所用之家字大致相同，可見家之一字在古代已應用之，其應用之方法及所含之意味既與現代略同，據此，吾人可以決定家字乃係古字。

二、家字究屬何類？從來字學家之解釋家字所屬種類者各持一說，意見紛歧，茲分述之於下：

(甲)認家字爲形聲者。家之首爲宀(𡧓)，交覆深屋也。古者屋四注東西與南北皆交覆也。宀者象深屋之形也。宀之下爲豕，蓋叚之省式也。按叚當讀爲 Kia，故家讀作 Kia，蓋取叚之省聲也。按此說，家字以宀爲形以豕爲聲，故當爲形聲字。

段玉裁深疑此說，故於說文解字中有云，「……按此字爲一大疑案。叚省聲，讀家學者但見從豕而已。從豕之字多矣，安見其爲叚省耶？何以不云段聲而紆回至此耶？……」

吾人查字典中所載從豕之字凡一百八十餘字，其讀作 Kia 者除叚之外殆無一焉。惟從叚之字如瑕遐瘕叚諸字讀作 Hia 或 Kia，可見古人創造 Kia 類之形聲字慣於用叚而非用豕。若家字果爲形聲字，則其式當作「寉」，而非爲「家」也。

(乙)認家字爲指事者。江元虎云，「……日本某雜誌，諷刺中國謂家之一字，上爲「宀」，乃象屋之形，下爲豕字乃豬也。……」作者於民國十二年夏，在齊魯大學暑期學校中聞教員某君云，我國家字爲宀下一豕，蓋古代之民以豕充食品，故每家必畜一豕，豕與人同處即同居於宀也。當時人民不知熟食，故嘗生啖豬肉，一日房屋遭火，豕被焚而熟焉，家人聞異香而試食其肉，此火食之始也。爲是說者，以爲宀者指示房屋之形狀，而豕者指示每

皆有畜豕之急須。故家當爲指事字。但按吾人所知人類經濟生活之進化可略分爲三級，各級內皆有所急需之家畜，誠然也。然在第一級爲漁獵時代。是期也，近水之民則漁，近山林之民則獵，爲漁獵生活的急需的家畜者厥爲犬，以其不但爲漁者之伴侶，且爲獵者之助手也。而豕於此期內決無豢養之必要。第二級爲游牧時期。是期也，人民逐水草爲生居處無定，其所最急需之家畜厥爲羊，以其性馴而易於遷移也。且羊之毛與皮可作衣服造帳棚。其肉又極適口是一羊而能兼給衣食住三大需要也。豕性汙穢，古人亦不知其皮毛之用途又以其懶惰成性「安土重遷」更爲游牧之民所不喜。故豕在此期內亦無受人豢養之資格。第三級爲農業時期。是期也，人民擇平原沃土而居。是時之生活已漸由漂泊而臻固定。又因農生活之出產品陡增頗有餘糧足供較多的家畜之喂養。於此，則家畜之範圍乃擴大矣。考我國經書中之左傳

已有六畜之說。按六畜者：馬牛羊鷄犬豕也。是期內之家畜雖曰六畜，而其最急需者厥爲馬牛。蓋因馬牛之力大有利於農作之業也。是時犬與羊之貴重地位早已被馬牛所侵佔。惟雞與豕因其有食品上之貢獻，遂被認爲農業時期之急需品。然其急需之程度尚遠在馬牛之下。僅與犬羊同其重要而已。總之，豕之爲家畜在本期內之急需僅得與犬羊平等而已。若强謂當時各家必畜一豕，遠不及假定當時各家之必畜一馬或一牛之更爲合理也。考之四千七百年前，卽文字初創之時期，正在伏羲時代。按史鑑所載，伏羲氏教民佃漁畜牧。此說果確，前當時之經濟生活正在漁獵與牧畜之交替時期。豕之爲畜更無每家必畜之必要矣。

總之，認家爲指事者乃臆度假設之說耳。無所謂實際之根據也。

朱駿聲說文通訓定聲有云「……考家古文有從宀下

犬者……」惜乎經傳不用此字，而後世不傳焉。若以「㝬」代表漁獵時代之家庭及經濟生活，頗合於經濟進化之學說。姑誌於此，以請教於字學專家。

(丙)認家字爲假借者。周伯温及段玉裁均謂，家之本義乃豕之居也。引伸假借以爲人之居。字義之轉移多如此。牢牛之居也。引伸爲以拘罪之陛牢，庸有異乎豢豕之生子最多故人居聚處借用其字。久而忘其字之本義。使引伸之義得冒據之蓋自古而然。

是說有顯然之錯誤仰讀者注意焉。夫宀者「交覆深屋」也。王筠說文云，交覆對待广而言，古者屋四注東西與南北皆交覆也。段氏曰，「有堂有室是爲深屋」。可見「交覆深屋」乃滲淡經營之建築。雖不必深堂邃宇，美輪美奐，然其堂室有界內外有別，固無疑也。古人禽獸有囿，牛有牢，馬有廐，豕者畜之以圈足矣。安能置之有堂有室之深屋中耶？且豕性愚笨懶惰遠不及牛馬之活潑而好動，故豢豕者鮮有「亡豕」之患。古人雖愚亦未必交豬深屋貯此齷齪不潔之豕也。況古代建造不易，曰堂曰室所費不貲，以當時之經濟情形度之，古人必不肯藏豕於深屋之中也。豈古人皆有「愛豕」之奇癖，鍾情於豕，對於豕有無限之憐惜，甘心以「金屋藏嬌」歟！

由此可知家者必非豕之居。故「引伸假借以爲人之居」之說，亦非確論。

(丁)認家字爲象形兼會意者。江允虎云，「……蓋宀爲房屋，一爲天花板之象形，下邊豕爲字三人集合之象形，衆多之意，即指一父一母一子聯合而爲家庭也。……」江氏之見解頗新穎而近理，惟其謂「一爲天花板之象形」，吾人不能無疑焉。按我國室堂房屋宮寓諸字皆無所謂天花板之象形，獨家字則有焉，何其特異耶？按辭源天花板即承塵亦曰藻井（見後漢張衡賦）以古時繪畫山水草及井形於上也。山房隨筆載金元好問妹自補天

花板。可見昔之所謂天花板者，美觀華麗之裝飾品耳。四千年前之古人生活至爲簡單，一切之急需品尚未克如願以償，安能有所華麗奢侈之品也。雖富有天下之帝王有時亦嘗毛茨土階，並「地板」而無之，又安得各家皆有天花板耶？

正字通載「……按六書故作豭人所合也。從丞三人聚宀下豕之義也。丞謂爲豕……丞卽古族字。……」

六書通載古文家字有作㝱者卽家下三人也。丞卽古族字之說頗近理。按周語有「人三爲衆」之說與此暗合。

總攬此四說而比較，吾人以爲第四說，卽認家字爲象形兼會意者最爲合理。蓋宀象屋之形而丞族也，衆也，卽多人聚居之義也。衆人聚居一宀下卽謂之家。但此乃吾人今天之結論耳。將來的時光苟與吾人以研究之機會，或許能以更精詳更合理之論斷貢獻於讀者諸君也。

所謂兩個先決之問題者現在業已解決矣。卽已決定家爲古字且爲象形兼會意之字，就本文程序而論，吾人當進言家字之意義，然在「家字究屬何類」之末段，業已在無意中言明家字眞正之意矣。茲爲提醒讀者之注意起見再重覆述之。

我國家字，絕無西洋家字的「一羣奴隸」之意義，惟在宀之下，確係「一羣」。非一羣之奴隸，乃一羣之衆人。斯衆人者非汎汎之衆，乃有血族關係之衆，卽所謂「族」者是也。簡言之，家者一族同聚一屋中之謂也。（此篇保留版權禁止轉載）

本篇參考書

段玉裁　說文解字　六書通
王筠　說文釋例　正字通
朱駿聲　說文通訓　中華大字典
江亢虎　社會問題講演錄
辭源

山東製紙方法及原料之研究

薛愚 著者識

本篇東省各區製紙之舊法，多藉友人張振河張敬誠張明清諸先生之助，特此誌謝。

一、山東紙業之概狀

紙流行於我國由來久矣。古者削竹爲簡，甚爲不便。後漢和帝時，製紙之法即出。後漢書宦官傳云：『古時書籍多編以竹簡，其用縑帛者謂之紙。縑帛貴而簡重，不便於用。蔡倫爲和帝時尚書令，乃用樹皮，麻頭，破布，網……以爲紙。……自是紙出，天下咸稱「蔡侯紙」……』又記學記云：古者以縑帛依書之大小長短，隨事截之，名曰「幡紙」。故紙從「系」。貧者無之。或用蒲寫書，則路溫舒蒲是也。至後漢和帝時中常侍蔡倫剉破布，擣鈔作紙，故紙從「巾」……』斯時之紙，專供文人揮洒之需。費工多而價昂，故多視爲奢侈品，未能普及。至唐宋時，蜀贛江浙閩……省製法精而用亦廣。元時始傳入歐洲而有今日之盛。雖然，吾國紙業發明雖早；流行雖廣，而山東製紙之史，僅數百年耳。區域狹小，而業紙業者，爲數又寥如晨星。法復較舊。（指用舊者言）邇來雖年有自江南諸省學習而歸者，產品亦未見有優良。溯其因：（一）舊法製紙，多以竹，蔗爲原料，東省非產竹蔗之區。（二）製紙非水潔而多不可，東省之水雖良，惜不多耳！無怪乎東省產紙少而劣也。近數年來，濟南新法製紙公司成立，東省紙業，始稍振焉。

表一　濟南所流行之紙及其產地（註一）

名稱	產地	名稱	產地
水紋紙	外洋	單萱紙	江西，安徽，
綢紋紙	同上	夾萱紙	同上
吃墨紙	同上	火紙	江西，湖北，
玻璃紙	同上	草紙	江西，湖北，山東
砑紙	外洋，江西，	書皮紙	外洋，江南，山東
萱紙	江西，安徽，	仿造西洋紙	江西，

竹連紙　湖南
報紙　外洋，上海，湖北
連史紙　上海，濟南
包皮紙　安徽，山東，江蘇
粉連紙　外洋，濟南
賬底紙　江西
文房紙　湖南，江蘇
桑皮紙　江南，山東
福建　皮紙　同上
花邊紙　外洋　洋竹紙　外洋，洋
毛邊紙　同上　竹紙　湖南，江西等省
圖畫紙　同上　信紙　安徽
裱心紙　江西，安徽　洋信紙　外洋
貢紙　江西　卡片紙　同上
包裹紙　江南，山東　黃表　江南
雜色日用紙　江南　油紙　同上
草板紙　外洋　寶鼎　江南，山東

上表之紙產自山東者僅草紙，桑皮紙，粉連紙及少數之包裹紙……而已。且此少數之紙，賣者甚少。除數小紙鋪及担紙喝賣之小販外，稍大之紙店，其紙多來自外洋及江南諸省，無本省之紙。是以濟南之紙店，無論規模大小皆冠以「南紙」二字，以示其來自江南也。

表二　山東紙之產額與他省之比較（註二）

產地	產量（單位爲元）
全國	二八，八五七，零一三
江蘇	六，二八七，六二五
浙江	三，零八六，四九九
福建	七，四二八，六二九
江西	八，〇一二，二三八
山東	（共）五六五，七三九
	（舊法約）六〇〇〇

觀此表則知山東紙額僅爲全國五八分之一，江蘇十二分之一，浙江六分之一，福建十五分之一，江西十六分之一。產量之小，可知一斑矣。

二　製紙之方法及原料

東省製紙之法有二：舊法與新法是也。舊法製紙者，規模雖小，而零星散布於全省。新法製紙者，規模雖較大，僅濟南華興

製紙公司而已。今分別述之：

甲　舊法

（一）濰縣——濰縣製紙者，皆靠近汙河一帶，以其水清良而多，便於紙業之進行也。

1. 區域——辛莊，紙坊，張氏，北楊四處皆產草紙，而辛莊，紙坊二處，除產草紙外，間產皮紙及粗窗戶紙。

2. 原料——原料以麥楷，破紙，桑皮，及蒲絮爲大宗。

3. 造法——先擇梗較長，色較白之麥稭，置於碾上，用人力或牛馬力壓碎，取出用篩濾之，後移於用磚石砌成之池中，（池之大小及容積隨業紙業者之資本及原料之多寡而異）加水及石灰（水及石灰之量隨原料多寡而定）使之腐碎。（時間之長短，隨溫度及原料之量及質而殊）迨其發酵完全，於是取出移於麻袋包或粗布包中，置於河中冲洗之，包中插一木棍，冲洗時，常攪動以助其速碎亂，易清潔。俟雜物及汙濁洗滌淨盡，再放於長六尺寬四尺深約三尺之石砌之盛漿池中。再攪拌之，使之成稀粥狀。於是用竹簾匣舀出搖動之，倒於大木板上，待池中料作罄，木板上之紙之水略去，乃取而一一貼於向陽之壁，藉陽光之力，令之乾燥。乾後，即行取下，束之成捆，以待顧客，或自售之於市。竹簾匣長約三尺，寬近二尺，每匣分爲三格，每格成紙一張，故每次可成紙三張。——紙之厚薄，精良，惡劣……純係乎執竹簾匣之工人之手腕，技藝之精巧與否耳。皮紙，窗戶紙之作法，與草紙同，惟原料殊異，蓋皮紙用桑皮，而窗戶紙用破紙也。且作時加蒲絮爲黏着劑。——紙之乾燥，既藉陽光之力，故雨天，陰日及冬季，皆不易於紙之進行也。

4. 種類——草紙，皮紙，窗戶紙，上好皮紙，（昔時用以作錢票）及書皮紙。

（二）煙台——烟台製紙者多自濰縣遷居者，故製紙之方法與原料及紙之種類……皆與濰縣略同。

（三）招遠—招遠製紙之區域在曲家灣一帶，原料以麥稭，破紙，麻繩，破布……其作法與濰縣同，惟原料既有破紙，破布，是以除草紙外則間出窗戶紙，白蓮紙，惜其無大規模，且不用漂白之法，故雖名曰白蓮紙，實則色皆淡黃灰耳。

（四）黃縣—黃縣產紙區域甚小，僅數家而已。所出之紙，亦僅以麥稭所製之草紙耳。

（五）桓台—桓台製紙之區，靠近烏河，即古之淄水也。產草紙爲最甚多，幾爲全省冠。所用之原料，爲麥稭。作紙之方法，亦同於濰縣。

（六）臨朐—臨朐製紙之法及原料與他處稍異，故詳述之。

1. 區域—柳家圈紙坊，黃崖埂，孫家店紙坊，靠近龍泉河，其他三處，皆近小河。

2. 原料—楮皮，桑皮。

3. 方法—此地製紙與前異，略分四步：（a）原料之購備。—農人將桑樹，楮樹之嫩枝，細條，於春末割下，剝其皮，束之成捆，售於製紙者。製紙者買時，亦細察其纖維之精粗；品質之良否；與夫乾濕而估其價值。蓋纖維品質，……與紙之質品精良有關也。買後儲藏室內，以爲製紙之需。（b）搗碎—將購備之原料，放於石臼中，（臼中鑿有多數細槽，俠其面粗糙而利於搗碎也。）用杵擊之。杵爲一大長桿，甲端懸重錘，近乙端處，繫於夾豎桿中，乙端懸麻製之帶以爲足踏之需。作時一人於乙端，置足於繩帶中，足下踏，則甲端之錘起，足上提，則甲端之重錘下落，擊打原料，向傍一人，常以手轉動石臼，使搗亂易均，如此進行，久之則原料成泥狀。（c）發酵—移搗碎之原料於不透水之池中，加水及石灰（水及石灰之多寡，以原料之量而定）使之發酵，待作用完全，取出洗之。洗淨後，則盛於大甕中，（甕之高低恰適宜作者）以備製紙。（d）成紙—作紙之時，用一模箔，模之大小不一，大者長約二尺四寸，寬約

一尺八寸；小長者約一尺五寸，寬約一尺二寸。模內置有鐵桿架，架上置以細竹簾。（鐵架三處皆結連，一處能自由開合。）用鐵杓自甕中舀一滿杓成粥狀之原料，倒於竹簾上，即刻以手搖動之，使之散布均勻。於是開離鐵架，移出竹簾，揭去簾上之紙，迨水分略少，則貼於向陽之牆上，藉日之逼射而乾。乾後移下，即可出售。中間不經漂白之手續。

4．種類—臨朐之紙有二：桑皮紙質較粗，色較暗，常爲棕色。楮皮紙質較細，色較白。

（七）其他如青州、濟寧、滕縣……亦有用麥稭製草紙者。惟規模過小，產量亦少，不足述也。

舊法製紙之量，雖無統計，但就其全省新舊法製紙之量推之，全省紙量共五六，五七三九元（見表二）而新法產量約五十萬元，如是則舊法製紙之量，當爲六萬元左右。

乙 新法

東省以新法製紙者，僅濟南一華興公司耳。法與西洋同，而大異於舊製。紙之品質既佳，而產量亦鉅。愚親赴該公司數次，幷和該公司之技師作一度之討論。今略述其要：

1．原料之購置

A．原料—原料爲破布，破蔴繩，破鞋，及舊棉套四者而已。

B．購置—購置原料，非有經驗者不可，否則必易受售者之欺蒙。大概購買時，宜注意原料之質，色，水分，汚濁及塵土……來自近城市者：質較細，色較白，水分較多，塵土較少；來自鄉間者：質較粗，色較黯，水分輕少，塵土較多。其價值不特與原料之質，色，水分，塵土……有關，亦因其種類而別。就均數言之：破布每百斤銅子４５０枚，破蔴繩每百斤銅子５００枚，破鞋每百斤銅子２００枚，舊棉套每百斤銅子３５０枚。

2．檢料—原料既買之後，送於檢料室，用人工鬆散捆中之料，察其質之殊異者，檢出之，令其歸類。且藉以除去料中之塵

土。其分類之法，不依顏色而按品質分爲棉布蔴毛絨三類。

3. 切割—移檢出之原料於割切機上，將其切斷，切割時，宜特別注意扣子，扣鈕幷夾帶之金類物……。

4. 蒸煮—蒸煮之目的有二：(a)除去原料之油渣塵土，顏色，膠漿……(b)使原料之纖維疎鬆，使便於洗濯。——蒸煮所用之機爲歐洲式之圓鼓形之鍋，將已割切之原料移於鍋內，加入石灰，石灰之量約爲原料百分之十左右，務使不燒亂原料爲宜。後遂以熱汽蒸煮，幷旋轉之，所需時間以汽壓大小爲準，均計之約蒸煮十小時左右，使原料之色除掉，幷滅殺其微生物。該公司所以僅用石灰而不用苛性蘇打及蘇大灰者，因石灰(一)價廉易購。(二)能除掉多數色料，(三)使原料之纖維之硬性加強，則製出之紙，添加精色。實則用石灰之弊亦多：如僅蝕少數汚垢，與脂起作用而成不溶解之沈澱，使製出之紙不易吸墨，難供印刷之需……。故該公司所製之紙，不十分潔白，僅供包裹之用。以愚意度之，不如因時制宜，稍加些許之苛性蘇打及蘇打灰爲善。

5. 洗濯—移蒸煮之原料於攪拌池中，使水流過不絕，攪拌機亦不斷旋動，機輪有利刃，轉動割切，使原料愈碎，且去盡塵垢及脂膠……。所用之時間，因攪拌池之容積，機輪之重量，每分鐘轉動之次數，機輪齒刃之利鈍，水之多寡及性質，及原料之質性而異。

6. 漂白—經洗濯之原料，移於大池中，加水攪之，使成糊狀。此時由鉛筒中自上噴漂白粉於池中，同時常用機攪動之，令其均勻。漂白粉不可過重，亦不可過輕，重則損傷原料，輕則不發生效力。大抵以百分之八左右爲適宜。漂白粉所含之氯之多寡，亦關係甚鉅，至少含有百分之三十氯方可應用。溫度不可高或低於攝氏表三十二度，或法倫表九十度。池旁有槽，約十二至二十四小時後，將所餘之漂白粉取出，再以清水洗之，

使無氯味而止。

7.成紙—漂白之糊狀原料，由池底之管流於地下之大池中，再加搗碎機搗之，於是由抽吸機抽於較高之池中。池中有大搗粉機，常旋動不息，使原料之纖維成爲粥狀，適成爲製某種紙所應需之料，搗粉時，與搗機齒輪之大小，刃之利鈍，池之構造，轉動之速度……有關。要之，俱成粥狀而已。—在此池中，亦加入膠漿（松脂），所欲用之顏料幷明礬……。有時所加之顏料經過造紙網而脫落，故常加入人工所製之易沈澱之顏料之後，再加明礬，以救脫落之弊。顏料，膠漿等加入之後，由抽吸機抽出粥狀紙料，便之順槽下流於製紙之模內網中，前行經壓輪榨出水分，則紙卽成。再前行經過第一乾燥機，有自上來之熱蒸汽，使之變乾。有時恐紙含水過多，不易乾燥，故更令其經過第二乾燥機，則紙卽全行乾燥。乾燥之紙，再移入割塊機中，則割成所欲要之大小，於是理之成刀，束刀成扛，卽可發售於顧客。

8.產量及種類—

A.產量—計每日製紙約百扛，每扛十五刀，每刀九十六張，共約一五，〇〇〇張。每扛十元左右，計全年產額約五〇，〇〇〇元。

B.種類—該公司之紙，多屬定製，故名甚殊異。計其要者，列表於下：

加重連史紙	甲種連史紙	乙種連史紙	丙種連史紙	丁種連史紙
日用粉連紙	財源茂包貨紙	盛字紙	藍色火柴紙	黃色火柴紙
矾紙	包棉紗紙			

（註一）表一所列各種紙及其產地，由濟南市上之洪源商行，大通南紙店，九如南紙店，三義南紙店……調察而知，產地是否十分確切？著者不敢的知，謹就所聞者錄此。紙來自南省，而實在地點不十分明確者，則以江南二字稱之。

（註二）表二所列諸產額，由山東實業公報第一百二十册（十三年八月出版）查知。

（十四，國恥紀念日脫稿）

病中之狂言

趙伯平

一…引言

疾病中人易胡思亂想。不健康者易趨悲觀。

二…一切愛我的人哪！假若我病死時，你們只要向着尸體微笑，千萬不要哭泣啊！因爲那時我便自由了：我不是食的奴隸了，不是愛的奴隸了，也不是榮譽的奴隸了！你們要爲自己哀哭啊，因爲還要多走些極不自由的世路呢！記着啊，堅堅記着啊！

三…LT啊！你眞奇怪！人親近你時，你就疏遠人；人不親近時，你就親近人。你既不欲被人愛，也不當愛人呀！你眞是一個奇異的女子啊！你將何以答吾？

四…你們這些穿灰色衣的流氓啊，眞是混帳之極！你們只能擾害自己的問胞們。狗且爲主人守家…我叫你們是些「狗不若」們。

五…我愛○○人啊！我將死給他們看了！因爲我能爲愛犧牲一切啊！我不愛他們別的，只愛他們無論怎樣，終是擁護政府！這是甚麼話？假仁假義的我也愛嗎？是的，我愛他能實行假仁假義！…我也愛○○軍人啊！甚麼緣故？是因爲他們不他作們正當的職務麼？是的，我只愛他們不作正事！…愛不好的人的就是不好的人。我眞要愛嗎？

六…珍女士是個老閨女，眞心要作老閨友！我不信啊！她一定是幼年時仗着念了一肚子書，傲氣凌人，目空一切；及至顏色落了，年紀長了，念過書的不要她了，未入過學堂也不敢要她。況且她現在酸的要命，人一挨近她就被酸倒，於是更無盼望了！…哈哈！

七…靠近某女校的潔白的牆上面，寫着「女學生眞令人可愛啊」幾個字。那些字寫在高處，字跡非常美麗，不用說，

一定是討厭的男學生寫的！照我說，這話不通：天真的女學生可愛，反面的也可愛嗎？沒有勢力眼的可愛，反面的女子也可愛？！不健強的可愛，自求嬌弱的亦可愛？！不青年人張狂的胡寫，真是不通的確不通！

八…夜晚下大雨，道路泥濘，沒有光亮可以指清好一些的一條路；猛風吹來猛雨點亂射人身！我遇見這景況，真難過啊！深處一想，這也是人處世界的一個寫真啊！

九…朋友！你嫉妬c先生作甚麼？他長的不體面而年長，得到了一位海棠花般的女士，是因爲有錢啊！你好好的幹，不要胡思亂想，日後有了錢，錢能夠吸引一個美女來…錢啊！就是你不在朋友手下，所以我朋友得不到他愛的，他愛的不愛他，他便嫉妬了！

十…有優先權的長子們啊！你們的優先權就是你們的困苦根源啊！你們是最困苦的牛：你們在前頭盡力走，你們的弟弟妹妹們的供給，就是鞭苛刻最厲害的鞭子，趕着你們猛往前走，你怎敢住下呢？

十一…世界上最可惡的人是心內有污物而不說，何時何地，總假意說好話！那心內有好意念就說好話的，有不好意念便說不好話的頂好了！因爲前者是虛僞人，後者是誠實人，誠實人是可愛的！

十二…我的兒啊！我盼望你終身要以國家爲你頂愛的，其次就是妻與子；至於愛我們不愛，我完全不管！胡說，我眞是胡說，我現在沒有兒子，沒有XY！…不算胡說，中國的爲兒子的，總要以國家爲頂可愛的，頂愛的！

——十四年六月念六日晚，微病中不能赴睡，窗外雨聲更擾人不眠，因之忽思亂想，莫知所以，特書出以誌當時心境，不顧廉恥。

靈巖寺遊記

段達三

我們遊靈巖寺有兩種動機：(一)常聽見遊客們說：「靈岩是泰山背景一個最清幽的所在，遊泰山的必須也到靈岩去；不然，雖是遊了泰山，也等於沒遊過的。」所以自從去年清明遊過泰山以後，就時時刻刻忘不下靈巖，總想着尋個合宜的機會去一次。(二)聽得許多人說：靈巖有著名的羅漢塑像，是世界上不可多得的美術作品，很有文學上重要的價值。我們相離這麼近，必須去看一看。今年清明，天人湊巧了，目的達到了，只因時日太少，未克流連盡興，引爲遺憾。作這幾節遊記，是受青本報編輯先生的督促，不然是不想作的；因爲「觀察不周到，不確切」很難着筆。這不過將那日記本上擇幾件寫下來，給讀者一個對於靈巖的概念罷了。

位置　靈巖是泰山西北麓的一巖，地屬長淸縣，離泰山三十餘里。崗巒起伏，東南接連泰山，東北接連濟南的千佛山與隆山，離濟南省城一百一十里，有大道可通，步行一日可達。若坐津浦車自濟南去，三等車價銀七角，自泰安去車價銀三角。下車的車站是萬德，離靈巖尙有十餘里，步行一小時可達。興隆山，靈巖山，泰山是能彼此相望的，在這山頂可以望到其餘的二山；若在淸晴之日拿枝望遠鏡去看，那就更淸楚更明顯了。

沿革　靈巖山古名方山，是像形而名的，也叫玉符山。山寺名崇善。普通叫他靈巖寺是因山而名。相傳東晉時候，竺僧朗降錫說法，猛獸歸伏，亂石點頭，白鶴翔舞，所以名爲靈巖，就是巖石有靈的意思。這不過形容竺僧說法，感動力之大。到後魏正光元年梵僧法定禪師始建道場，稱爲『中土四絕之一』歷隋及唐，殿宇齋寮日新月盛，到了宋朝太平興國天禧景德間又改名皇帝的錫號（景德）寺。那五花殿千佛殿都是彼時建

造的。從元到明，出的名僧很多，歷經興衰，如今是衰落不堪的了。

以前的住持僧人，是「十方」（他們的稱謂）意思是無論何方的僧人都可以來住的。現今改爲子孫制度，師徒相傳授，如同人家子孫遞傳的一樣。盛時僧人數百，今則只有四十餘分門別戶，八大院四小院，各自爲政，如同平常莊村住戶不兩樣的。有總方丈一人，也不過有名無實，自前年總方丈死後，至今羣龍無首，一團散沙。

形勢　山形似臥駝，自北折東轉而西抱，成「」形。環周六十里，自西口入，見峻嶺四面包圍中，鬱鬱蒼蒼，柏樹彌漫，不知幾千萬株，爲我有生以來所創見。萬綠叢裏，浮圖塔高聳，成了碧海中的船桅，下邊繫着那隱隱約約攢攢簇簇的古剎宮殿，就是那客舍了。風過處，蕩蕩漾漾，萬頃波濤；日月間，成成蘭蘭，長林古木，仰首山光淹映，俯耳溪水淙淙。這樣的一個境地，纔可說是別有天地呢！那些僧侶們住在這麼一個脫離紅塵的世界，修真養性，何難成仙！快樂極了！不想他們倒是不學無術，酒肉穢濁，鴉片婦女，自尋苦惱。可見清心寡慾，不是容易作到的；獨棲生活，是很不自然的。這些僧人，不過爲飢寒所迫，藉撞鐘以託命的，何曾甘心修道？英文諺語說：「一個人能牽馬入水，但是兩個人也不能強馬飲水。」就是這種意思了。

殿宇　殿宇參差，登山下望，好像鳳凰展翅起飛的樣子。前朝建築，大都頹廢。所餘者一片瓦礫。今存者，概在前清初年所建。有天王殿，五花殿，大佛殿，般月殿，白衣殿等。辟支塔，猶巍然立。其餘的就是些僧舍禪室，却也倒院宇整潔，一天淨，花木修齊，四時新。

羅漢　羅漢四十尊，在千佛殿內，環殿內壁，都是坐像，都是代表「意」。據梁啓超的題碑，說是宋朝的羅漢手筆。是「海內第一神塑」中西名人來遊的甚多，多半爲着看羅漢，尤以日

靈巖寺遊記

本人爲最熱烈，看了以後還要攝他們的影。我們本是不懂藝術的，見了也覺得他們神態畢肖，悠悠然有生氣。愈看愈想看，其初心裏總覺得無論如何，他是泥塑的像；然而我愈看他，覺得他愈看我，好像一個活人看我一樣；我不免要整容斂衣，恐怕有不敬失禮的地方；愈看他覺得他要同我說話，我也預備要回答他。宋朝至今已一千年了，這像不知經過了多少風塵剝蝕，依然意趣生動，骨脈顯露，太的不易！德人某博士前曾特來攷究，作書評論，此像當爲世界第一美術作品，願出十萬金購之。可惜前幾年殿頂破漏，雨水侵滋，間有指落衣殘，不甚完善者；自數年來內務部省政府數下命令飭令修理，福海和尚奔走號呼，募化集資，大興土木，二年工夫修理完竣，神像賴此得以保存，所最痛心者，前人好大喜功之流，藉修廟以斂財，以沽名。不知羅漢之寶貴，幾次爲之修容，敷粉，穿衣，矯揉造作，以致精神失眞，使令人於歎口不絕中，不免遺憾填胸襟。

古蹟勝景　除了羅漢以外的古蹟，也有幾樣可說的。李太白字在西廊下魯班洞中，洞甚黑，持燈入，下洞十餘步，折向南，內疊長石捲洞，高約九尺，寬約七尺，南行十數步，地門下窪，深可沒人，李北海靈巖寺碑頌并序，就嵌在洞的左壁，碑當中已經斷了；文也殘闕剝落，不可卒讀了；惟「靈昌太守」尙分明，「大唐天寶元年歲次壬寅朔十五日景辰建」尙完善。窘內昏黑潮溼，而碑字至今雄厚之魄力，雲麾之書法，還可以看出來的。蘇東坡字在千佛殿東垣壁東面，方石嵌入壁內，字字清楚，筆畫神妙，風流飄灑，一見心醉。無字碑，相傳秦始皇之題碑，經年既久，已不見字，在東山上。萬丈碑在東山上，乾隆所題。摩頂松在大佛殿西，相傳唐三藏法師玄奘譯經於御書閣，曾摩此柏之頂，所以得名。清高宗有一絕句刻其旁云：「是柏謂松松攫柏，謂松非柏柏成松，是非稱謂成何定，一笑眞教辨莫從。」漢柏在摩頂松東，柏旁有一碑中書「漢柏紀」三大字，旁跋云：

「此柏方萌芽時漢文帝夢靈左有千柏，命鄧通往觀之，至而惟見一柏方萌芽，回以實報，文帝祭而祝之，曰當與此山並垂不朽。」

鐵袈裟乃一鐵鑄之物，高可五尺，寬約三四尺不等，上凹如領，下拖如襟，中顯縱橫之紋，極像袈裟。來歷不明。在東廊下前溝南。碑支塔高約八丈，共九層，石所建，上有鐵製之頂。塔中有階級，可登而上。我們上至五層而止。白雲洞在東山上。飲虎池在北山上。南州大頂佛石龕，在功德頂下，中有大石造觀音。山眼係兩山通明之處。六泉是黃龍，甘露，獨孤，雙鶴，卓錫，石龜，都是水清味甘。七頁碑是清高宗乾隆每次下江南留的紀念碑，每次留一碑，共留七碑，在山門半壁上。康熙也有留下的幾碑。他們的大碑小碑，題景的，寄情的，多得很！石坊—靈巖勝境—崇興橋，（即通靈橋）接官亭，黃茅岡，十里松等，是入山路上所遇着的東西。從石坊以裏的地，都屬寺僧，有佃戶耕種之，拿租多寡以與僧人面子厚薄而定。

雜感與建議　看了靈巖寺的以後，我們覺得有幾條的雜感與建議：

（一）官府人民對於古跡的輕視，太害事了！今後必須改良，但這保存的事，並不是一紙官話可以奏效的。

（二）無用的僧侶和遊民一樣的當廢除。

（三）山林的利益，不可忽視。不但可以得利；還可以美觀；更能吸收水氣，使山景清幽。像這山上的柏樹，眞是所值不貲，聽福海和尚說，他們修千佛殿只伐了幾株，便省下了萬金的木料費。若是一切的荒山都像靈巖山一樣，如何呢？

（四）養鷄事業在靈巖是可作的。柏樹那樣多，雞有一年到頭吃不完的柏子。孵的卵大而富於油脂，養料格外的足，我曾和和尚們談過，不過他們享福慣了的，少養幾個夠自己用罷了，不願意找麻煩去大規模的多養。我的話總是格格不入，局外

人又沒法插手去辦，這一項天然的利源，祇好付諸東流啦。

(五)靈巖是避暑好地方，雖是比不上牯嶺，北戴河，西山，青島。然而他的長處也有的是他們不能及的。若是拿避暑爲花錢擺闊那自然要到牯嶺，北戴河……去，若是爲潛修靜養那可就比別地方好多了！一是脫却紅塵，與世無爭；二是生活便宜，不用多錢。幾年前他們青年會曾在這裏開過一次夏令會，大家都承認是個好地方。我這話說了以後恐怕不幾年就有實行的；如同數十年前的牯嶺，人一點也不曉得他的好。自從一個外人去遊歷，看好了，出錢買了，蓋起樓來了，大家纔爭前恐後的去呢！

(六)遊靈巖寺最好是步行，從濟南去或是從泰安去，都不要坐火車。因爲坐火車不但是有錢的不經濟；更有時間的不經濟；每次等火車，在車站上不知要消耗幾何寶貴的光陰。何如徒步看沿途的山色野景，鄉村生活，飽嘗些自然風味呢！

上邊就是我們五個人在轉輪藏所攝影片右首是福海左邊是乃徒常興

民國十四年四月五號六號記者與劉君柏齡王君曜宸偕遊靈巖寺，寫轉輪藏福海和尙處，和尙與其徒常興招待甚殷勤，謹作記。

評議會對學生愛國運動所發之通告

自五卅慘案發生後，本校同學，當仁不讓，曾奔走呼號，不遺餘力。冀徒喚醒國人，合力抵抗——督促政府急速交涉。心至誠法亦至善也。其時適在放假，未有妨礙上課之事，即學校對此，亦無何項表示。但此種不幸之事，一有發生，難免有礙學業。昨本校評議會，特別發出通告，對學生之愛國，既深表同情，對學生學業之保障上，尤有辦法。茲覓得其通告原文，刊載於此，諒必爲關心本校者，所樂睹也。

本大學謹再聲明其立學宗旨，乃在對基督守始終不渝之忠誠，其力行者，概循基督教教育之目的——純正文化之施予與基督化品行及人格之養成。本校確信以上目的之能貫達，端賴本校學員教員專心向學，各盡厥職。一切正當愛國之表示，本校不徒深表同情，且欲促進，學員俾臻合宜之方法，對國家效建設之勞瘁，故不得不殷期各學員等嚴拒功課上之騷擾，以至荒廢學業，貽累國家，遂於本校設學之宗旨，亦難免牴牾橫生矣。嗣後如有此等情事發生，或因學員罷課而本校教育人才之宗旨，受有阻礙時，本校擬即散學，特此議決。

一九二五年七月二十九日　齊魯大學評議會啓

瑞代校長回報年來之經過

1924—1925

段達三摘錄

回憶過去之一年，本校所處之環境，實大異於疇昔；匪之禍未已，非基督教運動，其產風波，廢除宗教，教育倡議交加並至。大風疾雨，愈喚愈吾惟一之目的，砥礪吾前進之精神，一年中完滿之工作，與夫穩健之進步，有以告慰關心本校者。

◎中學聯合會　爲作更深切之聯絡起見，清明節時（四月三號四號）本校特召集一中學聯合會，集各中學校長或代表於本校辦公樓，討論升入本大學問題，凡合議決條件，標準之學校，承該會認可，得保薦其學生免攷升入本大學。新會長

瑞代校長回報年來之經過

爲韋理華森先生(文華中學校長)前途定多佳果。

◉林先生之工作　此一年中教育系代表林森先生曾以其大部份時間走謁各中學校爲懇切之聯絡與服務。

◉附屬中學　本擬今秋開辦。主任林森先生竭力擘畫；乃以款項不充，暫擱。

◉宗教生活　本校對於宗教生活，極端注意，大半爲學生之自動，教職員居指導地位，毫無迫脅；乃師生間靈性上之友誼交通，則繼長增高。名人之演講如霍德進大夫誠靜怡博士華德博士收效尤大。學生之服務於廣智院社會服務處青年會各教會機關，有足稱者，學生之研究國際問題非基督教問題均極熱切。爲宗教教育與鄉村教會問題，神科學員教員已合力作實地上之工夫，與當地公會教會合作，以期得到贏人之術。

◉巴校長　巴慕德校長春間病假返國，途經合衆國堪拿大扶病爲本校奮鬥，天佑其衷，今漸恢復其健康與勇力矣。

◉職教員　會計賽保羅病假胡約瑟代理，胡約瑟六月返國，賴恩源代理。社會經濟系主任巴克先生歸國，英文教授貝克先生歸國。英文教授塔克博士慶女士離校遊歷。新聘英文教授三位。友愛會賽牧師快來履新。白向義老牧師有意復返神科作講師，麥美德博士復回任神科教授兼女生監督。醫科藍大夫謝世，艾禮士大夫扶其夫人回國養痾。

◉新醫院　本校得中國醫學會助美金$25,000女子委員會捐美金$170,000他種捐款$10,000合共廿餘萬美金特建新醫院於現醫院之北鄰，地基已購妥。

記述同仁等赴雲南之經過

邵寶亮

校友於中國境內任事最遠者當推雲南並非爲成蹟優美而誇耀於同學本無可述之價值奈以交通不便而竟有機會頗辦學務亦本校之一曙光謹供校友之參攷也光緒三十一年冬周易訓秘亭先生蒙上海商務印書館介紹與葉尚皋提學使同赴滇南歷四月之久始抵滇垣出就農林學堂授半載人不敷用三十二年冬卽來電靑島周銘九先生請四人到滇當卽有生恪敬字子久王志高字仰之朱學儒字希方及寶亮四人約期同赴雲南歷四十五日卽抵滇垣以取道越南而省時日也及抵滇當卽分派生子久王仰之及寶亮充兩級師範教員朱希方爲方言學堂教員此時適有陶立字竹軒修滇越鐵路到滇周秘亭介紹先充教員繼任庶務長兼監修五華山師範學堂用紋銀十六萬九千兩絲毫無弊大蒙雲南大吏說教會人才與官界實不相同也生子久三年返魯周秘亭五年返魯朱希方五年返魯寶亮八年回東王仰之已在雲南十七年有餘祇在滇垣之一切變化勿用多述不過雲南各校均爲吾同學施教之地盤民國二年貴州省來電約王仰之約次明均行拒絕不往朱邵二人辭教職時蒙雲南教育當道幾次挽留不得均格外給一咨文朱希方將軍府任用邵次明在滇服務八年勤勞素著成績甚佳以免攷縣知事任用王仰之有唐省長以縣知事儘先任用至於在滇之教授成績勿用自白中國數算學理化之名迄今尙有人稱文會館乃算理之出產地並述狄攷文之功口碑載道不朽之字惟邵君當之

畢業生姓名錄(續)

姓名	籍貫	通信處
一九一二年文理科畢業者		
劉晉卿	濰縣	中學
劉福增	安邱	禹城福音堂
聶同亮	益都	河南開封濟汴中學
孫永生	益都	已故
濯鳴鐸	章邱	本校共和與
濯天爵	安邱	已故
石榮光	益都	
宋化風	益都	已故
徐道昌	益都	河南尉東張市福音堂
徐宗民	萊陽	烟台青年會
秦文炳	安邱	已故
王守愛	博山	廣州嶺南大學
袁德沾	福山	烟台晨星報館
袁景唐	平度	杭州弘道學校
高德政	鄭州西關浸禮會禮拜堂	
一九一二年神科畢業者		
劉光照	安邱	安邱耶穌教堂
張慕德	臨朐	陝西三原福音村
張延昌	長清	齊河福音堂
盧廷藻	禹城	長清福音堂
黃樂德	壽光	樂安福音堂
魏允中	壽光	安邱德育中學
張樹椿	蒲台	范縣郵局
王益三	濟州	已故
尹學聰	益都	開封南關聖經學校
王繼澤	益都	本校文理科
張思敬	博興	博山福音堂
一九一三年文理科畢業者		
葛世澤	樂安	嶧縣務本實業學校
景恕堂	鄒平	已故

王雲峻	益都	青州城西大莊
魏興仁	壽光	合肥三育女學
武仰錫	濰縣	青州守善中學
尹學功	益都	河南開封濟汴中學
苑榮芳	臨淄	曲阜第二師範
葉凌雲	膠州	已故
鄧升階	昌樂	徐州青年會
張福生	益都	登州育英女校
張傳謨	襄陽	湖北樊城鴻文中學

（未完）

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聖經百科全書

是書爲林亭理先生編以俄珥 Orr's 氏聖經百科全書爲底本並參以戴威士氏 Davis『聖經詞典』及近世名人最新之論著洋洋二百餘萬言並附精美圖畫三百餘幅洋裝四巨册計兩千八百餘面長十寸半寬七寸八分書中英文目錄最便檢查洋裝硬布面紙墨精良誠研究聖經唯一之偉著全部價洋五元郵費八角國外郵費加三倍

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評基督抹殺論

讀者有沒有看見幸得秋水所著的基督抹殺論麼這本書實在是基督教最大的勁敵因爲他不是膚淺的攻擊基督教乃是從『神學』上『歷史』上『哲學』上提出許多問題來攻擊他的結論是『基督是揑造的』『聖經是僞作的』現在這本書早已到了全中國每個智識階級手裏他們就用這本書向基督教瞄準你們對於他所提出的有沒有答復能不能答復因此有幾位神學家哲學家從首至尾辨駁一下刷印成書不但可以解決許多神學問題也可幫助我們應付這種攻擊每册大洋四角郵費三分

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ALONG THE SACRED ROAD
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CHEELOO

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Tsinan, China.

VOL. II SEPTEMBER, 1925. No. 3

WITH THE EDITORS

Unity in Diversity.

OUR readers are doubtless already acquainted with the events that have taken place in China during the summer; and many are in all probability desirous to know what effect those events have had upon the University. It is too early yet to foretell the changes that the changing situation will produce in us; and the future is all unknown. But already certain significant steps in the life of the University have been registered, and it is of these we can speak with certainty. When the storm came upon us—people of different nationalities, and of different creeds—the supreme danger that overshadowed us was that of flying asunder; the history of the summer months has been the history of the manner in which we have drawn closer together; we have learnt the need of the other person's point of view; we have grown into deeper friendships; we have examined into the weaker parts of our work, and have questioned our aim and purpose; and triumphantly over all failure of the past has sounded the clarion call of our commission—simple and clear—and in the obligations of a common service we have transcended the bitterness of national strife.

It is usual under such circumstances as the present for editors to speak with profound and judicial wisdom. But perhaps we shall be

pardoned if on this occasion we forego our own wisdom, and draw from that of Rudyard Kipling in the story of "The Ship that Found Herself."

To the owner's daughter the little cargo boat was just a perfect ship—newly built, painted and polished; but to the skipper she was "just irons and rivets and plates put into the form of a ship." She had yet to find herself; she was all there but the parts of her had not learned to work together. Every bit of her had to be livened up and made to work with its neighbour—"sweetenin' her, we call it technically." The crew could do no more than drive and steer her, and so forth; but if they had rough weather on the trip, she would learn the rest by heart. "For a ship, ye'll obsairve, Miss Frazier, is in no sense a reegid body closed at both ends. She's a highly complex structure o' various and conflicting strains, wi' tissues that must give an' tak' accordin' to her personal modulus of elasteecity."

The little Dimbula took on her first cargo and put out to sea. "As soon as she met the lift of the open water, she naturally began to talk." She was strongly built, and "every piece had been hammered, or forged, or rolled, or punched by man, and had lived in the roar and rattle of the ship-yard for months. Therefore every separate piece had its own separate voice in exact proportion to the amount of trouble spent upon it." As wave after wave beat upon her side, mounted upon her deck, thrust her up from below: the deck-beams complained of the weight of the capstan; the stringers complained of the heaving of the deck-beams; the scores and scores of frames along the side of the ship called out against the stringers; and the thousands and thousands of rivets chattered against the frames. The screw raced as it was heaved out of the water; and the thrust-block cried indignantly against the screw; while the cylinder was almost choked with dirty water mixed with the steam. "'Hush! oh, hush!' whispered the Steam, who, of course had been to sea many times before."

Meanwhile the sea grew worse. The fore-mast, who was high enough to take a dispassionate view of things, telephoned down its wire-stays that there was an organised conspiracy against them, for every single wave was headed directly against their bows. "'Organized bubbles and spindthrift' replied the waves, 'there has been a depression in the Gulf of Mexico—which has advanced—as far as Cape Hatteras—and is now going out to sea—to sea—to sea.' 'That's all there is to it' seethed the white water roaring through the scuppers. 'There's no animus in our proceedings. We're only meteorological corollaries.'"

A huge wave rose under the middle of the Dimbula, leaving her bow and stern hanging free; then two waves lifted her at either end,

and the great weight of the cargo pressed down on her keel. " 'Ease off! Ease off!' " roared the plates, and the stringers, and the deck-beams and the frames all together. The hundreds and hundreds of plates tried to creep a little nearer or farther apart and complained against the rivets. " 'We can't help it! *We* can't help it!' they murmured in reply. 'We're put here to hold you, and we're going to do it.' "

" 'Rigidity! Rigidity! Rigidity!' thumped the engines. 'Absolute, unvarying rigidity!' "

At last one of the most important plates got a fraction of an inch play, and all the bottom of the ship felt the easier for it. " 'Then we're no good,' sobbed the rivets. 'We were ordered—we were ordered—never to give; and we've given, and the sea will come in, and we will all go to the bottom together!' " " 'You *had* to give a fraction,' whispered the Steam, 'and you have given without knowing it. Now, hold on, as before.' 'What's the use?' a few hundred rivets chattered. 'We've given—we've given; and the sooner we confess that we can't keep the ship together, and go off our little heads, the easier it will be. No rivet forged can stand this strain.' 'No one rivet was ever meant to. Share it among you,' the Steam answered. 'The others can have my share. I'm going to pull out,' said a rivet in one of the forward plates. 'If you go, others will follow,' hissed the Steam. 'There's nothing so contagious in a boat as rivets going.' "

The storm grew to its worst—boats were carried away, the scuppers were nearly drowned; there was groaning and straining in the ship; but not so loud or squeaky as before; and now " she did not jar stiffly, like a poker hit on the floor, but gave with a supple little waggle, like a perfectly balanced golf-club."

The stringers had discovered that the inward pull of the deck-beams, and the outward thrust of the frames, locked them more closely in their places. The deck-beams had discovered the support of the hold-pillars helped them, and the frames found that the plating of the bows and the stern, as well as the floors, helped them to resist any tendency to spring. And the cylinders who were a little less stiff in the back than before had to confess: " 'If you'd been hammered as we've been this night, you wouldn't be stiff — iff — iff — iff, either. Theoreti — retti — retti — cally, of course, rigidity is the thing. Purr — purr — practically, there has to be a little give and take.' "

And when the little cargo boat reached New York harbour, there was a new, big voice sounding through the parts.

" The Steam knew what had happened at once; for when a ship finds herself all the talking of the separate pieces ceases and melts into one voice, which is the soul of the ship." F. S. D.

About Teachers.

J. D. MACRAE

THE great teacher is a rare species. Yet his appearance is not confined to any one time or people. Wherever he does emerge he can scarcely miss recognition by discerning souls. You cannot pigeon-hole the qualities which make him great; they are too elusive, too much compounded of life-stuff itself for that. Suppose, however, that we endeavour to recall a few examples of those who have been enshrined in the hearts of grateful pupils, or whose fame has reached to our own day. Perhaps the exercise may be illuminating in its results.

Socrates is among the "Immortals" of the Greek world. Who does not know something about the "Socratic Method"? But what most interests us is not his method; neither is it his philosophy; for he left behind him no system. What attracts rather is the picture drawn by Plato and Xenophon, of the master at work to combat sham knowledge in all its forms and to prove that *sham* knowledge is *real* ignorance. We see him surrounded by a group of eager young men; here he was always at his best. Plato makes Alcibiades describe his master thus: "He has only to speak and my tears flow. Orators such as Pericles never moved me in this may—never roused my soul to the thought of my servile condition; but (Socrates) makes me think that life is not worth living so long as I am what I am. Even now, if I were to listen I could not resist. So there is nothing for me but to stop my ears against this siren's song and fly for my life that I may not grow old sitting at his feet. No-one would think that I had any shame in me; but I am ashamed in the presence of Socrates." With all due allowance for exaggeration this is surely a remarkable tribute.

Turn to Alexandria, a few centuries later, and try to estimate the work of Origen, another unforgettable teacher. He had been himself disciplined for his task in more than one school. His father Leonides, with a high conception of a Christian father's vocation, refused to depute to another the early cultivation of his boy's heart. Origen owed much, too, to the church in which he was nurtured. But he learned most of all in the school of trial. He was, at one stage, full of a passionate desire to die with his father, who had been thrown into prison; indeed he was only saved by some stratagem of his mother. His later years, too, were full of hardship and persecution. This is how one of his students described him; and it is worth while noting that it was in a valedictory address at his graduation and not in after years with the halo of distance round the head of an old master. "Origen took us in hand", he declares, "as a skilled workman may take some field unwrought. . . . He put us to the question and made propositions to us, and listened to us in our replies. . . . He set about

clearing the soil, and turning it up and irrigating it and putting all things in movement. And thorns and thistles and every kind of wild herb or plant in our mind he cut out and thoroughly removed by the process of refutation and prohibition, sometimes assailing us in genuine Socratic fashion, and again upsetting us, until by a kind of persuasiveness and constraint he reduced us to a state of quietude under him, by his discourse, which acted like a bridle in our mouth. And that was at first an unpleasant experience for us, and not without pain . . . and yet he purged us. And when he had made us adaptable he dealt with us liberally and sowed good seed in season."

In the English-speaking world the name of Thomas Arnold of Rugby has been widely known as that of a rare teacher. When his application for the new position as head of Rugby was handed in to the trustees, one of those who sent testimonials, anxious to do the very best for his nominee, expressed the conviction that if Mr. Arnold were elected he would change the face of education all through the public schools of England. This somewhat extravagant hope seems to have been fully justified. Under Arnold the school became not merely a place where a certain amount of classical or other learning was absorbed by boys but the home of an intellectual, moral and religious discipline. Here healthy characters were formed and men fitted for the responsibilities of life. Everything goes to show that what enabled him to gain such influence and retain the respect of so many grateful pupils was "the intensely religious character of his whole life." Of the Master of Balliol, Jowett, whose memory is so fragrant in Oxford, it has been said that "his pupils became his friends for life. He discerned their capabilities, studied their characters, and sought to remedy their defects by frank and searching criticism. Like another Socrates he taught them to know themselves, repressing vanity, encouraging the despondent, and attaching all alike by his unobtrusive sympathy." His real claim to the remembrance of later generations was, without doubt, his greatness as a moral teacher.

I recall the tributes paid to another great teacher of the North American continent. He seemed to his friends to have about him something which suggested the rugged prophets of Israel. At the same time he was marked by traits of gentleness, humility, patience, tolerance in an unusual degree. He taught his students that truth is a large and most precious thing; that none can grasp it all; that all do not grasp the same aspect of it; that the search for truth demands the use of heart and conscience as well as the intellect. He made men feel that the simple things are really the great things. In his attitude to truth he had the aspect of one who was ever filled with reverence; he led his students to worship what he, himself, loved and reverenced.

Tagore, the Indian mystic, furnishes a picture of his ideal teacher, a young man who was early taken by death. We feel as we read that we, too, should like to have known the man whom it depicts. "He never had any feeling of distrust for boys' capacity of understanding", writes Tagore. "He would talk and read to them about whatever was the subject in which he himself was interested. He knew that it was not at all necessary for the boys to understand literally and accurately, but that their *minds* should be roused, and in this he was always successful. He was not like other teachers, a mere vehicle of text-books. He made his teaching personal, he himself was the source of it and therefore it was made of life stuff, easily assimilable by the living human nature. The reason of his success was his intense interest in life, in ideas, in everything around him, in the boys who came in contact with him. He had his inspiration not through the medium of books, but through the direct communication of his sensitive mind with the world." Such a teacher was well fitted to carry out what Tagore conceives to be the purpose of education, the "fullest growth and freedom of the soul".

What most commends the education of the older school in China is its emphasis on what is ethical and the close personal relationship between pupil and teacher which it always cultivated. I question whether we have in the West many instances of a loyalty and an intimate friendship such as was the common thing in this land. Here the grown man continued to the end to look upon his former teacher as his guide, philosopher and friend; he sought his advice on any and all subjects. The abiding influence of the older man, gained through close association in some private school in a remote hamlet, was often the one support of good moral character in the life of the youth.

Can we find in these men whom we have studied any guide-posts for today? I believe we can. Whether in Peking or Alexandria, in the first century or the twentieth great teachers seem to exhibit certain features in common. (1) Intimate friendship between teacher and pupil. It ought to be an axiom that this personal relationship is the most fundamental thing in the practice of teaching. Without it the best *methods* are fruitless. Truth that really counts in the making of manhood must be pressed home through *heart* and *conscience* and not by the exercise of mental gymnastic alone. But how can these come into play unless conditions of intimate understanding and genuine sympathy, as between teacher and taught, have first been established? We spend much time in arranging time-tables, and plan for a place for everything else; have we always done justice to this essential feature of our work in school and university? Is it not more apt to happen that we fill the hours of the day so full of efforts to convey *knowledge* that we have no

place and no time for the making of men and women? I am convinced that the greatest service which we who teach could render to young China today would be to offer to individual boys and girls and older students our personal friendship without stint. For that we have the testimony of the life and practice of every great teacher of the past. We need a rediscovery of the individual in the halls and on the campus of our modern seats of learning. All corporate life and fitness for the varied relationships in society depend upon it. And the first step in the search must be taken by our teachers.

(2) A Love and Reverence for Truth. Nothing but resolute resistance will save us from becoming slaves to the text-book method. It is not only canned foods which may prove unwholesome; the lack of sufficient pabulum in the form of suitable books on which our students can be set to do independent work almost inevitably drives us toward the use of the text-book digest. The study each term of a few hundred pages of material *about* the subject tends to take the place of a real *mastery* of it. Truth is living and must be understood and assimilated to be lived out in character and personality. Our students are eager to listen to the teacher who with courage and reverence will follow truth wherever truth leads.

"Happy the man taught by the truth itself;
Not by the shapes and sounds that pass across his life,
But by the very truth."

(3) A Belief in the Ultimate Value of Character and Personality. The aim of education is something more than the fitting of students for a vocation, or intellectual culture of a high order. Few will be found to oppose the contention that it is moral and religious and has to do with the making of character. Here is the acid test of all our work. Will Christian education justify itself in China? The answer lies largely with our teachers. All that will contribute to the formation of noble character must be given its true place and value. The mere acquisition of knowledge without these elements is of little worth and daily demonstrates its own futility. Have we the courage to put first things first?

Book Reviews

Several publications of unusually widespread interest, produced by members of the University staff, have come from the press during the last two months. Below we mention three of the most important ones:—

T'AI SHAN by *Dwight C. Baker.* The Commercial Press, Ltd., Shanghai, 1925. Cloth, 225 pages. $3.00 Mex.

In publishing this book Mr. Baker has rendered a valuable service to all lovers of the Sacred Eastern Peak, and has filled the long-felt need for a good publication in English descriptive of this world-famous sacred mountain. The volume follows in general the guide-book style of arrangement, leading the reader up the steep T'ai Shan Road with its more than six thousand steps, to the lofty summit a mile above the surrounding plains. All the points of historic, religious, and scenic interest are described in vivid fashion, and the reader is constantly made to feel the reality of the long line of sages and scholars and emperors who have worshipped here through the ages and have left behind as evidences of their loyalty and devotion the innumerable temples and towers and monuments which dot the slopes and the summit of the mountain.

The book is well written and printed, and profusely illustrated throughout.

PRACTICAL ASTRONOMY (實用天文) by *Wang Hsi En.* Shantung Christian University Press, Tsinan, 1925. Paper, 280 pages. $3.00 Mex.

This book, which is in Chinese, forms a valuable addition to the scientific literature available in this language. The purpose and scope of the work is well set forth in the Introduction prepared by Dr. W. M. Hayes, from which we take the liberty of quoting:—

"For a number of years there has been no work accessible to the Chinese student, not acquainted with western languages, by which he could obtain any knowledge of Practical Astronomy. The following treatise has been prepared by Prof. Wang Hsi En in order to meet this need, and being more complete than any work of this nature hitherto compiled in Chinese, affords facilities for the study of astronomical mathematics equal to that afforded in high-class universities in America and Europe.

"Probably no one in China is more competent than Professor Wang to deal with these problems, and his clear, logical presentation makes it comparatively easy for the student of higher mathematics to comprehend his treatment"

WHAT IS HAPPENING IN CHINA, by *Harold Balme.* Edinburgh House Press, London. Paper, 24 pages. Twopence.

This pamphlet, though prepared primarily to present to the British public a clear-cut statement of the present situation in China, contains much that is of great value to Christian workers in China, both foreign and Chinese. Taking a viewpoint keenly sympathetic toward the ideals and aspirations of the Chinese people, Dr. Balme outlines some of the activities and misunderstandings of the last quarter-century which have contributed toward the present state of unrest in this country, and emphasizes the underlying ideals and motives which are too frequently obscured by the more easily discernible unsettled conditions. In his conclusion he points out a number of ways in which the friends of the Chinese people can best aid them in their task, and most helpfully "extend to them the hand of sympathy, of confidence, and of brotherhood."

A Laboratory Guide for Middle School Teachers of Physics

DWAN REN DEH
AND
HAROLD W. HARKNESS

PREFACE

THIS is not a text-book nor laboratory manual in the ordinary sense. It is intended to be nothing more than a suggestion to teachers of Middle School Physics. The authors, however, cannot claim that it is more fool-proof than either a text-book or laboratory manual and if it is used in the mechanical way in which many text-books and manuals are used, it had much better not have been written. The authors' only claim for it is, that put into the hands of a teacher who knows something about, and has a real interest in teaching, Physics, these suggestions will help him over the many difficulties encountered in arranging individual experimental work for students when the equipment at his disposal is as meagre as it is in most of the Middle Schools.

The object of the laboratory course suggested in this manual is, in general, threefold. Firstly, it is intended to train the student in correct methods of quantitative observation. By this is meant, not only the actual mechanical process of making an observation, but the habit of making a clear record of observations with a view to interpreting them correctly. Secondly, it is intended to train the students in the elements of laboratory technique, by which is meant the ability to visualize the details of an experiment before it is set up as well as the ability to carry out, carefully and without unnecessary delay, these

序

依普通之意義，此册既非課本，亦非實驗手册；不過聊作中學校物理教員之一種建議耳．但作者不敢云其過於菲妄，如一課本或一實驗手册，用之如機械者，不如不作之之爲愈．作者惟一之請求，乃際茲多數中學校儀器設備俱在虧乏之中，是册得供諸顓曉物理而尤具教授物理興趣教員之手，此中擬議，將助之勝過佈置學生各自實驗所遇之諸般困難．

此册擬議之實驗課程，目的大要分三：第一，意在訓練學員以定量觀察之確對方法，此不獨謂作觀察之實地機械手續；且須養成作清楚觀察記錄之習慣；以及確對之見解．第二，意在訓練學生實驗室內之技藝，即當未作實驗前即明瞭其實驗底蘊之能力，一如作之之能力，

details. Thirdly, it is intended to aid the students in acquiring a working knowledge of the simpler and more fundamental IDEAS in Physics, without which it is as impossible to think Physically as it would be to speak a language whose vocabulary was unknown.

No text-book is suggested. The authors' preference is that no text-book should be used. References for teachers use are made in the manual and whether the students are to use any of these suggested books as text or for reference is left to the judgment of the teacher. The more the teacher makes use of reference material and keeps his eyes open to the physical world about him the better. It is his business to put the "breath of life" into the dry bones of this manual.

The list of apparatus suggested is intended to be a minimum. The list has been compiled from actual experience, and without other material this course in elementary physical measurements can be well taught. If however any laboratory has an equipment which exceeds this minimum, it ought to be used up to the limit. If better equipment than suggested in this manual is available for any experiment, use it. All of these experiments are easily modified to suit any equipment. The working drawings of apparatus to be made locally, have been made with a view to simplifying apparatus as much as possible, and require, for the most part, simple carpentry. Occasionally, as in the apparatus for finding the period of a tuning fork, the skill of a local watchsmith will need to be invoked. The form and dimensions of the apparatus should be changed to suit local conditions.

小心庶不致有不必須之滯遲. 第三,意在助學員得一簡淺根本物理意義之作用知識,缺此便不能有物理之思想,恰如欲操某種方言者而尙不知其名辭然.

末建議所用之課本,以作者之意無合用之課本,教員所用參攷則已列是冊內,學員用所擬之本,作爲參攷,或作爲課本,一聽教員之裁選. 教員愈多用參攷材料,並持寬大目光察觀物理世界愈爲有益. 伊之任務爲置「生氣」於是冊枯骨之上.

儀器表所建議者,爲最小之限度依經驗而編成,即不須加他種材料,而初級物理計量之課程,卽能作好. 但如有實驗室設備超過此最小限度,亦應完全使用之. 如有儀器較是冊所擬優良,而又合宜於某實驗,亦至好用之. 是冊一切之實驗至易修改,而適宜於任何儀器. 此中自作儀器之圖一見而知爲至極單簡者. 大概皆可用木工作之. 有時,如求音義週期之儀器須要一當地鐘表工匠作之. 儀器之式樣與大小,有時可斟酌更變以適於本地之狀況.

So far as preparation for entrance to the University is concerned emphasis should be put upon the first twelve subjects. For those who are not going on for further work the sixteen subjects cover the ground of General Physics very well.

It is assumed that students studying this course have already had a course in General Science. Assuming that this course is to be covered in a year it is suggested that the work be arranged somewhat as follows, the time allocated to laboratory being a minimum. In general, two weeks should be given to each subject. During these two weeks there should be one period of one hour given to introducing the general subject, two periods of two hours each given to individual experimental work, and three periods of one hour each given to discussion of the general subject, reports by students upon their experimental work and criticism of same, and drilling in the working of problems. It is not necessary that each student should have done each experiment, but during the seminar period each student should make himself familiar with every experiment whether he has personally done it or not. It is suggested that each student might do at least two of the experiments under each subject from I to XII inclusive.

General Introduction

Students' Equipment. It is suggested that the students equip themselves with two note books of any description, provided all students have the same type of books. One of these books is to be used to record all the observations just as taken in the laboratory. This book should be kept as neatly as possible even though it does not represent

論及攷大學之準備，可注重首十二題．爲不升學者計，此十六題已足包括普通物理之疆場．

意以學此課者，皆已學過普通科學．意以此爲一年課程分配略如下：(分與實驗之時間爲最小之限度)大概每題可用兩星期，此兩星期內可用一小時於題之概論；兩小時之課時兩次學員各自實驗；三小時研究普通題目學員回報其實驗工作，與實驗之論評，並練習問題之工作．不必須每學員每一實驗皆作之，但在研究班每學員須自己熟悉每一實驗，毋論其自己作過與否．意謂每學員至少須自題一至題十二各題目下作過兩實驗．　　七，十九，一九二五，於齊魯大學校物理樓．

總　論

學生之準備。 聽意學生自備二記簿，任何種類皆可，惟須各生所用者式樣相同．一爲實驗室內作實驗時記錄一切觀察所得，雖非爲作終結回報；但亦須至極整潔，此爲習作整潔原始回報之初步，據此

the final report of work done. The students should learn to make their original records neatly, since to insist upon this is to insist that students think their own way clearly through an experiment before they commence work. The other book is used to record the final report of the experiment in the general form directed by the teacher. There is no reason why this book should not be a model of neatness and clarity of presentation. If possible have the students write in ink in this book. A brush pen may be used except for drawings which should be made accurately with straight edge, triangle, and compass.

Data Sheets. It is suggested that the laboratory provide itself with sheets of blank paper marked with the date, or preferably printed forms, upon which the student will record a copy of only the essential data recorded during the laboratory period. This should be handed to the instructor when the student leaves the laboratory. It is sometime useful for the teacher to compare this data with that used in the calculation of the student's report.

Calculations. The students should have it impressed upon them from the first that this is a course in PHYSICS and not a course in mathematics. All calculations made depend upon figures which represent *quantities actually measured* and must be used as such. From the very first the teacher should consider as incorrect a result which contains more significant figures than the poorest reading upon which the result depends. The accuracy of a result is not increased by a long array of figures following the decimal place. The probable correctness of the calculation can usually be determined by estimating the reasonableness of the result. In dropping needless decimals always increase by one the last figure retained, if the part dropped is more than five; if just five or less, do not add one.

可見學生在未作實驗前，已諒透其作之之道．餘一記簿作終結回報之用，法式概依教員之指示，此簿表模更須整潔清楚．至好用鋼筆謄寫，如用毛筆亦可，但如畫圖須規矩方圓者，則鋼筆尙焉．

記錄單．竊意實驗室應備有空白紙單，號有日期，印刷者尤善．學生於正當實驗時間內在其上可記錄其重要得數，完班前交於教員，教員可用以較對此與其回報計算，是否符合．

計算．學員自起始卽須認明此功課爲物理而非算學，一切計算數碼，須依據實在計量數量．教員一見卽能意度其不對如結果包含過多數碼，係依據不甚可靠之察讀；因結果之準確並不以過多之小數數碼位數，而規定，而計算之準對，概以計議結果之合理規定之．制乘無用之小數，過五者進一，五及不足五者棄之．

In reading scales of any kind the last figure recorded is usually estimated by the eye and consequently doubtful. It is obviously useless to extend a result beyond this doubtful figure. Every figure of a product obtained by multiplying by a doubtful figure is doubtful and is therefore of no value.

For example if we have data such as 4.85 and 6.78 which require to be multiplied in order to obtain the result of an experiment, we have,

$$\begin{array}{r} 6.78 \\ 4.85 \\ \hline 3390 \\ 5424 \\ 2712 \\ \hline 32.8830 \end{array}$$

The first decimal figure is doubtful so there is no point in retaining any of the decimals after the first. The result is then 32.9 and this is the CORRECT result whereas to record 32.8830 is quite INCORRECT and should be considered so quite as much as though the arithmetic were incorrect.

The teacher may wish to introduce a contracted method of multiplication and division so that doubtful figures need not be recorded. The authors do not think this necessary and there are reasons why it might be unwise to use it. This is left to the discretion of the teacher. If

察讀任何種度分最末之數碼，往往靠目觀之核計，而往往不甚可靠.故依據此不甚可靠之數碼所得之數，顯然無用. 任何數碼得自不甚可靠數碼之乘積，皆係不甚可靠，皆係無價值.

例如吾有數如485與6.78須乘之以得實驗之結果.吾有.

$$\begin{array}{r} 6.78 \\ \times 4.85 \\ \hline 3390 \\ 5424 \\ 2712 \\ \hline 32.8830 \end{array}$$

此第一位小數卽爲不甚可靠者，故無由存留其以後者，而結果自然爲32.9.此爲準對結果，如錄32.8830則爲十分錯誤，而其算學亦爲錯誤矣.

教員或須介紹一淺略之乘法與除法，顯示不可靠之數碼勿須記錄. 作者亦不以爲係必須且有充分之理由，以證其妄，教員可自由引用.

however, it is used the students should always be conscious of WHY they are using it. For such contracted methods refer to any standard laboratory manual.

Error. In order still further to impress upon the minds of the students the fact that their final result is based upon measurements which may be in error their reports should contain a few notes as to the possible sources of error in the experiment. In any experiment giving a numerical result the percentage error should be calculated and recorded.

The Student's Report. The report may be made in any way the teacher wishes, provided that all the required information in the report stands out clearly and in an orderly form, so that any one may at a glance see the object of the experiment, apparatus used, method, data, calculations, results, and, last but not least, the student's name. The authors' preference is a report which is clearly arranged under the following headings:

Student's Name
Object of Experiment
Apparatus Used
Theory and Method. Under this heading there should always appear a clear diagrammatic drawing of the apparatus used, showing clearly how it is set up.
Observations. These should where possible appear in a neat tabulated form, with all lines neatly drawn parallel to the edges of the report sheet.

如有學生仍用，可使其自覺爲何用之．此等淺略示例散見各實驗手册中，可供參攷．

錯誤．俾學生更爲銘心者，以終結結果基於計量，計量有錯誤之可能，故其回報須附小注，書明實驗錯誤之來原．任何實驗內含有數目結果者，百分差須計而錄之．

學生回報．回報依教員之意用任何法作之，惟須回報清楚齊整，俾人一見而知實驗之目的，所用之儀器，方法，得數，計算，結果等；並學員之名．按作者管見，一清楚列舉之回報，似宜隨下列之綱領：

學生名：
實驗目的：
所用儀器：
理論與方法：在此項下，最好有所用儀器之清楚線圖，顯明如何安置．
觀察：此須爲一整齊表式，畫其表線與回報紙邊平行．

Calculations. Here should appear any special remarks about the calculations and in particular a sample calculation in full.

Results and Conclusions. If the result is a mere numerical constant record it clearly. Here it is not often necessary to make a comment. Where the result is in the form of the relation between two variables it should *always be shown graphically*. This should also be accompanied by a general statement about the relation obtained.

The Graph. Under the student's report, it has been pointed out that a graph should always be required where it is possible to represent the result graphically. The reason for this is simply that the relation between two variables appears most clearly and directly when shown graphically. It is not necessary to make this too complicated for Middle School students but with the teacher's guidance they ought soon to learn that a direct proportion is represented by a straight line, an inverse proportion by an hyperbola and a quadratic relation by a parabola. They should learn to recognize the general form of these curves so that with a moment's glance at a curve they could make a first estimate of the relation existing between the variables under consideration.

Here it is essential too that students be drilled in the idea that of two quantities, if one is proportional to the other, then a constant ratio exists between the quantities and hence one quantity equals this constant times the other. This is very simple but is of the utmost importance and is a point with which they do not readily make themselves familiar without endless drilling.

In this connection, the authors' experience has taught them that when student see that a variable A increases with another variable B,

計算：此處舉任何等特別記載論及計量，特別標模完全計算.

結果與決斷：如結果只爲一數目恆數，清楚記錄之即可，無須加以注解；如結果爲關於二變數之式者，則須以圖表顯明。又須加以概括說明論及所得之關係.

線表 於學員回報之後已指明須用線表將結果明瞭代表，緣如此代表能使二變數之關係，顯明極清楚，極直接。但爲中學學生勿須作之太繁複，祇須藉教員之指引，使其洞曉直線係代表正比例，雙曲線係代表反比例，拋物線係代表平方，凡此普通式樣之曲線，一應學習認明，於是一見一曲線首即意度其變數間具有之關係爲何.

此處最重要者，學生應練習此意義：如二數量彼此有比例，即必具有恒比數，此一數必等於彼一數乘此恆比數.此雖係極淺白。然而極爲重要，亦即學生難解之一點，若非熟念而時習之.

they at once jump to the conclusion that A is proportional to B. Conversely if a few observations show that A decreases as B increases they are inversely proportional. Try to get the students to maintain an open mind toward such relations until the exact index which the variable should have has been determined. Point out that we may have the relation,

$$A = K B^n$$

where n has any value such as 1,2,3,—1,—2, or—3 etc.

The experiment will determine this index.

The Laboratory Arrangement and Equipment. The teacher is referred for suggested designs for the laboratory to drawings by Dr. Adolph, which appeared in the minutes of the Shantung Board of Christian Education in 1924. If these are, in general, followed the teacher should have no difficulty in carrying out the course herewith suggested. There are, however a few suggestions as to details which will greatly assist the work.

It will be found useful to arrange at least four wall boards at points in the laboratory where there is ample space. These should follow the design given in the introduction, except that only two of these need have shelves at their base. The boards should be fastened firmly to the wall by first inserting large wooden pegs to which the board can be screwed. The bottom of the board should be approximately the same height as the laboratory tables. These boards can be used for suspending pendulums, springs, pulleys etc.

在作者個人之經驗中，已得證明當學生見一變數A，如隨他一變數B增加，學生立即興起決斷，謂A與B有正比例．反而言之，如A增加而B減少，即謂其有反比例．試使學生開展其心胸，應付此等關係，以至確定變數應有之係數時，則可指出下列之關係：

$$A = K B^n$$

此處N能有任何數值，如：1, 2, 3, —1, —2, —3,

此等指數依實驗規定之．

實驗室之安置與準備 教員須參攷 1 9 2 出版之山東部宗教教育 竇維廉博士對於實驗室之建議圖式，如依彼議，則以下課程之建議，不難施行，此處敘述之計畫，將於事功上大有補助．

最有用者，於實驗室內空閒之處，安置至少四支壁板於壁上．兩支須要板底有擱板，兩支勿須．先於壁上安插大木橛，後將壁板用螺絲牢結於橛上，壁板下端幾與實驗桌同高．此等壁板可用以懸掛擺，簧秤，滑車等．

It will be useful too, if above two of the laboratory tables ceiling boards could be fastened quite rigidly and hooks placed in these at useful points. These boards need only be approximately half the size of the wall boards.

There should be a good supply of the following simple things in the laboratory:

Wooden Cylinders (Right) about 10 cm. long by 5 cm. diam.

Wooden Parallelopipeds about 10 cm. ×8 cm. ×4 cm.

Wooden Laboratory Blocks for blocking up and supporting pieces of laboratory apparatus. These should be of various sizes. A very useful size is 10 cm. ×10 cm. ×5 cm.

Half a dozen small drawing boards about 40 cm. ×40 cm.

Spring Balances. The authors are of the opinion that spring balasnce should be put to greater use in the Middle School Laboratory. This will avoid the necessity of rough scales. The teacher should however, make a point of calibrating all the balances at the beginning of the term and supplying each balance with a calibration curve WHICH SHOULD BE USED. A suggested design of spring balance to be made locally will be found amongst the drawings which will probably be cheaper than balances bought from abroad or from Chinese firms, but it is suggested that the laboratory be equipped with at least six good spring balances. The size of the balance shown in the drawing should of course be varied to suit the use to which it is to be put.

Parallax. In nearly every experiment care will need to be taken to avoid the error arising from parallax when measuring lengths. When a length is to be measured by means of a scale, let the scale be set on

如當二實驗桌之上，能牢懸天花板，掛勾於其上，亦屬有用，此天花板大小只須抵壁板之半.

下列單簡物體，實驗室須有良好之供給.

木圓柱(正)約10糎長5糎徑.

木平行立方體約10糎長8糎寬，4糎厚.

實驗室木塊爲支舉實驗儀器之用，各式俱備，最有用者，爲10糎長10糎寬5糎厚.

半打小圖畫板，約40糎長40糎寬.

視差 各實驗中凡關乎計量長度者，皆須小心以避免自視差而生之差誤.當用尺計量長度之時.務令尺順其邊，如是則尺與欲量物之

edge, so that the distance between the scale and the object being measured is negligible. The students will have ample practice in this while doing the experiments under Subject I, but the teacher must see to it that these are not special precautions to be taken during these particular experiments only, but that they apply equally to all physical measurements. Sometimes it will not be possible to place the scale directly upon the object being measured, in that case a mirror may often be used to advantage as in Subject VIII, Experiment 3. By placing a mirror beside the scale it is only necessary to place the eye in such a position that the scale division which is in line with the point observed and its image in the mirror is observed.

Though parallax introduces these troublesome errors it is often useful, as the students will learn in experiments under Subjects XI and XII. It is important that the students thoroughly understand this "method of parallax" as used there and appreciate the fact that it is a very accurate method of locating an image. In explaining the method there is no need to do more than to appeal to daily experience.

References. For more detailed discussion of the points referred to in this short introduction the teacher is advised to look up the following works:

The Introduction to "A Laboratory Guide to Accompany Carhart and Chute's Physics"—Chute.
The Introduction to "Exercises in Elementary Physics"=Stiffler.
Pages 68 to 67 inclusive of "Elementary Practical Physics"—Watson.

間距，可以忽略．當作題一諸實驗時，學員對此須有充分之練習；然而教員不可以此爲是等實驗之特別預防，舉凡一切物理計量，皆須如此．但有時或不能直接置尺於欲量之物體上，則常用面鏡以作之，如題八之實驗然．如安面鏡於尺旁，作者只須置目於尺之度分衝觀察之點之線上，觀察其鏡中之像便妥．

雖視差法能引出如此之煩瑣差誤，然往往甚爲有用，此將於題六題七學習之，學員於此洞曉「視差法」乃最緊要之事，以其確爲尋求物像最準確之法．此處可不必贅述其方法，其於日常經驗中求之可也，

參攷 於叙述討論以上簡略總論各節以外，尚請教員注意下列參攷：

A Laboratory Guide to Accompany Carhart and Chute's Physics—Chute 之總論

Exercises in Elementary Physics—Stiffler 之總論
Elementary Practical Physics—Watson 68到67面所載

Apparatus and Stock Required for a class of Fourteen Students.

Apparatus to be Bought from Instrument Maker.

Meter Sticks	14		$ 9.80
Spring Balances			
250 Grs.	4	$10.00	
2000 Grs.	10	19.00	29.00
Balance and Balance Weights—Sensitivity 20 Mg.			40.00
Weights with Hooks—20 to 5000 grs.—3 sets			36.00
Pulleys—3 single $1.50, 3 double $2.40			3.90
Aneroid Barometer			12.00
Tuning Fork	256 vibrations per second		3.00
Thermometers	—10°C. to 110°C.	12	12.00
Alcohol Lamps	2		4.00
Protractors	6		1.50
Concave Mirrors	2	about 25 cm. F. L.	1.00
Convex Mirrors	2	„ „ „	1.00
Triangular Prism	60°	2	2.00
Convex Lenses	2	about 15 cm. F. L.	2.00
Concave Lenses	2	„ „ „ „	2.00
Blast Lamps	2		10.00
Bar Magnets	6		6.00
Compass Needles	about 1.5 mm. long	3	1.50
Simple Galvanoscopes	2		7.00
Galvanometers	Simple D'Arsonval Type	2	18.00
Keys	Single Contact	3	4.50
Switch	Single Contact		.60
Electric Bell			1.20
One Ohm Coils	4		5.60
200 Ohm Coils			2.50
Friction Glass Rod			.40
Friction Vulcanite Rod			.70

Stock and Supplies

Kerosene			
Alcohol			
Glass Tubing—			
1 mm. capillary tubing	1/2 lb.		$ 1.00
6 mm. glass tubing	1 lb.		1.40
8 mm. glass tubing	1 lb.		1.60
32 mm. glass tubing	1 lb.		1.10
Annealed Glass Tubing	100 cm. long 4 cm. diam.		2.50
Mercury	5 lbs.		
250 cc. beakers	8		2.40
500 cc. beakers	8		2.00
Supply of Naphta Balls about 1 lb.			
Thumb Tacks	1 pkg.		
Sealing Wax	a few sticks		
Aluminum Foil	1 book		.50
Bell Wire	1 lb.		1.00
D.C.C. Magnet Wire			
No. 26 B & S Gauge	1/4 lb.		1.00
No. 30 B & S Gauge	1/4 lb.		1.50

German Silver Wire, Bare,			
No. 22 B & S Gauge	1/4 lb.		4.80
Erlenmeyer Flasks	250 cc.	3	1.00
Florence Flasks	250 cc.	2	.70
Rubber Stoppers			
No. 4	1/4 lb. (1/2 one hole $ 1/2 two holes)		.90
No. 5	two holes	2	.35
No. 6	two holes	2	.35
No. 8	solid	2	.60
Glass Funnels	100 mm. diameter	3	3.00
Rubber Tubing—thin wall ordinary type for general laboratory work—1/4" diam.—36'			4.00
Test Tubes—			
1" diam.	8" long	3	.40
3/4" „	6" „	6	.25

Apparatus Made Locally According to Working Drawings Shown

Total Cost should not exceed ..... $ 25.00

If necessary the cost of apparatus as bought from instrument makers and agents may be somewhat reduced by purchasing fewer spring balances and substituting home-made ones. As the list stands it assumes that six spring balances will be made locally. The cost of the laboratory balance could be still further reduced to thirty dollars by getting a still cheaper instrument but this is not advised.

Prices vary considerably amongst different firms, but in order to save freight etc. it is advisable to order entirely from one firm. The list of apparatus, with the exception of the balance, will come by Parcel Post.

The following firms are suggested:

Messrs. The Central Scientific Co.,
460 East Ohio Street,
Chicago, Ill., U.S.A.

Messrs. Braun-Knecht-Heimann-Co.,
San Francisco, Cal., U.S.A.

Messrs. Baird & Tatlock Ltd.,
14-15 Cross Street,
Hatton Garden,
London, E.C.1, England.

Messrs. Schmidt & Co.,
1 Hsi-Tang Tsi-Hu-Tung,
Peking.

Messrs. The China Educational Supply Association Ltd.
C 58-59 Honan Road, Shanghai.

Subject 1. Measurement of Length

Introduction. Let the teacher give a short talk upon the importance of learning to measure length correctly. When measurements in Physics are analysed it will be found that practically every measurement, in the last analysis, amounts to the measurement of a length. For example the very common observation of the time upon a watch or clock amounts to estimating, to one tenth say, the fraction of a space, the minute, over which the minute hand has travelled. When we make a measurement of weight upon the laboratory balances we are also estimating lengths, for what we observe is the point, upon a scale of lengths, where the pointer of the balance reverses its direction and we try to estimate the smallest division upon the scale to one tenth. Numerous other examples will occur to the teacher but will probably not be appreciated by the students just at this stage. These may be referred to later in the appropriate place.

Now if lengths are to be compared we must of course have a unit of length, just as when market values of goods are to be compared we must have a unit of value, the dollar or the cash, etc. The unit of length used in all scientific work is the *centimeter* and it is one hundredth of the *meter* which is a standard length kept at Paris.

長 度 計 量

題 一

概論 教員須作一簡單談話論到學習長度計量確對之重要，如分析物理學上之一切計量，實際上將見每種計量的最後分析，必推到長的計量上面去．拿最普通的計時鐘表觀察作個比方，如說鐘表推計到十分之一分，實卽分針所經過如許空間長之分數．再如實驗室天平稱物，也是計量長的，因爲我們所觀察的乃是指計在度分盤的所在處與反向時所指之處，我們也是盡力要得到度分盤上最小及十分之一之區分．諸如此類的比方，教員能引許多；但此時學生未必能盡了解，可待諸日後適宜之地講明．

我們若要比較長度，自然必須有長度單位，正如我們比較貨物價值的時候，必須有價值的單位——銀元或銅子……一樣．在一切科學的事功上，長的單位是粁，卽巴黎城中所藏的標準長度釈的百分之一．

Here all the students should be given meter sticks and with the supervision of the teacher a thorough study of these must be made. This will save much time later.

From this, advance to the unit of area, the square centimeter, and finally the unit of volume, the cubic centimeter, getting clearly into the students' minds how one follows from the other. Discuss the square meter and the cubic meter and have the students think out for themselves the relation between these and the unit of area and volume.

Experiment 1.

Object: To Measure the Area of a Laboratory Table.

Apparatus: Meter stick.

Method: Place any point of the meter stick at one edge of the table and let the edge of the meter stick rest upon the table so that there is no parallex between the scale and the point read. Record the point on the scale which is opposite the edge of the table and put a mark upon the table opposite some other point of the scale. Note that these two points on the scale need not, and preferably will not be the end points of the scale. Now placing any point of the scale opposite the mark upon the table record the point upon the scale and make a mark opposite a point near the other end of the scale. Thus proceed until the end of the table is reached. Here record the point on the scale which is opposite the edge of the table. Do this three times for each edge of the table and take the average as the true length. Record as shown below:

此時須給每學生米一桿，教員監督他們作周全的查究，如此省去將來若干時間.

自此前進至面積單位，方糎，至體積單位，立方糎，務使學生心中清楚了解如何此隨彼後.研究方米與立方米，使他們自己想出此與面積單位體積單位間之關係.

實驗一

目的：計量實驗室桌的面積.

儀器：米桿.

方法：將米桿任一點準對桌之一邊，安定米桿之一邊於桌上，使他的分度和觀察之點不出視差.記錄對桌邊之分度，號出桌邊對某別一分度之處.注意此兩點不必須且也不必是米桿端點.再置分度任何點對桌邊之記號，記此點並號桌近彼端對分度之一點.如此進行計量

First Measurement		Second Measurement		Third Measurement	
Readings cm.	Lengths	Readings cm.	Lengths	Readings cm.	Lengths
0.56 96.43	95.87				
1.42 98.75	97.33				
1.02 10.65	9.63				
Totals	202.83	etc.		etc.	

Average Length.....

Similarly measure the other edge of the table and the width at both ends and thus calculate the area, being careful not to take the result to more figures than justified by the measurements.

Experiment 2.

Object: To Find the Volume of a Block of Wood.

Apparatus: Rectangular piece of wood, meter stick.

Method: Proceed to measure the edges of the block of wood, as the edges of the table were measured in the previous experiment, except that the edge of the block being much shorter than the length

至桌之彼邊，記彼桌邊對何分度．每桌邊如此計量三次，拿平均數作實長．記錄如下：

第一計量．	第二計量．	第三計量．
示度釈数、長度．	示度釈數、長度．	示度釈數、長度．
0. 5 6 9 6. 4 3	9 5. 8 7	
1. 4 2 9 8. 7 5	9 7. 3 3	
1. 0 2 1 0. 6 5	9. 6 3	
共合 2 0 2. 8 3		

平均長度.....

仿此計量桌之彼邊與兩端之寬，計算面積．小心不可使結果數碼多於計量準確位數．

實驗二．

目的：求一木塊之體積．

儀器：長方木塊，釈桿．

of the meter stick, the latter can be laid once upon the edge of the block and the readings of the scale opposite the edges of the block taken. Repeat the measurement three times for each edge, each time changing the position of the block with respect to the scale. Why? Having recorded all the readings, and thus found the average length of the edges, the volume can be calculated. Make a neat tabulated record:

Experiment 3.

Object: To find the Ratio between the Circumference of a Circle and the Radius.

Apparatus: Rectangular cylinder of wood, scale, pin.

Method: First find the circumference of the block by wrapping a narrow strip of paper once around the block. When it is thus wound about the block, make a pin prick so that it will go through two layers of the paper just where the ends overlap. Unfold the paper and measure the distance between the two pin-pricks. Repeat several times at different points upon the block and take the average.

方法：進行計量木塊之邊如上試計量桌邊同，但木塊之邊較粃桿尙短，所以只須對好粃桿於塊邊，觀察兩端對何分度便妥，重作此試，每邊三次，每次更換木塊對粃桿分度之部位．爲何？從所記一切示度中，尋得各邊平均之長，體積能藉此計算．

作一整齊記錄表．

實驗三．

目的：求圓周與其徑之比例．

儀器：圓木柱，尺度，定針．

方法：用細紙條繞卷木圓周一週，在二端彼此恰相掩歷之處，用定針釘之．開展紙條，計量二針刺之處之距離，重作數次於木塊不同之各點，求其平均數．

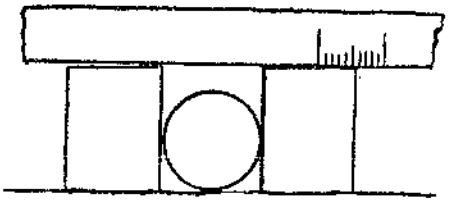


Figure No. 1 第 一 圖

Now place the cylinder horizontally upon the table and on each side put a rectangular block of wood (See Fig. 1). With a scale measure the distance between the edges of the blocks of wood. Do this at several points and get an average. This result, divided into the former, will give the ratio, circumference to diameter.

Subject II. Density

Introduction. *Weight* is a measure of the pull of the earth upon a body. Last day we fixed upon units of length, area and volume. The unit of weight is the pull of the earth upon one unit volume of water.* This unit pull is called the gram.

Density. The earth pulls different substances differently, as for example the pull upon lead is much more than that upon wood. That upon the air is less than that upon water, etc. If we wish to compare the earth's pull upon different substances we must consider unit volumes of the substances. The pull of the earth upon unit volume of a substance is called the density of that substance. Thus,

$$\text{Density} = \frac{\text{pull of earth on the body (its weight)}}{\text{number of units of volume in the body}}$$

and we say that a body has a density of so many grams per c.c.

*This definition should be modified when subject IX is studied.

平置圓木柱於桌上，每邊靠一長方木塊，(見圖)用尺度計量每相對二木塊之距離．在數點上作得均數，用此結果除所得圓周之長，卽得圓周與其徑之比例．

題　二

密　度

概論•

重量•是地球施於物體引力的一個計量，如上次我們已經規定了長的單位，面積的單位，體積的單位，這重量的單位，是地球施於一單位體積水的引力．*這引力單位名爲克．

密度•地球對於不同物體所施引力也不同，如引鉛之力較引木之力大；引空氣之力較引水之力小；……若是我們要將地球施於不同物體的引力比較一下，我們必須拿單位體積作準．地球施於一單位體積——立方粁一物質的引力，叫作物質的密度．如此：

$$\text{密度} = \frac{\text{地球施於物體的引力(他的重)}}{\text{物體的單位體積數}}$$

所以我們說某物體每立方粁有若干克的密度．

Specific Gravity. The pull of the earth upon a given volume of a body compared with its pull upon the same volume of water is called the specific gravity of the substance. Thus,

$$\text{Specific Gravity} = \frac{\text{pull upon x units of vol. of substance}}{\text{pull upon x units of volume of water}}$$

Notice that this is a pure number, a ratio only. Because of the unit of weight which we have chosen the number representing this ratio is the same as the number representing the density of the body.

Note that the earth attracts, or pulls down *all bodies*, wood, iron, glass, stone, brick, water, alcohol, air, etc., but with varying pulls.

It we wished to measure the density of any body, according to our definition, we should find the weight of the body, then measure its volume. Its density will be the former divided by the latter.

Experiment 1.

Object: To Find the Density of a Block of Wood.

Materials: Parallelopiped of wood, meter stick and spring balances.

Method: Weigh the block of wood as accurately as possible with the balances which you are using. Measure its volume, as in Subject. I, Experiment 1.

比重• 地球施於某體積物體的引力和他施於等體積水的引力相比的數，爲某物體的比重．如此：

$$\text{比重} = \frac{\text{施於X體積某物體的引力}}{\text{施於X體積水的引力}}$$

由上看出比重是純粹的數目，只是比例數，和密度是不相同的；不過因爲選擇的重量單位的緣故，偶而和代表密度的數目巧合罷了．

注意 地球吸引或說下牽一切物體；木，鐵，玻璃，石，磚，水，酒，空氣，……但是施有不同的引力．

按上解說，若是我們要計量某物體的密度，(一)我們先要求得定量物體之重量；(二)再計量他的體積；密度就是用（二)除(一)所得之數．

實驗一•

目的：求某木塊之密度．

儀器：長方木塊，秤，彈簧平．

方法：用簧平稱木塊至極精確，仿照題一實驗一計量他的體積．

Record.

	Length	Breadth	Thickness
	12.01	4.61	7.15
	12.00	4.63	7.15
	11.98	4.61	7.14
Av'g.	11.99	4.62	7.15

Weight.....grams.

$$\text{Density} = \frac{\text{weight}}{11.99 \times 4.62 \times 7.15} = \text{grs./cc.}$$

Experiment 2.

Object: To Find the Density of Limestone.

Materials: Sample of limestone (irregular in form), spring balances, overflow can, and small beaker to catch water from overflow can.

Method: Weigh the stone. Fill the overflow can and carefully place the stone in it, catching the overflow water in the small beaker. See that no air bubbles adhere to the stone. Weigh the water which overflowed. Now suspend the stone from the spring balance which was originally used to weigh it and arrange a beaker of water in such a way that the suspended stone is completely submerged in the water contained in the beaker. Record the weight.

記錄:

	長	寬	厚
	12.01	4.61	7.15
	12.00	4.63	7.15
	11.98	4.61	7.14
平均	11.99	4.62	7.15

重量.....克

$$\text{密度} = \frac{\text{重}}{11.99 \times 4.62 \times 7.15} = \text{.....克/立粁}$$

實驗二.

目的:求石灰石的密度.

儀器:標模石灰石,(無定形)簀平,帶溢口杯,小玻杯接溢口杯溢水之用.

方法:稱石灰石,將溢口杯盛滿水,小心將石灰石放進去,溢出的水接在小玻杯裏,看無氣泡附在石面上,稱溢出之水,將石懸於原用之平簀稱之;再以玻杯盛水置於石下,使全石浸入杯水內,記他的重.

Record.

Weight of stone in air =———grs.
Weight of stone in water =———grs.
Loss of weight =———grs.
Weight of water in small beaker (from overflow can) =———grs.
Volume of stone from overflow can experiment =———cc.

From your data what do you conclude is the relation between the loss of weight of the stone in water and its volume? Notice that this gives you a simple means of determining the volume of irregular bodies. What is Archimedes' Principle?

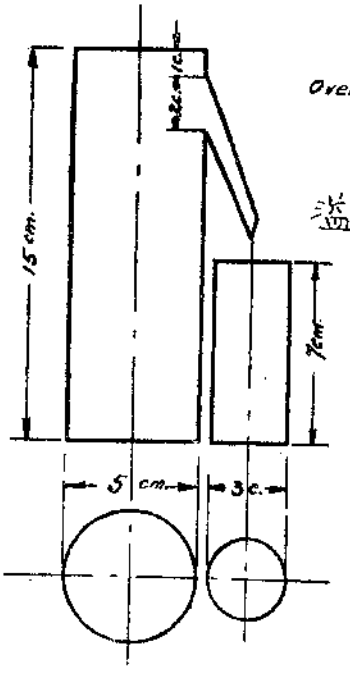


Figure No. 2

第 二 圖

記錄:

石在空氣內重……克
石在水內重……克
失重……克
小玻杯內水(自溢口杯溢出)重……克
自溢口杯實驗
得石之體積……立粁

從你實驗上所得的,你要給一個什麼結論,論到石的失重和他體積的關係?留意此處給了你一個單簡計量無定形物體體積的方法.何爲阿基米的公理?

From data calculate the density. What is your precentage error if the average density of limestone is 2.70 grs./cc?

Experiment 3.

Object: To Find the Density of Alcohol.

Materials: Alcohol, small bottle, spring balances.

Method: Clean and dry the bottle and then weigh it. Fill with water to a given mark, and weigh again. Empty the water, and fill the bottle with alcohol to the same point to which the water filled the bottle. Weigh again.

Record.

Weight of empty bottle =———grs.
„ „ bottle & water =——— „
„ „ water =——— „
Volume of bottle (to mark) =———cc.
Weight of bottle and alcohol =———grs.
„ „ alcohol =——— „
Therefore density of alcohol =———grs./cc.

The average density of alcohol is 0.80 grs./cc. What is your precentage error?

從你實驗所得的計算密度，若是石灰石的平均的密度是 2.70 克/立粁，你所得的與他的百分差若干？

實驗三。

目的：求火酒之密度。

儀器：火酒，小瓶，戥平。

方法：洗淨小瓶，弄乾稱之，裝水到某定記號再稱之，將水倒出，弄乾，裝火酒到水所到之某定記號，再稱之。

記錄：

空瓶重……克
瓶水共重……克
水重……克
瓶之體積（到某記號）……立粁
瓶火酒共重……克
所以火酒密度…… 克/立粁
火酒平均密度爲 0.80 克/立粁

你所得的與他的百分差若干？

Subject III. Forces and How to Add Them

Introduction: If we see a wheelbarrow starting to move, or a moving barrow stopping, common experience leads us to say that there must be a force acting on the barrow. But there may be forces acting on the body and yet the body not change its state of rest or motion. For example the foundation of a house has all the weight of the walls pushing on it but it does not move. Why? The earth pushes upon the foundation with an equal and opposite force. The SUM of the forces is therefore equal to zero. Similarly two boys pull upon a rope and it does not move if both pull with equal but opposite forces. We see then, that when the SUM of the forces acting upon a body is not zero, the body will commence to move, or a moving body will be brought to rest if the total force upon it opposes its motion.

Similarly a boatman pulling a boat on a canal may move along at a constant speed. He pulls one way and the water pushes the boat in the opposite direction with just an equal and opposite force. If the man stops pulling, one force is removed, the sum is no longer zero and the boat soon comes to rest. Thus we see that bodies which are not moving or which are moving at a constant rate, have forces acting upon them, the *sum of which is zero.*

The forces referred to above are all parallel forces, and we can readily see that if the forces are in the same direction we add them in the arithmetical sense, and if they are in the opposite direction we subtract them. Or in the terms of geometry and algebra if we called

力並如何以加之

題　三

概論：若是我們看一個小車開始運動，或是一個運動的小車停止的時候，依我們平常的經驗說必須有力施在他的身上．但也有的是施力於物體，那物體不改變他原來靜止或運動的狀態的，例如房基受着牆壁的總重所壓，並不運動，爲何？此乃地球推抗房基用與壁壓等多而反對力的緣故，所以他的總力等於零．類此，二童牽繩各施等大相反之力，繩也不動從此，看出施力於物體，若總力不等於零，此物如爲靜體，必要啓動；如爲動體，必要停止，如所施總力反對他的運動．

類此一舟子以恒速度推舟溯運河行，他推舟的推力和方向正與水抵舟的抵力和方向相等而相反．若是此人停止不推，是移去一力，那合力不等於零了，舟必頃刻停止，如此看來，物體不動的，或是以恆速度運動的，概有力施在他們身上；且是這些力的總數等於零．

forces in one direction minus and the forces in the opposite direction plus, we could always ADD forces which are parallel. Notice then that our conception of forces includes an idea of direction. Two forces of 10 grams are not the same unless they are in the same direction.

The problem of finding the sum of two forces is not so simple if the forces are not parallel. For example a rope, as in the illustration, is fastened to two posts, and a weight W is suspended near the center. The point O, it will be readily recognized, has three forces acting upon it in the directions OA, OB, OW. The point is also at rest from which we know that the SUM of these forces is zero. This will suggest an experimental means of finding a method of adding forces which are not parallel.

加不平行諸力
題三概論

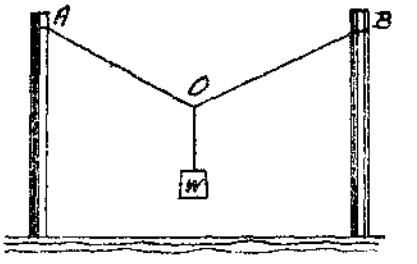


Figure No. 3 第三圖

Experiment 1.

Object: To Learn How to Add Parallel Forces.

Materials: Meter Stick, four spring balances, nails and string.

Method: Arrange three balances and the meter stick as suggested in the figure, adjusting the length of the strings until they are exactly perpendicular to the meter stick. Record the reading of the balances.

以上所論的是平行力，我們也很看出 按數學的意義. 同向諸力的合力是相加，反向諸力的合力是相減；若是以幾何代數的說法，名此向力爲負，與此向力相反的爲正，我們可以都說平行力的合力是諸力相加. 留意我們力的概念裏，含着方向的意味在裏頭，兩個十克的力是不相同的，若非他們的方向相同.

求不平行二力的合力問題不似求平行二力的合力那末單簡，例如一繩繫兩端於木桿上，(如圖)中懸重物W，於O 點上顯然有三力施在上面，方向爲OA,OB,OW. 此點既靜止，所以我們得知這些力的合力是零，這就是加不平行力的方法實驗上的途徑.

實驗一.

目的: 研究如何加平行力.

儀器: 杪桿，彈簧平四，釘子，線.

方法: 安置三彈簧平與杪如圖所示，較準線長直到他們正與杪作

Repeat using four balances. What is the relation between the forces pulling up, (in the illustration) and those pulling down? What is the sum of the forces?

Tabulate data and results neatly.

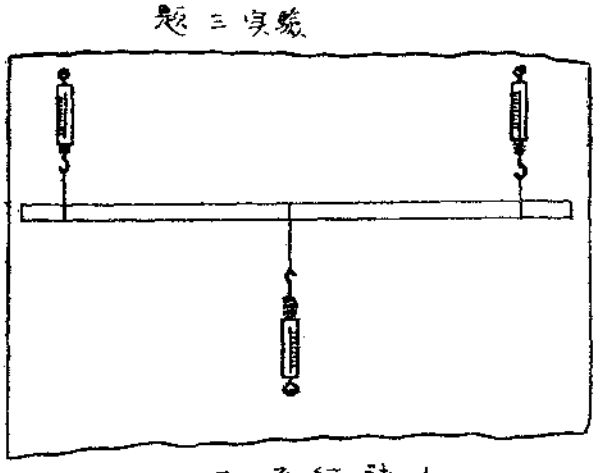


Figure No. 4

第 四 圖

Experiment 2.

Object : To Learn How to Add Forces which are not Parallel.

Materials : Board with pegs, three spring balances, string.

Method : Arrange the balances in any way so that their readings are within the middle third of their scales. Under the strings fix firmly a sheet of paper and carefully mark the directions of the strings A good way to do this is to place next to the string a good straight thick block of wood and rule along the wood. Mark the balance eadings on each line and remove the paper. Continue the lines until they all three meet in their common point. Now decide upon a scale

正交，記錄簧平示度．再用四簧平試之，上牽之力與下引之力有何關係？這些力的合力是什麼？

將得數與結果整齊列表

實驗二：

目的：研究如何加不平行力．

儀器：帶木概之方木板，彈簧平三，線．

方法：用任何方法安置簧平，使他的示度居全度中三分之一，線底安置紙一張小心記線之方向，在線底下放一支直且厚的木塊，準之畫線．在每線上畫明簧平之示度，移出此紙，引長各線使遇於一點，規定若干糎長代表若干克數，以線顯力，再任擇其中二線以代表力之一

so many cm. to the gm. and selecting ANY TWO of the forces scale off their lengths, and complete the parallelogram upon them. Draw the diagonal from O and measure its length. Reduce this to grs. by the scale chosen and compare this magnitude with the magnitude of the third force, OB. How are the directions related? What is the sum of the force represented by this diagonal and the third force in your exp.? From this experiment suggest a means of representing a force in magnitude and direction.

Draw the two forces OD and DA, parallel to and perpendicular to OB respectively, also draw the two forces OE and EC parallel to and perpendicular to OB. Add the forces OD and OE. These can be added algebraically since they are parallel. How do they compare with OF or OB? What is the sum of the forces DA and EC?

From this result it is seen that we may use the forces OD, DA to represent the force OA and the forces OE, EC to represent OC. In

段長作準，作一平行方形，自O作他的對角線；量此對角線之長，按規定糎長克數二者互抵之數，將線長變作克數，拿他和第三力OB比較一下他們的方向有什麼關係？對角線代表之力與第三力兩個的合力若干？從這個實驗上想一個代表力之大小與方向的方法。

畫OD與OA二力一與OB平行，一與OB正交，再作OE與EC二力，一與OB平行，一與OB正交，將OD與OE二力相加，他們既是平行定能依代數法相加。他們與OF或OB相較如何？DA與EC二力之合力若干？

從此結果可以看出來，我們可以用OD與DA二力代表OA力，也可

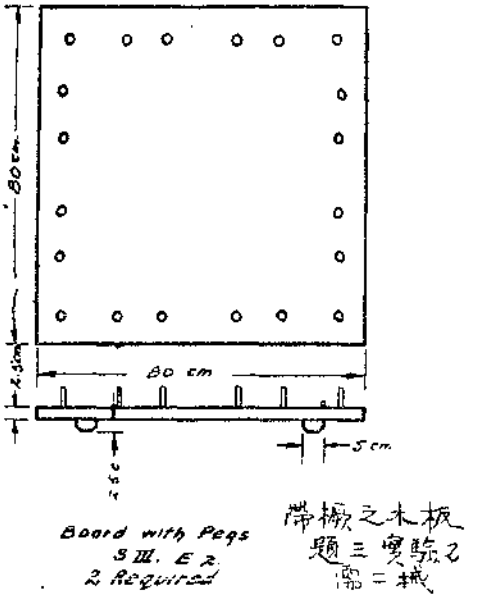
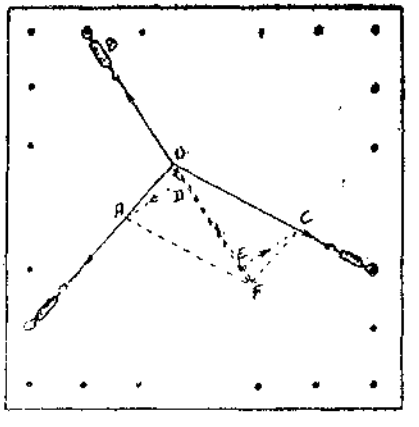


Figure No. 5 第五圖

題三實驗之



以線顯力

Figure No. 6 第六圖

each case these two small forces are called the components of OA and OC parallel to and at right angles to the direction OB.

If we wish to add non-parallel forces acting at a point, all that is necessary to do is to resolve the forces into component forces in two directions and then add algebraically.

Repeat the experiment using different forces at different points.

Experiment 3.

Object: To Study the Simple Derrick.

Materials: Two spring balances, board nailed to the wall and having several hooks screwed into it, stick about one meter long, and weights.

Procedure: Set up the derrick as in the illustration. Record the reading to the spring balance C and of the weight W. Attach a spring balance to A and by means of this balance pull the stick AB out parallel to itself until the end B just leaves the wall. Take the reading of the balance. This will be equal to the force with which the stick is pushed against the wall. Now the point A is obviously stationary under three forces and these three forces are parallel to AC, AB and AW.

Measure the lengths AC, AB, and BC. On paper draw a triangle abc which is similar to the triangle ABC formed by the members of the derrick. Now with a suitable scale of forces scale off upon the sides ac and ab of this triangle the two forces which are parallel to AC and

以用OA與EC二力代表OC力，在每種事實上，這兩種小力都名謂OA與OC的分力，方向與OB或平行或正交.

若是我們要加施於一點上不平行的諸力，最要緊的是必須先定他們在二種方向的分力，再以代數法加之，用不同的力在不同的點上，重作這個試驗.

實驗三.

目的 研究單簡起重機.

材料 彈簧平二，木板釘於牆上，上帶幾個勾子，一粗長之木桿，法碼，

方法 將起重機安置如圖.記錄簧平之示度與重W.將簧平擊於A，向外牽AB.以至B端離壁，記簧平之示度，此必等於木桿抵牆之推力，故A點顯然靜抵三力，此三力平行於AC.AB.與AW. 量AC.CB.與BA之長記之，以三長爲邊於紙上作ABC三角形與起重機上之ABC相似.尋一合宜之分度將三角形與AC,AB,平行之兩邊AC,AB化作分度.如

AB. Let these lengths be ac′ and ab′. Now join c′b′ and having reduced its length to grams by means of the scale chosen compare it with the weight W which is the force acting down at A.

Keep the students' minds fixed upon the fact that we are considering the forces acting upon the point A. Now the stick is pushed against the wall but is also pushed out against the point A. The string pulls up at A. If we draw arrows upon the diagram we get the result that for a point at rest the forces when placed end to end make up a complete triangle. This is a useful result to remember, but it is still better to remember how the result was obtained.

其長爲AC′ 與AB′,連C′B′,計量C′B′,邊長，化作克力數，與起重機施於A之力W比較之.

使學生之心專注於受力之A點，木桿推抵牆壁，但亦外推A點，簧平上牽A，如吾在線圖上畫矢頭，吾可得一結果.曰靜止之一點，其諸力端端相連，將成一完全之三角形.此爲有用之結果，須記之，但尤須記其如何得到如此之結果.

第七圖

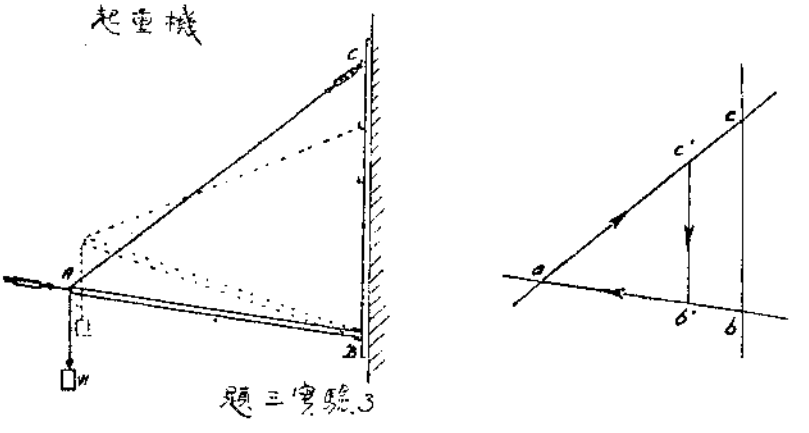


Figure No. 7

第八圖

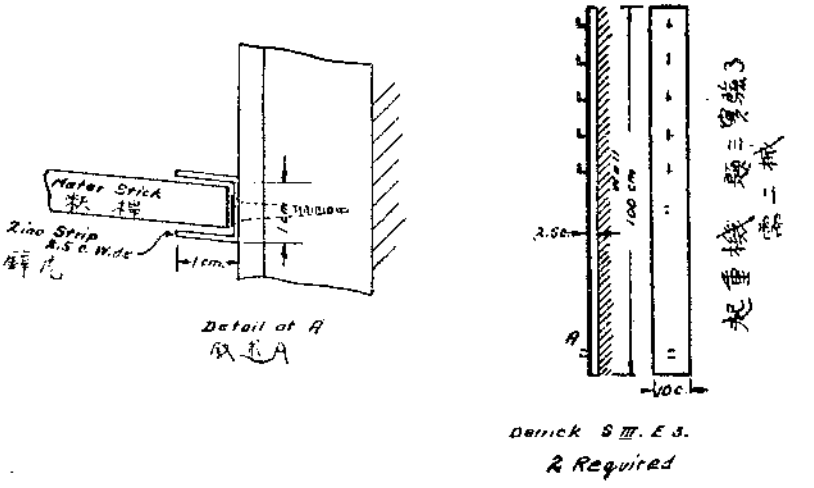


Figure No. 8

Repeat the experiment by altering the positions of the rod, string, point C, and the value of the weight W.

Experiment 4.

Object: To Calibrate a Spring Balance.

Materials: Spring balance, weights, co-ordinate paper.

Procedure: Suspend the spring balance upon one of the wall boards. Remove the scale pan and place it upon the balances. Add shot to the pan until shot and pan weigh just ten grams. Now replace the scale pan and shot to the spring balance. Using the knot B on the string as an index read the scale. This is the scale reading for a weight of 10 grams. Increase the weight by ten grams at a time until the total weight is 100 grams, in each case reading the scale division which is opposite to the knot B.**

Record in two columns the stretching force and the sale readings.

Plot the results upon co-ordinate paper, choosing a proper scale. Draw a curve through the points plotted. This is the calibration curve for the balance and if the number of the balance is recorded upon the paper this curve can be used to measure weights.

** Remove the weights one by one and again record each resting place. Note whether these differ from the resting points as the weights were added. If they differ seriously the spring has been stretched beyond its elastic limit and a new spring ought to be made.

更變木桿，線端C點，與重量W之位置，再重作之.

實驗四:

目的:校正簧平之度分.

儀器:簧平，法碼，方格紙.

手續:懸簧平於壁板上如圖，移去度分盤，置於天平盤上，加彈丸於盤上，以至彈丸與盤共重十克. 再放盤及彈丸於簧平上，用線上B結作表號讀分度，此即十克重所抵分度，按每次十克加重至百克，每次記對B結之度分份數.

將引伸之力(重)與分度份數兩格開列. 將結果揀一合宜分度作點於方格紙上，連諸點作曲線，此即簧平之校正分度曲線，如簧平之號數記於紙上，此曲線即能用以計量重量.

按序將法碼一一移去，再記每次止點，注意此諸點，與加重時之諸止點，不同否，如大不相同，是簧平引伸已過其彈力限，不能復用，須另製新者.

Using several objects of unknown weights, weigh them upon the spring balance using the calibration curve to find the weight corresponding to the scale division which is opposite the knot B.

Note that the curve obtained is a straight line, i.e. the stretch is proportional to the stretching force.

第九圖

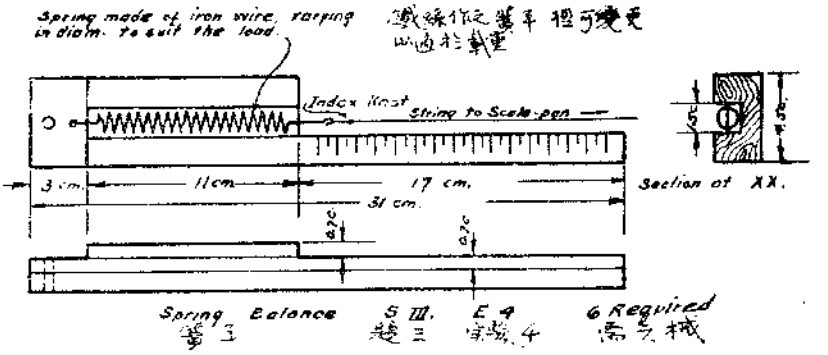


Figure No. 9

Subject IV. Moments and How to Add Them

Introduction. Everyone is familiar with the fact that when a cart is loaded the load is arranged so that the mule which is to pull the cart does not need to support the load, but only needs to pull. A glance at the accompanying sketch will show what is meant by this. The earth pulls down on the load in the cart, but if this load is properly located the pull will just go through the axle of the cart, and hence it cannot overturn the cart. The second sketch shows the same thing considered in another way. The earth pulls on the rear part of the load and tends to turn the cart in the direction A, but if the front part of the load is properly adjusted in quantity and position, its tendency to overturn the cart in the direction B, will just counterbalance the tendency of the rear part to overturn the cart in the direction A.

用幾個不知重量的物體，在簧平上稱他的重；尋得線上對合線結B度分部位的重，就是物體的重.

注意此曲線爲直線.卽伸長與引伸力爲正比例.

轉矩並如何以加之

題　　四

概論：人都曉得當一個車載東西的時候，載的法子不是要駕騾担任他的重，乃是要駕騾能拉他就夠了.一看右圖便明瞭這個意義：地球下引車重，但載重裝置的正使地引車重，穿過車軸，如此車便不會傾倒，第二圖是用別的一個樣子顯明同一的事實：地球下引車之後部

Notice that under these circumstances there are three forces acting upon the cart, two down and one up. The cart does not change its motion up or down, that is it does not leave the earth's surface and it does not enter the earth, therefore the sum of these three forces is zero. The two downward forces are then equal to the upward force. The sum of the two downward forces is the force through the axle as indicated in the first sketch.

The teacher is to note other illustrations of balanced tendencies to rotation, as in the rickshow, wheelbarrow, carrying pole, a grinding mill being turned at a constant rate, the common balance (秤) etc.

The Moment of a Force is defined as the force multiplied by the distances of the force from the center about which it tends to turn the body. Notice that the direction of the force and the line along which the distance is measured must make an angle of 90^0.

要使他順A方向傾倒，但車的前部是如此的順應他的數量和位置，正使車順B方向傾倒．這A．B兩個相抵相消，車乃不傾倒．

在此狀況之下，有三種力作用於車上；兩種向下，一種向上，車不上行亦不下行，不離地面，也不深入地內，所以這三種力的合力必爲零．二下引之力必等於一上牽之力．這兩種下引之力，就是第一圖上那穿過車軸之力．

教員當提起他種平衡趨向的旋轉運動，就如：人力車，小車，提重桿恆速度轉動的碾磨，平常天平，……．

力轉矩的界說是：力乘力與轉體中心的距離．注意力的方向與力的距離直線必須作90°的角．

第十圖

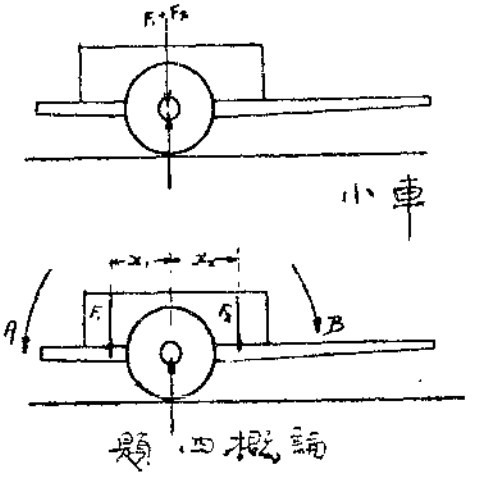


Figure No. 10

In the illustration of the cart, the moments are F_1x_1, F_2x_2 and $Fx0$. Of these the latter has no turning effect about the axle of the cart and the first two tend to turn the cart in opposite directions and therefore like the forces which we talked about in Subject III. If we call one direction positive the opposite direction is negative and taking this into consideration we may add algebracially all the three moments about the axle of the cart, and they will appear as follows,

moments in one direction = moments in the other direction

$$F_2x_2 + Fx0 = F_1x_1$$

or

$$F_2x_2 = F_1x_1$$

Experiment 1.

Object: To Learn How to Add the Moments Acting upon a Body.

Materials: Meter stick, support, needle* weights.

Procedure: Balance the meter stick, with its width horizontal, upon a sharp edge. When this is carefully balanced, mark the point of balance and at this point and a distance of one-third of the width of the stick from the edge drill a fine hole which is just large enough to take a coarse needle. Insert the needle and place upon the support.

By means of a string suspend one of the balance weights, say 100 grams, from one half of the stick, from any point. Select another 100

*The experiment will be improved by using a suitable knife edge, instead of the needle. These may be purchased from the Central Scientific Co. for about fifty cents each.

在那車的示例上，轉矩是 $F_0\ X_0$, $F_2\ X_2$, 與 $F_1\ X_1$. 他們的方向是相反的．其中末者無繞軸旋轉的效果，但首二者欲傾覆車於反對之方向．所以按我們以上題三所研究的諸力，若是以此力爲正，那與此力反向的力就是負．如此類推，我們就可以用代數法加起繞車軸的三個轉矩來：

此向轉矩 = 彼向轉矩

$$F_2\ X_2 + F_0\ X_0 = F_1 X_1$$

或

$$F_2\ X_2 = F_1\ X_1$$

實驗一．

目的：研究如何加施於物體之諸轉矩．

儀器：杈桿，鋒刃與支架，天平法碼，

方法：較正杈桿，使他平衡在鋒刃上，用線懸 100 克法碼於杈之一端任一點上，揀另一 100 克法碼懸於杈之彼端，合宜之點上以至平衡．

gram weight and suspend it from the other half of the stick at such a point as to put the stick back into balance.

How many forces are now applied to the stick? How does the distance of the two weights from the knife edge compare? Calculate the moments of the two forces.

Notice that the earth pulls the stick itself. When therefore the stick alone was balanced, where must the sum of all the forces pulling each cm. of the stick down have acted? This is called the center of gravity of the stick, because as we have seen the earth pulls the stick as though it were all at this point. When therefore we are discussing the pull of the earth upon a body we may think of it as pulling through the center of gravity of the body.

Now add several weights of different sizes to each side of the balance arm until a balance is struck. Record weights and distances from the needle. Calculate the moments, placing those which tend to turn the body in a clockwise direction in one column and those tending to turn in an anti-clockwise direction in another column. Add up the moments in the two columns. What relation exists between them?

Weigh the meter stick on a balance. Set it up again, but this time have the needle at some point other than the center of gravity of the stick, for example at the 30 cm. mark. Add a weight to the short end until the stick is balanced. Since the moment exerted by the weight balances the moment exerted by the pull of the earth upon the stick, which is the weight of the stick, calculate the point at which the earth's pull acts. Compare this with the point at which the stick was originally balanced.

二重與鋒刃距離比較如何?計算二力之轉矩.

注意地球下吸秤桿,所以當秤桿自己平衡的時候,地球下引各粒之總力在何點上?這點就叫重心.因爲我們可以看出來,地球的引力好像是都施在這個點上似的.因此我們研究地球引力施在一個物體上的時候,我們可以以爲是總施在他的重心上.

再於秤桿每端各加上不同的法碼,以至平衡,記錄各重各與鋒刃的距離,計算轉矩,將趨向鐘表方向的放在一格裏,反對鐘表方向的放在另一格裏,將二格的轉矩加起來,看有什麼關係?

用天秤稱秤桿,將他安起但不要使鋒刃支在秤桿的重心上,(比方放在 30Cm. 點.)加法碼在短端上以至平衡.既然重量(法碼)的轉矩,與地球引秤桿(桿重)的轉矩相平衡,計算地球引力所施之點,拿此點與起初秤桿自己平衡時的重心比較一下.

Record:

$F_1 x d_1$ $F_2 x d_2$ $F_3 x d_3$ $F_4 x d_4$ $F_5 x d_5$ $F_6 x d_6$

F x d (Clockwise) F x d (Anti-clockwise)

Point of Balance of Meter stick ... ... cm.
Weight of stick ... ... grms.
Calculated Center of Gravity ... ... cm.

Experiment 2.

Object: To Find the Center of Gravity and Weight of a Non-uniform Bar.

Materials: Non-uniform bar, knife-edge and support, balance weights.

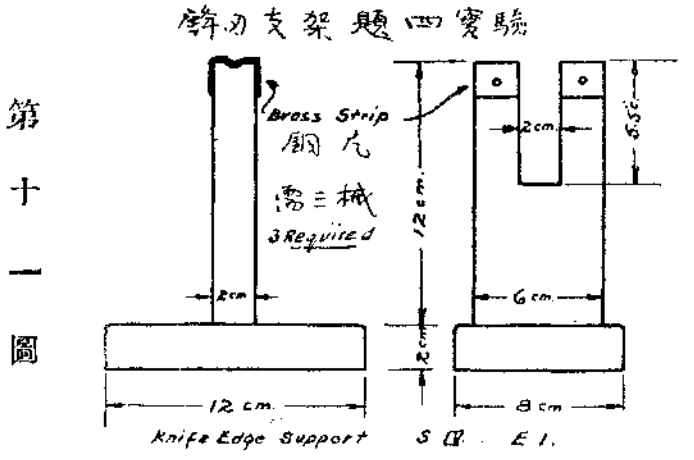


Figure No. 11

記錄:

$F_1 d_1$ $F_2 d_2$ $F_3 d_3$ $F_4 d_4$ $F_5 d_5$ $F_6 P_6$ $F_7 d_7$ $F_8 d_8$

F×d (順鐘表向的) F×d (逆鐘表向的)

秤桿平衡之點 = ... cm.

秤桿重 = ... G.

計算C/G = ... cm.

實驗二.

目的:求不等均木棒之重心與重量.

儀器:不等均木棒,鋒刀與支架,天平法碼.

Method: Set the bar up about its mid-point. On each side hang balance weights until a balance is struck. Record weights and distances from the knife edge, not forgetting the weight of the bar and the distance of the center of gravity from the knife-edge. (Let X = the distance and W = the weight of the bar).

Next change the weights or their positions or both. Balance and record as before. Make a record as in Experiment 1. You will now have two separate equations connecting the moments acting on the bar and from these two equations you can find the two unknown quantities, W and X.

Weigh the bar and compare the weighing with the result obtained from your experiment.

Balance the bar by itself on the knife edge and compare the point of balance with the position of the center of gravity obtained from your experiment.

Record the percentage error in your experiment.

Experiment 3.

Object: To Locate the Center of Gravity of an Irregular Plane.

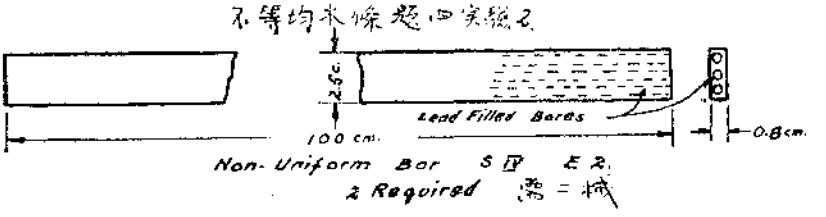


Figure No. 12 第 十 二 圖

方法:支起木棒中點，兩端各懸法碼以至平衡，記法碼重與離鋒刃之距.不可忘記木棒之重與重心離鋒刃之距,(以X代表距,W代表木棒之重.)

再改換法碼,或法碼位置,或二者俱改變.使其平衡,如前記之. 作記錄如實驗一.現在你有關於木棒轉矩的兩個程式,從這兩個程式裏,你能找出你所不知道的W和X兩個數量來.

稱木棒之重與你得的實體結果比較一下.

將木棒放在鋒刃上,平衡,比較平衡點與你實驗所得重心的位置.

記錄你實驗的百分差.

實驗三.

目的:追求無法形平面的重心部位.

Materials : Plane piece of board or metal, plumb-bob, and nail.

Method : Hang up the plane on a nail and on the same nail hang the plumb-bob. Since the plane is balanced the upward pull on the nail balances the downward pull of the earth on the board and this pull must act through the nail, or otherwise the board would rotate. Also the pull of the earth not only acts through the nail, but it acts straight down in the direction indicated by the plumb-line. With a straight edge block, mark this line on the board. We know that the center of gravity is somewhere in this line.

Now hang the board and plumb-bob up by some other point in its plane and repeat the experiment. The center of gravity is in the new line obtained and therefore is must be at the intersection of the two lines.

Support the plane horizontally at this point and see if it is balanced.

第十三圖

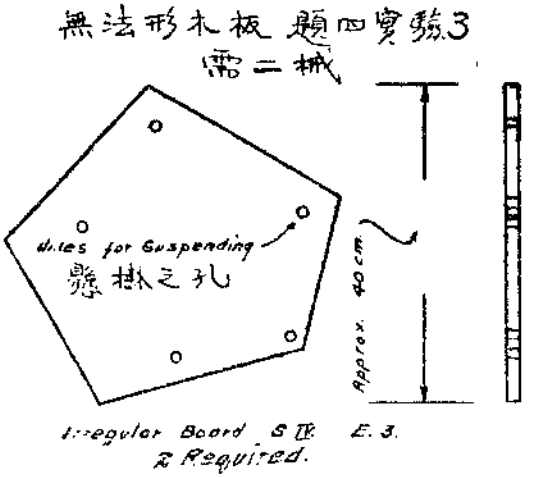


Figure No. 13

儀器：平面木板，或金類板，垂線球，鐵釘．

方法：懸平面木板於木橛上，又懸垂線球於同一木橛上，既至平面穩定．木橛上牽之力與地球下引之力相平衡．則下引之力必通過木橛，否則木板必轉動．力不但須通過木橛且必直指垂線之方向，用筆尖畫明此線於木板上．我們知道重心必在這線的一點上．爲何？

再懸木板與垂線球在別的點上重實驗之，重心也必在新得線的一點上，因此重心必在線的交點上．

平支平面於此點上，看其是否平衡．

Experiment 4.

Object: To Learn to Add Moments, (Forces Inclined to the Lever Arm).

Materials: Meter stick with small pin hole at the center and at the 50 cm. mark and small wooden pegs of the decimeter points, two spring balances, capillary tube, paper, square.

Procedure: With thumb-tacks fix a large sheet of paper to the table, and at a point about an inch below the upper edge of the paper and at its mid-point fix a needle firmly through the paper and into the table. The needle should be quite vertical. Over the needle place a piece of capillary tube about 0.5 cm. long, (See Figure 14), and over this place the meter stick. The meter-stick will then form a lever moving in a horizontal plane with the needle as fulcrum. Holding the meter-stick steady and as nearly parallel to the edge of the paper as possible draw a line along its lower edge with a sharp pencil. At the 20 and 80 cm. points draw, by means of the square, two lines perpendicular to the edge of the meter stick (i.e. the line just drawn).

Hook one of the balances to the pin at the 30 cm. point and stretch it, keeping the meter-stick parallel to the line originally drawn, until the index is about half-way down the scale. See that the edge of the balance scale and the string are in the line which was drawn perpendicular to the edge of the meter-stick. Fix the balance in this position. In the same way adjust the second balance, which is to be hooked to the 80 cm. point, until the meter-stick lies parallel to its original position, i.e. the edge lies over the line originally drawn.

實驗四.

目的:研究加轉矩(呈顯於槓桿臂之諸力)

儀器:粁桿有針孔在中心點與50糎度分處,與小木釘在每十分之一粁之點.簧平二,微管紙,短尺.

方法:用拇指按壓一張大紙於桌上,在離紙上邊約一寸距離之中點上,堅釘一針,透紙釘入桌面,針必十分垂直.拿約0.5糎長之微管套於針上,(見圖)以此作軸,按粁桿於上,此粁桿卽成槓桿,以針爲支點,能旋轉於水平面內.穩定粁杆近與粁桿平行,順其下邊用尖鉛筆畫線;並與20糎與80糎點用短尺以紙下邊作二垂線.(垂於剛作之線上)

勾一簧平於30糎小孔,引伸之,保持粁桿與原畫之線平行,以至簧平指針約指其度分之半,看簧平度分邊和線與所畫粁桿垂線相合時.釘簧平於此地位.如此較正第二簧平,勾於80糎點小孔,以至粁桿與原來位置平行.(卽下端順原畫之線)

Now take the readings of the balances. Show from these that the moments about the fulcrum are equal.

Now readjust the right hand balance so that (1) the lever comes back to its original position, (2) the string of the balance is parallel to its scale. When this is so the edge of the scale of the balance will point directly to the place upon the meter-stick at which the balance is attached. Take the reading of the two balances, and run a pencil along the edge of the scale of the balance ab. Now remove the balance and produce this line to f; also draw the line gh, from the fulcrum g, perpendicular to af, and measure the distance gh, i.e. the *perpendicular distance between the fulcrum and the direction of the force acting at f*, Multiply this perpendicular distance by the reading of the balance when in the position ab, and this will be found to be equal to the moment of the other force acting at e.

Hence it follows that the moment of a force about a point is equal to the product of the force into the perpendicular distance between the point and the line of action of the force.

第十四圖

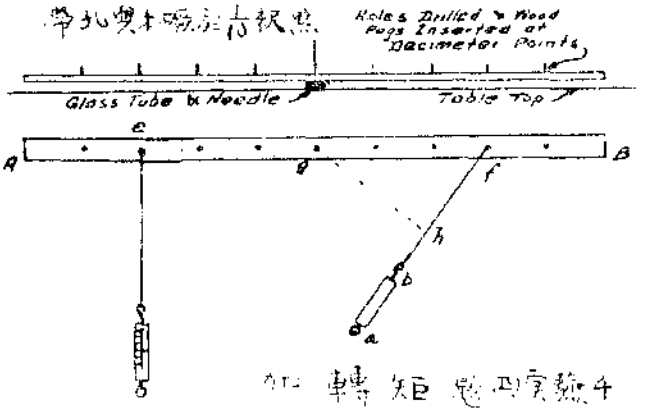


Figure No. 14

於是記簧平之示度，依此顯明繞支點之轉矩相等。

重校對右端簧平示度，(1)槓桿退回原來位置，(2)簧平之線與其度分平行，如此簧平度分邊直指釈桿切簧平之點，記二簧平之示度；並以鉛筆順ab簧平之度分邊畫線，摘去簧平，引長此線至f；自支點g亦畫gh線與af平行，計量gh之距離，卽支點與施於F力之方向二者間之垂距，用簧平在ab部位之示度乘此垂距，所得之積，必等於施於e之力之轉矩。

因此繞一點諸力之轉矩，等於力與此點與施力線間垂距二者之乘積。

Experiment 5.

Object: To Learn to Use the Laboratory Balances.

Materials: Balance, balance weights, bottle.

Procedure: The first thing to do always when using a balance is to find its resting point and its sensitivity. First study the construction of the balance carefully. If the scale beneath the pointer is not marked then mark it as shown in the figure below. Now raise the balance fulcrum by means of the lever provided and watch the pointer as it moves over the scale. Starting at the left of the scale record the turning points of the pointer for three successive turnings. If for example they are as shown below:

Left	Right
5.1	14.2
6.2	

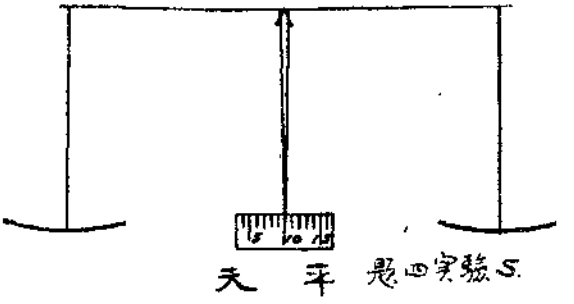


Figure No. 15 第十五圖

then obviously the resting point is 9. 9, i.e. the average of these turning points. This then is the correct resting point.

Now put the bottle into the left hand scale pan, and add weights, *by means of the tweezers provided, and systematically*, until a resting point

實驗五.

目的：學習使用實驗室天平.

儀器：天平，天平法碼，稱瓶.(普通瓶即可)

方法：用天平第一要緊的是尋求他的止點與他的靈度.先精心察驗天平之構造.如指針下之度分盤原未刻畫，可即刻畫之，如下圖.轉捉下面橫桿，上舉天平支點，看指針擺動過往度分盤，自左邊起首連記指針之轉移點所指分度三次.(左二次右一次)如作例如下列:

左	右
5. 1	1 4. 2
6. 2	

是顯然止點爲9.9.即三者之平均數.一先得左二者之平均數，以此數再與右一者平均.

by a rough observation nearly the correct one is obtained. Let the weights added be 30.5 grams. Now find the resting point exactly. Let it be 7.8. Are the weights added too many or too few?

Now remove a 0.1 gram weight, and record the new resting point Let it be 11.5. Then by the removal of 0.1 gram the resting point moved over 11.5—7.8, i.e. 3.7 scale divisions. But we need only remove enough weights to make the pointer move over 9.9—7.8, ie. 2.1 divisions. Hence we should have removed,

$$0.1 \times \frac{2.1}{3.7}$$

i.e. 0.06 grams. Hence the correct weight is 30.5—0.06 = 29.44 grams.

From the above result the sensitivity of the balance is 3.7 divisions per 0.1 gram, and for future use of this balance during this experiment this result can be used to calculate the correct weighing directly.

Now put some water into the bottle and weigh again. Let the weights added be 56.3 grams, and the resting point be 12.4. Are the balance weights added too heavy or too light? To obtain the correct resting point the resting point must move through 12.4—9.9, i.e. 2.5 divisions, therefore we must add to the balance weights $0.1 \times \frac{2.5}{3.7}$ i.e. 0.07 grams, and the correct weight is, 56.3 + 0.07 = 56.37 grams.

置稱瓶於天平左盤上，加法碼，用置備之零小法碼對稱．以至止點約合所定者，如所加法碼爲30.5克，再求此時之恰切止點，如爲7.8，法碼加的過多?或是過少?

如移下0.1克法碼，再求其止點，如爲 11.5，如此移下0.1克法碼，止點過往11.5—7.8即3.7度分；但是我們所須移去者爲正使指針過往9.9—7.8即2.1度分之法碼，因此我們必要移去，

$$0.1 \times \frac{2.1}{3.7}$$

即0.6克，所以確對重量是30.5—0.06=29.44克，

依以上結果，天平之靈度是0.1克3.7度分．爲以後應用作稱重實驗時，可直接用此數計算確對重量．

再將稱瓶中盛水稱之．如所加法碼爲56.3克，止點爲 12.4，法碼加的過重?或過輕?要得確對之止點指針必過往12.4—9.9即5.2度分．所以我們必須加法碼 $0.1 \times \frac{2.5}{3.7}$ 即0.07克，確對重量必爲 56.3+0.07=56.37 克．

What is the weight of water in the bottle?

All the students should sooner or later, be given a chance to do this experiment, and it should be impressed upon them that this is the only way in which the balance should be used.

The above illustration should be varied to fit the sensitivity of the balance in the laboratory. Here a very rough balance has been assumed.

In this experiment all the turning points of the pointer in each case should be recorded and reported in the experiment. In future experiments where the balance is used it is only necessary to record the sensitivity, and where an absolute measurement is required, as distinct from a difference of two weighings, the resting point, light, should be recorded, as in the above illustration.

Let the teacher see that the students appreciate the fact that this experiment comes properly under a study of moments.

(Continued in the December issue of CHEELOO)

瓶中之水重量若干？

凡學員遲早必得一機會作此實驗，將此用天平獨一之法，銘刻於心。

以上範例有時須視天平靈度更變，此處所用乃指粗略天平而言。

在此實驗上各項指針之一切止點，必須記錄報告，以後凡用天平之實驗，只須記錄其靈度足矣。如有時需要絕對計量，分別二重之差，則止點，平衡點，必一一記錄，如上範例。

請教員察視學生是否鑑別此實驗之事實，純係出自轉矩之研究。

（未完——本卷第四期續登）

CheeLoo

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