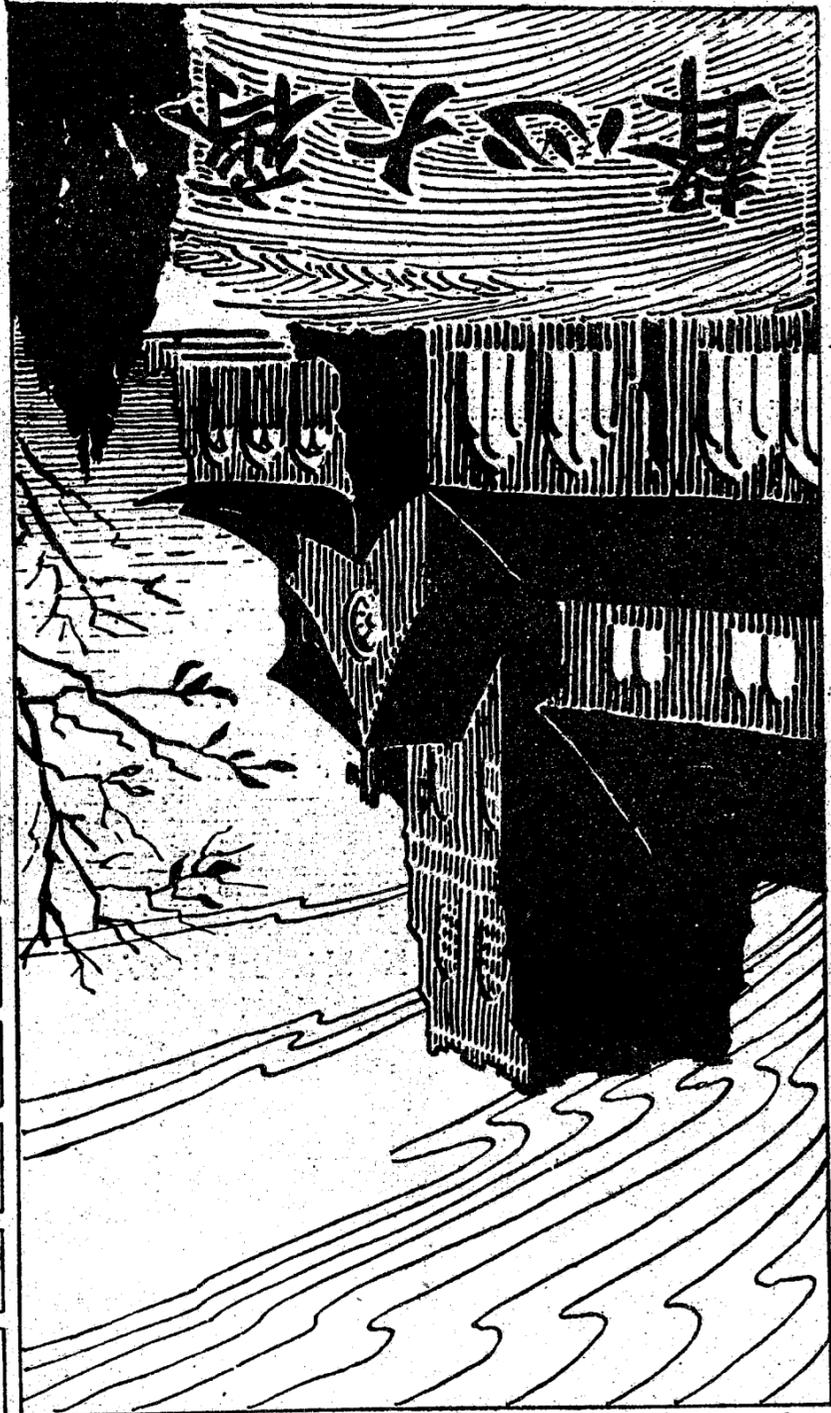


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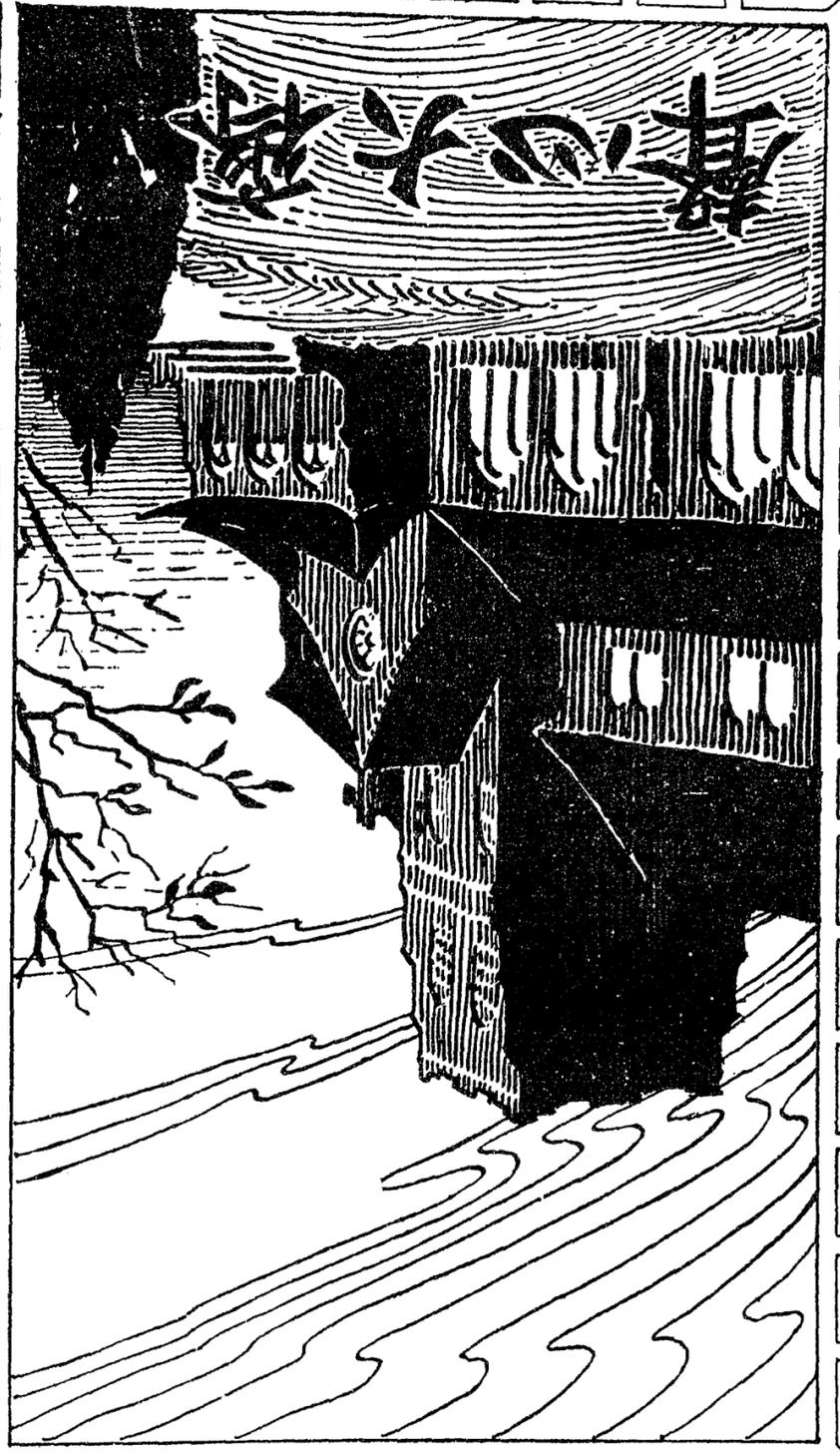


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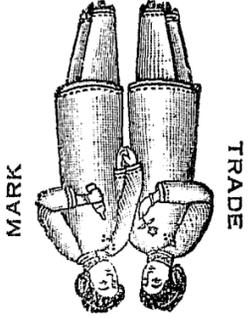
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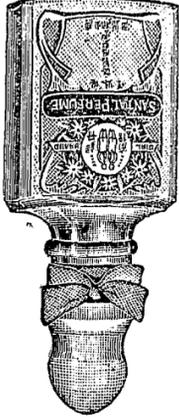
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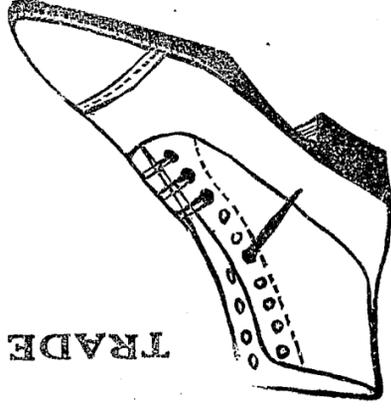
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此等殼層係等厚且其平均直徑比例為1:2:3:4.....故

其球面積比例為1:4:9:16.....每殼層所含電子數

自外數第一殼層含二電子第二殼層含八電子第三殼層

含十電子其餘殼層中每殼層可含一電子或二電子但必須內層

數足而有餘時方能將所餘者分配於外層之胞內此此外層

又必須每胞均有一電子始能開始分配其第二電子

(二) 泡利原理：一電子可以繞原子核旋轉於大部分可

之軌道內(如下圖)且每一軌道皆依牛頓定律可以算學

方程式表之如下。其 $\frac{p^2}{2m} = (2\pi n)^2$  即電子電量

與核之電量係軌道直徑。係進行次數。係電子之質

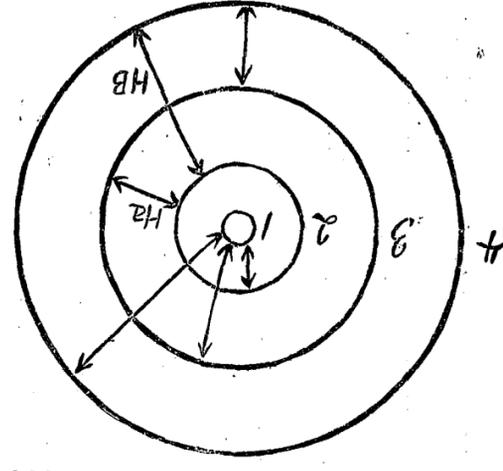
量。放射現象只發生於電子自軌道跳動於彼軌道時若

A<sup>2</sup> 係電子在軌道內之能力。A<sup>1</sup> 係電子在彼軌道之能

力。電子由此軌道而跳動於彼軌道必放射能力  $\Delta V = A^1 - A^2$

原子

入軌道所致。所生現象。係紫外光線 Lyman Ultra-Violet lines  
線H<sub>1</sub>。自軌道跳入軌道所生現象H<sub>4</sub>。係H<sub>1</sub>—A<sub>2</sub>—A<sub>1</sub>—H<sub>1</sub> 係  
線H<sub>2</sub>。自軌道跳入軌道所生現象H<sub>3</sub>。係H<sub>2</sub>—A<sub>2</sub>—A<sub>1</sub>—H<sub>1</sub> 係  
線H<sub>3</sub>。自軌道跳入軌道所生現象H<sub>4</sub>。係H<sub>3</sub>—A<sub>2</sub>—A<sub>1</sub>—H<sub>1</sub> 係  
線H<sub>4</sub>。自軌道跳入軌道所生現象H<sub>5</sub>。係H<sub>4</sub>—A<sub>2</sub>—A<sub>1</sub>—H<sub>1</sub> 係



之線  
線H<sub>4</sub>。自軌道跳入軌道所生現象H<sub>5</sub>。係H<sub>4</sub>—A<sub>2</sub>—A<sub>1</sub>—H<sub>1</sub> 係  
線H<sub>5</sub>。自軌道跳入軌道所生現象H<sub>6</sub>。係H<sub>5</sub>—A<sub>2</sub>—A<sub>1</sub>—H<sub>1</sub> 係

三 各種圓形軌道。係按其運動能力而規定如下。  $U = \frac{1}{2}mv^2$

係一殼數。係軌道次數。係普蘭克數。

原子分裂。原子之為電子所構成。且依電子之數目多寡

而別。此種之確。已實驗證明。此實之殼。係一殼。係

精製真。管內裝一電極。自幾分之一。至二。之。用

極高壓力。使電氣火花通過之。此火花有極大之遊子化力。使

其內欲試之稀物質。遊子化。其原。子層之電。子。於。是。分。裂。

如(吾所熟悉者。常見有。離。酸。等。原。子。觀。其。在。週

期。律。表。之。位。置。二。條。三。條。四。條。五。條。即。係。第。五

位。核。內。有。五。自。由。正。電。子。故。內。必。有。五。負。電。子。與。之。相。衡。

此。五。負。電。子。之。分。配。內。殼。有。三。外。殼。有。二。此。外。殼。之。三。電。子。

為。價。電。子。蓋。以。此。種。定。原。質。之。價。數。也。此。有。三。價。電。子。故。稱。為

三。價。電。子。蓋。以。此。種。定。原。質。之。價。數。也。此。有。三。價。電。子。故。稱。為

氏。與。德。氏。以此。花。分。裂。各。種。原。子。見。離。離。等。等。

例。如。原。子。組。織。完。全。可。同。其。核。之。電。量。按。1234.....比

自。加。而。已。裂。其。裂。之。電。子。自。外。軌。道。跳。入。內。軌。道。

即。第。五。軌。道。跳。入。第。四。軌。道。時。其。放。射。光。之。頻。次。按。理。推。斷。

為。原。子。之。電。子。自。第。五。軌。道。跳。入。第。四。軌。道。放。射。光。之。頻。次。

九。倍。故。其。波。長。必。為。4500 Angstrom。電。位。即。0.000045 cm。

在。普。通。光。圖。中。藍。色。位。置。內。此。種。會。未。經。見。之。光。線。自。二

氏。發。現。自。其。得。得。之。事。實。上。所。得。波。長。為。4499 A。

位。即。0.00004499 cm。此。推。理。推。算。之。數。相。差。五。千。分

之。一。此。見。彼。預。推。之。掩。飾。在。原。子。夫。文。軌。道。內。確。切。無。誤

矣。氏。推。算。電。子。自。第。五。殼。層。跳。入。第。二。殼。層。應。得。波。長

678 Angstroms。此。波。線。應。在。紫。光。圖。中。但。實。際。所。得。波。長

Angstroms。此。波。線。應。在。紫。光。圖。中。但。實。際。所。得。波。長

而。氏。推。算。高。度。分。光。鏡。所。得。亦。如。所。期。此。二。光。線。波。長。一。為

























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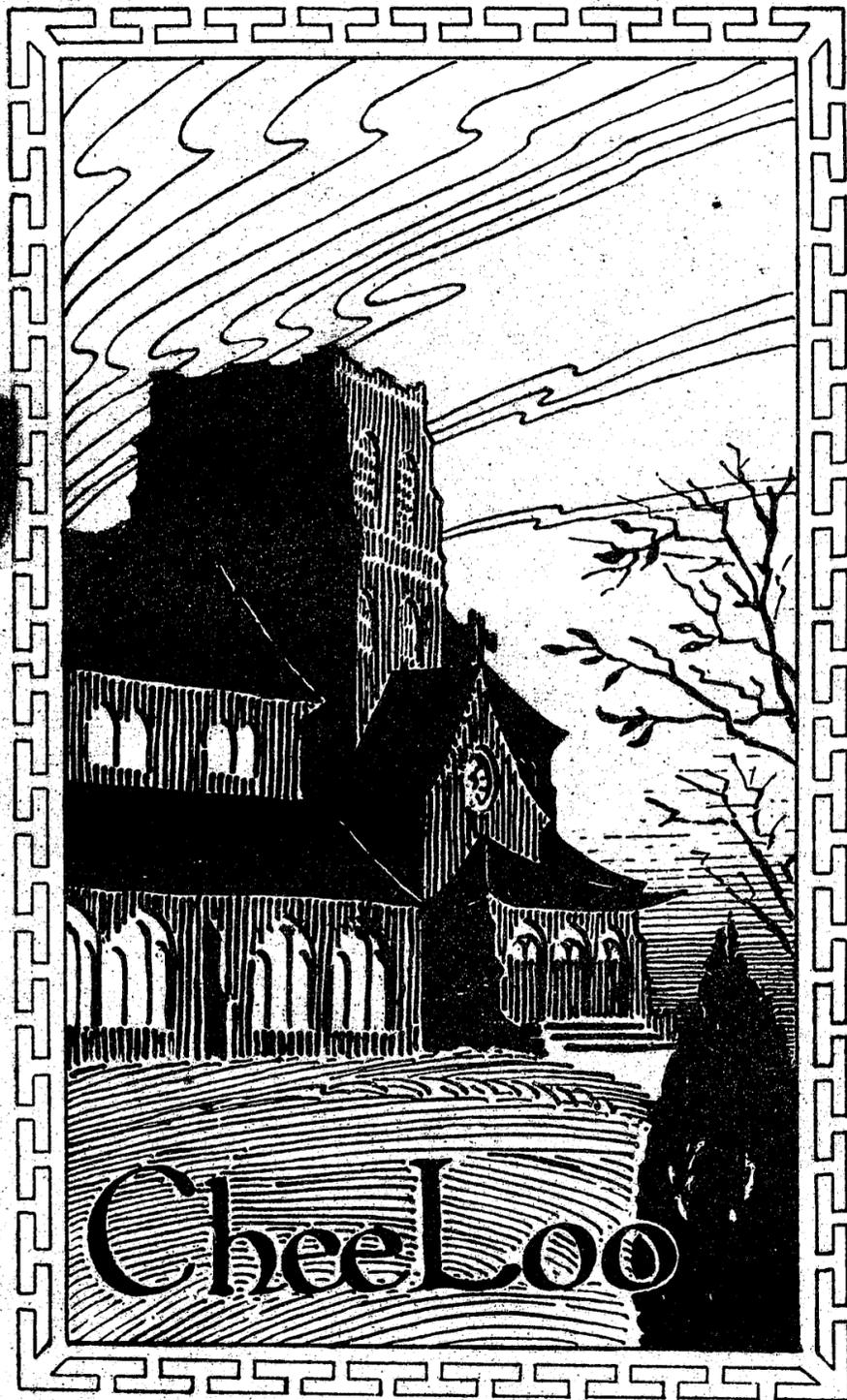
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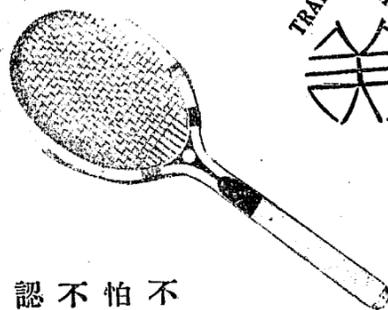
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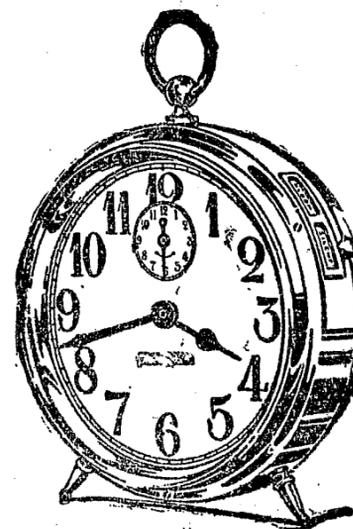
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The Quarterly Magazine of  
Shantung Christian University

VOL. II

MARCH, 1925.

NO. 1.

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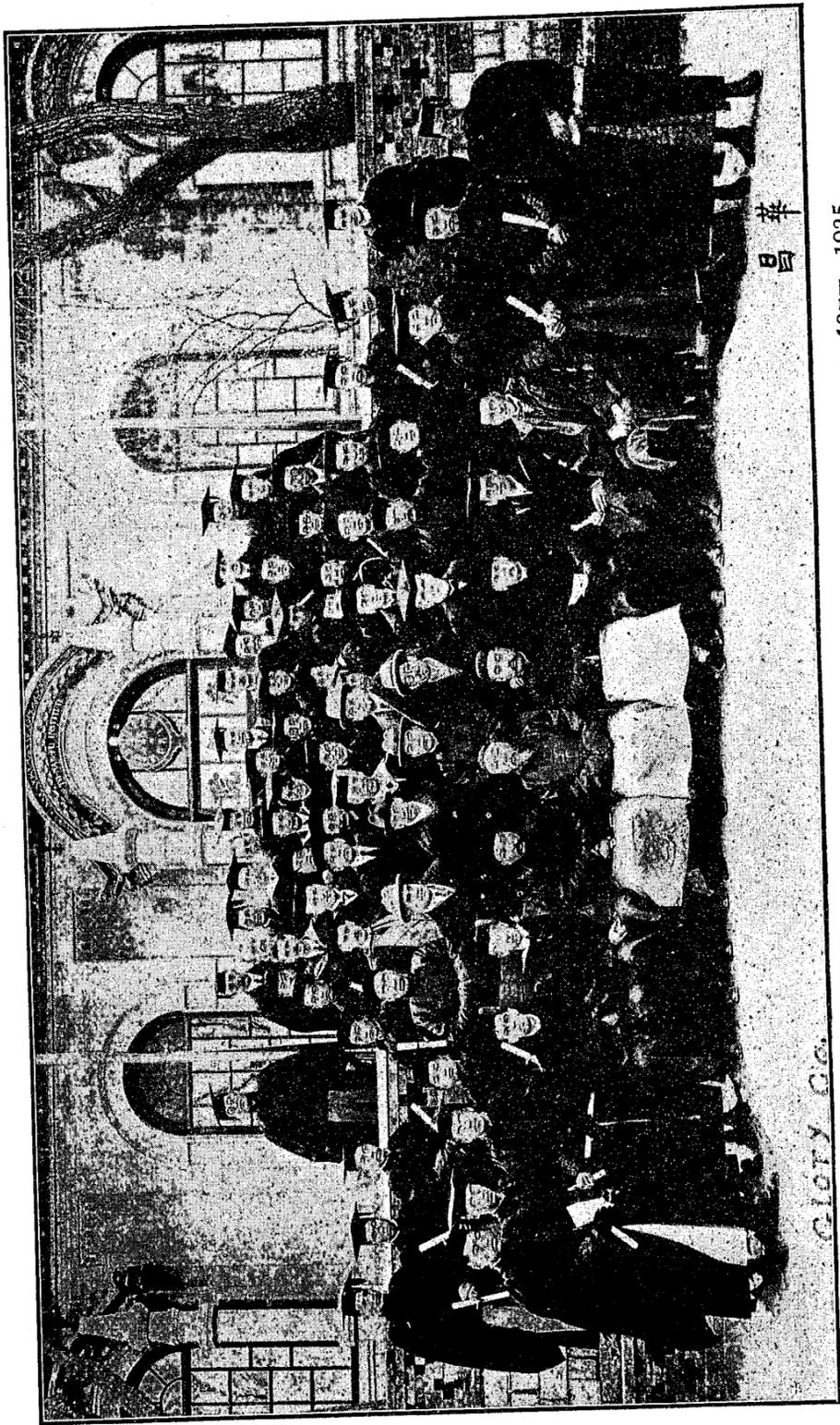
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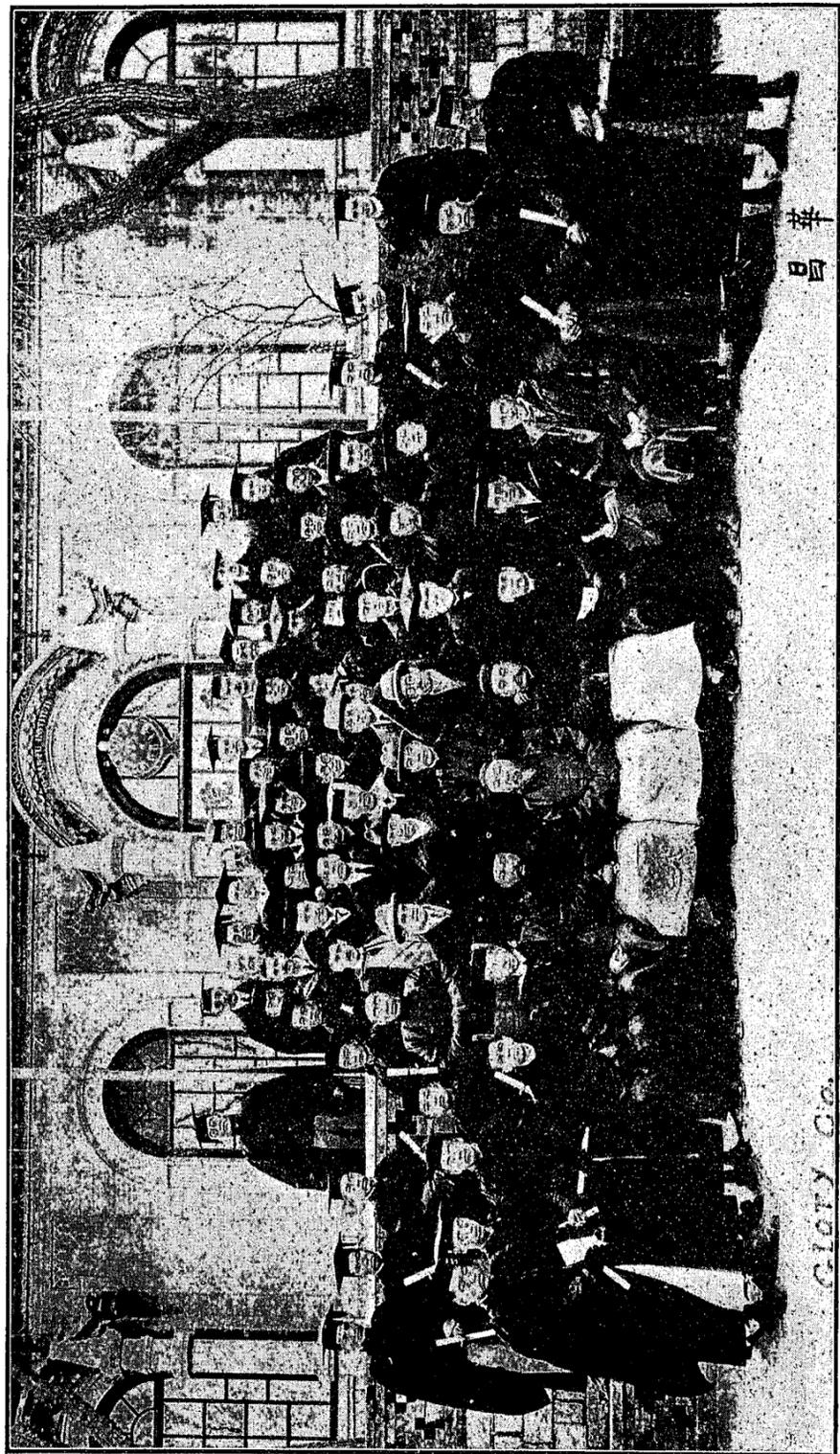
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At the close of the year, when we are conscious of the problems of students in seeking or considering teaching vacancies in secondary schools, our thoughts naturally range over the whole extent of education in China, and especially dwell upon the condition of those Christian Schools, in which we are directly interested. Gradually three

outstanding features of the situation emerge: the rapid rise of the scale of expenditure in secondary schools; the extraordinary contrast between the status of the secondary school teacher and that of the primary school teacher; and the obvious appeal that a piece of difficult, poorly remunerated, but worthwhile service, makes to the graduate, once he has caught the vision of the importance and possibilities of the work.

One of the most disquieting considerations regarding education in China is that of the contrast between the remuneration of the secondary school teacher, and that of the primary school teacher. For the difference in remuneration indicates the difference in esteem in which the two callings are held. Both in Christian and in non-Christian schools, the primary school teacher receives in most cases a mere pittance, that could not by any stretch of imagination be called a living wage. In non-Christian secondary schools the teachers are usually well, or even lavishly paid; and the salaries of the teachers in the Christian secondary schools are following hard after them. Accordingly while the work of the secondary school teacher is sought after, that of the primary school teacher is despised. Why should these things be? One is tempted to think that the distinction is due to a misapprehension of the function of the teacher; that the position of the secondary school teacher is regarded to some extent as an official rank, and that it is sought much in the same way as the successful candidates in the old competitive examinations sought lucrative positions in the government. When to this consideration we add that of the rapidly rising scale of expenditure in secondary schools, the situation becomes still further disquieting for the Christian schools. In the Christian secondary schools the scale of salaries alone for first class teachers has nearly doubled during the last three years. In order to meet the strain, the expenditure upon the primary schools has been curtailed. At the present rate of increasing expenditure a few years will suffice to place a great number of the Christian secondary schools in a very precarious position. We may even see a large proportion of them closed. Under the circumstances, what is to be done? If the above analysis be correct, the pace is being forced by a wrong conception of the teacher's office. The answer would seem to be, proclaim the true purpose of the teacher's calling, and when a glimpse of the Vision has been caught, appeal for volunteers.

Many are the disappointments of devoted and veteran missionaries, when the gifted and spirited student whom they have assisted through a long college course finally accepts a position in some outside institution. I suggest the fault in general has often been with the missionary

body in all unconsciously fostering a wrong attitude of mind. The salary, small or great, has too often been fixed in terms of the teacher's worth. Thus the amount of a man's remuneration indicates before the world the value at which he is rated. For this reason many a spirited and devoted man refuses the poorly remunerated position that he would otherwise be glad to fill. It is not that he cares for the pay; it is that he cannot for his honour's sake accept the stigma of an unworthy class. Let us therefore strive to remove this false conception. Let us plainly declare that we do not and cannot pretend to pay in the Christian schools the salaries that a man is "worth"—that is to say, that he can earn in a non-Christian school, backed by the resources of the Government. Let us cease to make distinctions of value in the all too small salaries. Let us clearly state. "This, and this alone is all a needy school can bear; but such, and such, is the hard and difficult service we ask you to share with us." Let us not attempt to follow the non-Christian schools in their unhealthy contrast between secondary and primary teaching; but let us rather to the best of our ability, remove the difference of status, seeing that all are rightly provided for, and then let us appeal to the youth of our colleges, by revealing to them the vision of the teacher's special ministry to the body, mind and spirit of men. From our own observation of the way in which graduates of this present year have considered different appointments offered to them, we are confident in saying that they will respond gladly and with noble self-sacrifice to such an appeal.

F. S. D.

### Cheeloo Becomes A Quarterly

With this issue, CHEELOO appears in a new guise as a quarterly publication. This change in policy has been adopted by the staff of the magazine because it gives an opportunity to increase materially the size of each issue, and also permits greater care in the selection and preparation of material. Under the new arrangement we hope to give more pages of reading material in four issues than was formerly supplied in the five numbers published during a year. We trust that this new policy will meet with the cordial approval of our readers.

## Education And The Masses Of China

Ts'UI HUNG TSAI\*

**T**HE people are the foundation of a country. The solidarity of the country is determined by the quality of the people. So to educate the people to be efficient, intelligent and moral becomes one of the most essential functions of modern government. The old education in China did not reach the masses of the people. It was confined to a selected few. The governments of past dynasties did not provide public education for the masses, but only provided competitive examinations and conferred degrees. Their purpose was not to educate the people, but to select men to serve the government. Modern education was first introduced into China in the latter part of the nineteenth century. It has made much progress since the establishment of the Republic.

As space does not permit me to discuss Chinese Education in detail, I cannot do better than mention only the essential features of those phases of education which bear an important relation to the masses.

### POPULAR EDUCATION

China has been called "the Republic without citizens." She has one-fourth of the world's population, but eight of ten cannot read or write. Millions upon millions, even to-day, have not the least idea whether their country is a monarchy or a democracy. Concerning the state or government they are blind, deaf and dumb. In a republic, the citizens are in theory, and to some extent in practice, the rulers of the government. They rule the government by means of public opinion and elections. They must be educated if legislation and administration are to be sound, orderly and progressive. How can China have a good government, if she has so great a number of illiterates? If China wants to be a republic in reality as well as in name, the first thing for her to do is to educate her illiterate millions. There is no other problem confronting China to-day more fundamental and more pressing than this.

China adopted a modern educational system towards the end of the Manchu dynasty, but the government did not begin to pay proper attention to educating the great mass of illiterates until the Republic was established. For only then did China realise the importance of

\*Mr. Ts'ui's article on "Education and the Masses of China" was awarded first prize by the judges in charge of the competition for the best article in English prepared by a student of Shantung Christian University.—Ed.

educating the members of the nation, who are the active citizens of the Republic. The Ministry of Education has created a new bureau, the bureau of Popular Education, to take charge of all affairs relating to the education of the general mass of the people. For educating the masses, the bureau has established numerous institutions which may be divided into two kinds according to their nature: (1) those giving instruction in the fundamental principles of a democratic form of government and in general knowledge, and (2) those giving instruction in the tools indispensable for daily use and for the acquisition of further knowledge. The former include lecture halls and lecture-groups, public libraries, newspaper reading-rooms, and museums. The latter include different kinds of schools, such as Continuation Schools, Half-Day Schools, Language-Made-Easy Schools and Open-Air Schools. By mastering the indispensable tools, they can not only read and write to increase their knowledge; but can also share with others the common conceptions,—the basis for common action and attitude, essential to a democracy. By understanding fundamental principles, they can vote, and can express themselves intelligently in national affairs; and thus contribute their full share to the upbuilding of the nation.

For educating the village people of China, it may perhaps be desirable to establish a community centre in each village, where a lecture hall, a library and a newspaper reading-room can be included. Such community centres can be established without erecting new buildings; for in every village of China there is some sort of temple, which can be easily be remodelled for this purpose. Public school buildings can also be used for community centres; and teachers of village schools should be trained to be leaders and to conduct the activities of the communities in which the schools are located. Such a community centre may in addition be used as a meeting-place for social and other purposes. By this means the clan spirit may be extended to that of a community; and this furnishes a basis for creating a national consciousness.

### OTHER AGENCIES FOR PROMOTING POPULAR EDUCATION

*The National Popular Education Association.* The splendid results of the experiments in popular education made by such localities as Changsha, Hankow, etc., attracted the attention of the leading educators of the country. Among them are Mme. Hsung Hsi-ling, Drs. W. T. Tao, Hu Shih, and Hwang Yen-pei. At the call of Mme. Hsung these gentlemen met for two consecutive days in Shanghai to discuss ways and means for extending the movement for popular education throughout the country. In August of 1923 the National Popular Education Association was formally established with the purpose of promoting

popular education throughout the whole nation. The Association set to work at once. Hsung was elected Chairman of the Association. She travelled through many provinces and gave lectures in many large cities and encouraged local leaders to cooperate with the Association. The results of experiments at different places were rather surprising. Let us take Nanking as an illustration:—"Within only two months, from August to September, sixty classes were very satisfactorily and successfully conducted. More than 5000 persons were thus educated. They can now read and write quite easily. It is expected that 20,000 persons will be able to read and write to the same extent at the end of the year."

*Reforms in Language.* Language is a means for communicating ideas, and an instrument for acquiring knowledge. From the educational standpoint it is of great importance. The simpler the language, the easier the popularisation of education. The Chinese language is a very complex one. The written language is so different from the spoken one, that they might be two different languages. It cannot be mastered by any one without ten years of effort. This at once excludes the common people from learning it. This is a great obstacle in the way of the democratisation of education. Fortunately the Literary Revolution has achieved the substitution of the spoken language for the old classical style of writing. The spoken style has been approved by the Ministry of Education as the National Language, which should be studied in all elementary schools. It has also been recognised as the instrument for journalism and literature, as well as for popular education. In order to facilitate the learning of characters, the Phonetic Script has been invented. This is not supposed to replace the old characters, but to supplement them. However, common people who cannot afford to spend a great deal of time in studying the characters, may learn these symbols only, and use them as a means of communicating with one another. Furthermore China is trying to unify the different dialects of different parts of the country by means of standardising the spoken language.

#### PRIMARY EDUCATION

Confucius said that a child is to be regarded with respect, because his future career is full of hope. We all agree that childhood is the best period for forming certain fundamental ideas, ideals and habits, which should guide our later life. So primary education is more important than any other kinds. It is generally admitted that the victory of Germany over France in the Franco-Prussian War is largely to be attributed to the kind of education which the Germans—and later the Japanese—received during their years of schooling. At present

primary education is made compulsory in practically every civilised country. In China the modern public school system was created in 1903, and from that time primary education began to occupy a recognised place in the public school system. After the establishment of the Republic, the Ministry of Education proposed that lower primary school education be made compulsory; but the conditions were then such that it was impossible to enforce a law of compulsion.

Although there have constantly been internal troubles since the Revolution, yet education has made much progress. Many provinces, such as Kiangsu, Shansi, Chihli, etc., and many districts such as Nantung, Peking etc., have mapped out a programme for making primary education universal in those provinces and districts. Their experiments have produced very satisfactory results. The number of those attending primary schools has been greatly increased. According to the census of the Ministry of Education there were 2,933,000 children attending schools in 1912, the second year of the Republic. In 1922 the number increased to 5,270,000. Most of the primary schools are maintained by the community. The annual expenditure amounted to \$24,000,000 in 1916.

In spite of the great progress that has been made in education, nine-tenths of the children of school age do not go to school. In 1920 the Ministry of Education issued an order that the following programme should be carried out in all provinces in China:—"All children from seven to fourteen years of age in the following localities must attend lower primary schools for four years, beginning at the assigned dates respectively:

1. Provincial capitals and trade ports	1921
2. District seats and important cities	1922
3. Localities with more than 500 families	1923
4. Localities with more than 300 families	1924
5. Localities with more than 200 families	1925-6
6. Localities with more than 100 families	1927
7. Localities with less than 100 families	1928

The district magistrates and local school officers are responsible for carrying out the above programme, and for working out its details."

The fact that many provinces have mapped out concrete plans, and set to work to carry out this programme, indicates that the future of compulsory education is very hopeful. As to progress in the future, the Ministry should urge different localities to meet at least the minimum requirement of four years' attendance, and should encourage other

localities, where circumstances allow higher standards, to provide free education for a longer period. The fact that there are now always more applicants for admission to any school than the number that can be accommodated, shows that the Chinese people are eager to educate their children. To enlarge the existing schools, to open new ones, to train better teachers and to provide better equipment and buildings, are perhaps more important than to enforce the compulsory law at the present time. At present primary education lays too much stress upon quantity. People always desire to have more schools and to gain greater attendance; but do not care what kind of schools they are, and how children are educated in them. We should know that quantity and quality are two factors equally important in education. Progress depends upon both factors.

To improve the quality of education, better preparation of teachers is most essential. "The teachers of children and youth, while not the sole instruments, are by far the most influential instruments through which a people may consciously control its future; they directly determine in great measure both the extent and degree to which sound fundamental ideas pervade, unite and move a people..... Free and true ideas important to human welfare must be brought skilfully and vividly, and through a prolonged period, not to prospective leaders only, but to every child and youth."

The educational investigations made by our famous educators show the poor status of primary school teachers, and the lack of well trained teachers. In many schools one teacher is required to take care of from sixty to one hundred children, and supposed to teach all day long, with an income of less than fifty dollars a year. How can these teachers render good service? A poor teacher will harm the children rather than benefit them. In order to attract competent persons to teach in primary schools and to obtain their devotion in service, salaries should be raised and pensions should be provided.

At the present time most of the primary school teachers are men. For teaching young children, women are undoubtedly better than men; for they can take better care of the children than the latter. Women should be encouraged to enter the teaching profession. The change in their social life and the increasing opportunities for higher education in the future will be important factors determining their entrance into the teaching profession.

In order to obtain competent persons to teach, the certificate system may be adopted. One who wants to teach must pass a certain examination. When he passes the examination given by the provincial

authorities, or other institutions, he is given a certificate, which shows that he is competent to teach in a certain kind of school.

For improving the teachers in service, all normal schools should be encouraged to open extension classes and to offer summer courses. Close cooperation between the normal schools and the public school teachers is very desirable and should be encouraged.

Moreover, education should be closely related to daily life. Things studied by students in school should have practical use in community life. In addition to the rudiments—reading, writing and arithmetic—students should be taught citizenship, which is the very purpose of public education and essential to a republic.

In conclusion we may say that China has laid a foundation in education which needs our further efforts to bring it to a thoroughly democratic system. She is the country with the largest population in the world. To provide a universal education for such a large mass of people is quite a task. There must be difficulties; but when a more stable central government is organised, and when the provincial governments are established on a sounder basis with more autonomy, and a definite responsibility, such difficulties can be successfully surmounted.

If we want every member of the nation to be provided with proper education, there must be a much greater appropriation for education. The United States spends annually \$6.50 per capita on primary schools alone while China spends less than two cents per head a year on all branches of education. How much more should be appropriated for education in China! When the financial system is thoroughly reorganised, an adequate amount of money may be appropriated for education.

Communications are also an important factor in promoting popular education. The means of communication in this vast area are poor. In spite of the growing interest in building good roads, and in introducing railways, two thirds of the country is not easily accessible. When the means of communication are improved, the country can be more closely knitted together, and the universalisation of education may be much easier. All these are waiting for the future efforts of the people. "When education is thoroughly democratised, we may hope that a genuine democracy political, social and economic may be established in the ancient land of Cathay."

## Social Glimpses Of Tsinan

Prepared by  
THE DEPARTMENT OF SOCIOLOGY  
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### PART II

#### *Recreation.*

Recreation centers in seasons and places. The chief period for recreation is the Chinese New Year season which occurs near the end of January and varies each year according to the lunar calendar. Then all work stops for from ten to twenty days and the people enjoy themselves with eating the best food they can afford, and with resting and talking as Chinese are well able to do. Other festivals follow, each with its centuries-old traditions of ceremony and food. The lantern festival comes on the fifteenth of the first month. The spring festival comes about Easter time when graves are put in order and the people get out in the country. Also at this time hundreds of kites of many wonderful designs are flown. Outside of the south suburb in Tsinan is a place where there are many graves and here the people gather to attend to the graves and to fly the kites. The fifth day of the fifth moon is the dragon boat festival. The fifteenth of the seventh moon is a festival of lesser importance. The fifteenth of the eighth moon is the chief autumn festival. Then moon cakes are eaten and in the evening one might walk along the streets and hear the sounds of celebration from behind closed doors. This celebration often takes the form of gambling in which the loser must take a drink. In Tsinan on the ninth of the ninth month is an important festival which will be discussed later. Using the lunar calendar the Chinese have at the time of the full moon the festivals which center in evening activities. With the long period of dry weather in the year they can usually be sure of having beautiful evenings for their celebration. With these regular periods of festivity following one another with their old customs, the Chinese are certain that they get a great deal more enjoyment out of life than foreigners do.

Tsinan has three famous places which are centers of amusement,—the Thousand Buddha Mountain with its temple, the "Great Clear Lake," and the Pao Tu Spring with the largest flow of water of any of the springs in the city.

At the Thousand Buddha Mountain there are two festival seasons. The one in the spring is of little importance, but the one on the ninth of the ninth month is a great event in the life of the city. On this day people mount a high hill to leave their sins behind them,—at least that is the idea with which the festival is supposed to

have started. Now it is more like a circus day in America. This mountain is a little over half a mile outside of the south suburb wall. About sixty thousand people make the trip to the mountain, most of them walking, but those who can afford it ride on donkeys or in chairs. The road to the foot of the mountain and the steps to the temple are lined with two or three hundred beggars who offer to everyone splendid opportunities to acquire merit. From the foot of the mountain clear up to and into the temple every available place is occupied with tables where those who can afford it sit and drink tea or small cups of liquor as they eat melon seeds and watch the crowd thronp past. The crowd is composed of the middle and higher classes, for the workers have no holiday. Shops with several clerks may give some the opportunity to go. Women hobbling along on their bound feet are the most devout of the crowd. In the temple they are the chief ones to burn incense, to toss a few coppers into the box before the altars and to kow-tow nine times before the various Buddhas. Just outside of the South Suburb Gate are all kinds of cheap amusements, the admission to which is from one to a few cents. There is a one-ring circus; many arrangements for looking at pictures, some of which are salacious; jugglers; acrobats; medicine and food vendors; and a gospel tent. It is really a big day in the life of a city that will take one-fifth of its people out for a social and mental catharsis in the country.

Another famous place is the lake. There are passageways cut through the reeds for boats carrying people to the seven temples that are on the islands or along the shores of the lake. There are three hundred boats, varying in size from small row-boats which will carry only three or four persons, to large covered boats which will carry a score of people. The large boats are poled along, for the lake is shallow. Prices vary from ten cents to two dollars and a half. The busiest seasons are the fifteenth and thirtieth of the seventh month, when candles are lighted and set afloat in natural or artificial water lilies. At the temples and wharves there are places for tea drinking and other amusements.

The Pao Tu Spring is surrounded by two score of shops selling jewelry, toys, small articles of clothing and decoration, and food. There are four large tea-houses and four small ones. In each tea-house the management provides story-tellers or musicians for the entertainment of the guests who eat water-melon seeds and drink tea as they listen. The cost for this entertainment is from three to ten cents. There are more than ten fortune-tellers. There is always a crowd surging to and fro at this place. The spring itself is in the center of a pool which is a deepened and widened part of a stream

which flows into the moat. There are four heads of water pouring gallons of water each second up through the pools. A temple stands at one side of the pool for those who are inclined to worship.

The other centers of amusement are the two markets, which are composed of scores of small shops or booths selling every kind of small goods and food. There are also tea-houses, story-tellers, fortune-tellers, jugglers, small theatres, and picture shows of the stereoptican type.

The park is a place of recreation. It is a tract of about eight English acres in the center of the Settlement. It is filled with plants and trees. The regular admission charge is about a cent and a half, but a higher charge is made in summer weather in the evenings from five o'clock on. At this time the park is frequented by men who entertain girls from the houses of prostitution.

There are three large Chinese theatres and more than ten small ones. The plays are usually given by groups of actors who travel over China. To get crowds a theatre must have special attractions, such as a famous actor from some other place. Actors earn from twelve dollars a month to as high as several hundred dollars. In old China the wealthy people invited companies of actors or musicians to come to their residences to play. This custom is still followed to some extent. During the performance the people in the crowd drink tea, eat melon seeds, and chat with each other in a most sociable manner.

There are three moving picture theatres in Tsinan. Most of the films come from America. Some films rejected by American censors are shown, and there are too many of the cheap serial pictures. Some of the better films arrive here, although they may be somewhat late and worn. The entrance charge varies from twenty cents to a dollar. Women attend as well as men.

In recent years the students are taking up athletics as a means of recreation. Each year there is a field meet of the high schools of the province held on the athletic field of the University. This meet draws a crowd of more than five thousand. The regular field sports of the west are used and the players have adopted the track clothing of the west. In the spring of 1925 the North China Athletic Meet will be held here and it will add to the growing interest in athletics.

In China meals are not used for family recreation as they are in the west. Confucius taught that the honorable and worthy man does not talk when he eats. There is some social life in connection with Chinese restaurants, but it is not so pronounced as in the west. For the most of the people probably nothing is more recreative than to sit,

talk and drink tea with a friend. This form is vegetative and social. It is adapted to a climate that does not incite one to feverish activity. It may be much more wise than the hurried rushing here and there that western people are inclined to do in their leisure hours. If it makes the Chinese people sure that they are enjoying life, it is probably achieving as much for them as western forms of recreation achieve for western people. The future still holds the solution for wise recreation for both the east and the west.

#### *Prostitution.*

Prostitution is a problem in Tsinan as in other cities in China. It has existed in China from early times as it has in all other countries. It is increasing in China with the modern growth of cities. Although the eighty-five or ninety percent of the people of China who live in the villages maintain a very high standard of family morality, the ten or fifteen percent who live in the cities have a greater problem of prostitution than western countries. Counting licensed and unlicensed prostitutes the large cities of China have from four to ten times the proportion of prostitutes that western cities have.

The chief causes of this growth of prostitution in cities are the excess of unmarried men over unmarried women, the lack of public opinion against the practice, the lack of a natural and happy social life in the home and between the sexes, and the lack of customs of restraint among men. The Chinese system of early marriage has not required the development of any mores of restraint for unmarried men, for there have seldom been any unmarried men. A large percent of the people in Chinese cities regard this practice as a natural thing with little or no moral blame. Prostitutes can advertise as other business firms do. The students and workers in the city, as well as many men who are married, lack enjoyable social contacts with women, and so they resort to these houses. Not a small part of the use made of prostitutes is mere social entertainment. It is quite a common thing for men to go to the houses only for the purpose of drinking tea, smoking, and talking with the girls, who are trained to be interesting in conversation.

The girls get into the houses in several ways. Some are the children of the managers, some are bought when they are young and are trained for the trade, some are placed in the houses by parents or husbands who have no other way to get money. In such cases the keeper pays a certain amount of money to the parent or husband and releases the girl after a period of service. They often find at the end of the period that no easier method of earning money is available and

so they continue as long as they are young enough. During a period of famine in the country many children are sold. In 1921 in one district of less than a million people over eighteen thousand children were sold. Most of these were sold and kept in the district, but not a few hundred of girls from that one district were taken out to be sold to managers of houses of prostitution. In most cases the parents probably did not know what life was ahead for the girls, but the money was their only means of living and they did not question the destiny of the girls.

In Tsinan there are 530 registered houses with about 1080 registered prostitutes. Besides the registered ones there is an indefinite number of others. The registered houses are divided into four classes according to the furnishings of the house, and the youth, beauty, attractiveness and dress of the girls. The houses are divided among the classes as follows;—106 first class, 27 second class, 62 third class, and 335 fourth class. The manager is usually a man, but sometimes a woman; or even a prostitute herself is the manager of a house. The average number of girls to a house is only about two, so there are many cases where there is but one girl. There is a matron who acts as a high class servant to the girls. In the larger houses of the higher classes there is a book-keeper, a musician, and men and women servants. There may also be small girls who are learning the customs, manners and music of the trade. The charges in the first and second class places are so high that only quite wealthy men can patronize them. The girls are usually treated well by the managers and the life and financial rewards are such that most of the girls are willing to continue.

Although most of the managers of the houses here say that business is bad, they are not leaving it and many of them have entered it only in the last few years. There is no indication at present of any turning of public opinion against this institution. The diseases connected with it and the damage to the high standards of family morality in China will probably increase before public opinion is aroused.

#### *Health Conditions.*

Tsinan is probably as well supplied with doctors, hospitals and medical schools as any city in China. The police records list 85 doctors with training in western medical science, 18 of whom are women. This includes the Chinese and Japanese doctors who practice medicine in a modern way. There is one of these doctors for each 3500 of the population as compared with one to 650 of the population in America. Besides these doctors there are 149 doctors who use old Chinese methods.

There are four hospitals opened under foreign management. The Japanese Hospital was opened by the Japanese government; the University Hospital is operated by a number of churches doing missionary work in China; and the men's and women's hospitals in the East Suburb, opened by the Presbyterian Mission, are largely under Chinese management. The first two of these are the largest hospitals of the city. The University Hospital cared for 1,399 in-patients and had 31,108 visits to the out-patient department last year. The Japanese Hospital has an even larger out-patient work than this. The five hospitals under Chinese control and two in the East Suburb also do a larger out-patient than in-patient work.

The University Medical School with a staff of more than thirty teachers and with over one hundred students, of whom eighteen are women students, is the only medical school in the city that is up to western standards. The students study five years in the school after completing two years of college pre-medical work. The provincial medical school for men has 98 students; and a private school for girls has sixty students, but its standard is so low that it scarcely deserves to be mentioned here.

A few drug stores in the city sell western drugs. There are 65 Chinese drug stores which belong to the guild. The Chinese medicines are bought chiefly from one center in Shansi at a great yearly market. The prescriptions usually call for several packages of medicine which together cost from a few cents to twenty cents.

We have noted that the police have charge of the sanitary and health conditions in the city. They keep a record of the diseases and deaths; but it is not complete or accurate enough to be of much value. There are about seventy men employed by the police to clean the streets of the Chinese city and the suburbs. A large part of their work is sprinkling the streets, but they are not able to keep the dust down, and many diseases are transmitted through this medium. Much cleaning is left undone. Piles of ashes or refuse often lie untouched for weeks in the street corners. There are many moist ditches over the city which are gathering places for filth. Besides the dirt on the streets, vacant lots are gathering places for trash and in the rainy season they often become pools of stagnant water. The night soil is removed from the public toilets at regular intervals, but the sanitary conditions surrounding these places is bad. The Settlement fares better than the rest of the city in health. The health department employs more men for cleaning and they are able to keep the streets and vacant places in a better condition.

Most of the people are ignorant of proper methods of caring for health. Bathing is not as frequent as it might be if it could be made more convenient. The houses are so cold in winter that bathing at home is extremely uncomfortable and the houses are so crowded that privacy is difficult. Bath houses provide places where men may bathe at a cost of from three to fifteen cents. The cheapest provide a large common pool of hot water; and the most expensive a private room and tub. The bath houses are also used for social conversation by the men who give a few hours to the cleaning process.

The Chinese methods of eating, in which all people reach with their individual chopsticks into the common bowl, can spread those diseases in which the bacteria may be found in the mouth. The tendency to close the rooms tight in the winter so as to make the best use of what heat there is helps the spread of tuberculosis. Many people even sleep with their heads under their bedding, which is not aired as often as it should be. They are not careful about diseases in the early stages but wait until the disease is advanced before they seek medical attention. There is little protection from flies either in the food shops or in the homes. Waste bits of food and garbage are thrown on the floor or in a corner and are allowed to lie for days or weeks. Surrounded as the people are by dust, decaying matter, flies and contagious diseases, there is naturally more sickness in the homes here than there is in western countries where knowledge of health and sanitary laws is more wide-spread.

In the care of children the women are very ignorant. At birth very unsanitary methods are used; so that perhaps one-fourth of the children do not survive their birth, and the death-rate for women because of infections at child-birth is high. After children are born they are allowed to eat things which should have no place in a child's diet; they are not kept clean; they can not be kept warm in winter; and in sickness they do not get proper treatment. As a result of these conditions probably not more than three out of ten babies ever grow up. While it is probably true that those who do grow up have developed immunity to most diseases, it is also true that even they would be stronger if they had had proper care all their lives, and it is true that probably twice as many of the babies could have developed into adults of full strength, if they had had proper care.

The Chinese have developed some good health habits which have been valuable in spite of the restrictions placed on their manner of life by their economic conditions. The custom of drinking boiled water is one of these habits. Another that has probably saved an endless amount of suffering is the habit of rinsing the mouth with warm water after their meals.

### *Industrial Conditions.*

Modern factories have come to Tsinan, mixing new industrial conditions with the centuries-old conditions of shop labor. There are nine flour mills employing from 60 to 120 men each, two match factories employing about 1500 workers, one cotton mill employing 3000 workers, several hair-net inspection factories employing about 3000 people (this number has been reduced to some extent by the fashion of bobbed hair in the United States), one sugar factory, one paper factory, one railroad repair shop with a thousand men, several iron and brass goods factories, one soap factory, one dye factory, one leather factory, one needle factory, one cement factory, one wine factory, several cloth factories using semi-modern methods, one printing establishment, a telephone company, and an electric company. These are the chief industries that can claim to be more or less new in China. Altogether there are about forty establishments which employ more than twenty men each. The total number of workers in these factories is about ten thousand.

Before we go on to discuss the working conditions in the factories we should point out that of the total population between the ages of fifteen and fifty who might be expected to be in some kind of employment, only about one-sixteenth are in these factories. The others are to be found among the 10,000 ricksha men; the 5000 wheel-barrow men; the 30,000 or more in the shops which chiefly sell goods; and probably as many more in the shops which chiefly make goods; the 70,000 or more girls and women who work at home; and the other smaller occupational groups. The factory workers, representing only one-sixteenth of the working power of the city, must necessarily have their working conditions largely influenced by the working conditions outside of the factories. In general, we can say that the factory conditions in regard to general health, hours and wages are better than the conditions in the small shops. Most of the industries of Tsinan are under Chinese management.

In these forty factories there are about 5600 men, 3500 women, and 1000 children under sixteen years of age. Only a few factories employ women and children, the chief of which are the hair-net factories, the cotton mill, and the needle and match factories. Few of the other factories admitted that they employed more than one or two boys under sixteen, and the appearance of the workers seemed to verify their claims.

The greatest amount of child labor in the city is to be found in the smaller shops where either the children of the family work or

apprentices are taken in. The apprentice system is common in both factory and shop. In the factories they usually get food and shelter and a few dollars each year. In the small shops they get food and shelter and less money. They are treated better after each year of their apprenticeship. Many of the trades at which children are apprenticed cannot lead to a very lucrative life work, and in these cases apprenticeship is merely a system of getting cheap child labor.

The factory workers usually work eleven or twelve hours a day. Very few are favored with a ten-hour day, and some work as high as fourteen hours. In the family shops the hours are usually longer, even as high as fifteen.

Wages vary from two dollars a month for the unskilled work of children who are not apprenticed, to twenty dollars for skilled workers. The sum of \$7.50 per month might be taken as the average wage of an able-bodied unskilled worker. Of the male workers of the city less than a third depend entirely on wages, the others receive payment in food, clothing, and shelter in addition to more or less actual money.

Match boxes are put together in the homes from material furnished by the factory and work is paid for at the rate of six cents for one thousand boxes. In the factory the children get one copper for filling about 170 boxes with matches. They can earn from five to twelve cents a day at this work. Hair-nets are made in the homes for from fifteen to twenty cents a dozen, the rate depending on the demand of the market. Ricksha men can earn, above the rent they pay for their rickshas, from thirty to sixty cents a day, but few can work at this trade for as many as ten years.

Some of the modern factory buildings have plenty of light and the work rooms are kept quite clean. With a few exceptions there is much to be desired in sanitary practices. There are always piles of rubbish that could be cleaned up with little expense. In the older buildings the workrooms are often dark, damp, cold in winter, hot in summer, and filled with bad odors or dust. In the match factory there is danger to a few workers from phosphorus. One or two factories provide medical care for the workers in cases of minor sickness. In a majority of cases the small family shops are crowded, dirty, dark, damp, dusty, and cold in winter.

A majority of the men live in the factories where they work, just as the apprentices live in the shops where they work. As a rule, the sleeping quarters of the men are not well kept and are crowded; but, even in this case, they are probably better than the conditions in most shops. Several social problems become related in this unnatural

method of life for the men. It provides living quarters for some of the excess of men in the city. The low wages in proportion to transportation costs make the time distant when men might live far from their place of work. This lack of natural family life for men is a cause of the growth of prostitution in modern cities. Many social conditions will have to change before it will be possible for all the male workers of the city to have a natural home life.

The workers average about fifteen holidays in a year. Some have as low as ten and some as high as thirty. The longest period is at Chinese New Year and the two shorter periods are at Ch'ing Ming, a spring festival, and on the fifteenth of the eighth month. Only a few shops close on Sundays and only one or two provide even a half holiday fortnightly or monthly.

#### *Standard of Living.*

An estimated cost of living for an unskilled worker in Shanghai is \$11.85 a month and for a family of five it is \$21.34. This would provide sufficient simple food and clothing and allow of suitable housing—from one to three to a room. From what little study has been made in Tsinan we conclude that probably \$7.50 for a single worker and \$15.00 for a family of five would compare with the Shanghai estimates. It is impossible with our present knowledge to estimate with any degree of accuracy the number of people in Tsinan who live under this standard. Most of the 79,000 unmarried boys and men are earning little more than their own living. The unskilled married laborers who have families of even two or three members have to depend to some extent on the income of other members of the family for its support. There are 1700 people in the city listed by the police as paupers and beggars. The police also list 80,000 as being without an occupation. This includes the women and children in the homes who do not work for pay, and it must also include several thousand who have no regular employment and who consequently are not earning a living wage.

Western readers can well imagine the standard of living endured by the majority of the working people, when they know that in the case of most materials one dollar will not purchase more in China than it will in western countries. This year American flour has undersold Tsinan flour in Tsinan; foreign cotton cloth is used here when qualities better than the coarsest are desired; fuel is about as expensive as it is in the west, and the materials for building are as expensive, even though the labor is cheaper. The diet of the poorer classes consists of dry unsweetened cakes about eighteen inches in diameter and about an inch and a half thick, made of wheat flour or

cheaper grains; salted vegetables in small quantities; onions; and a grain gruel usually of millet. They get the liquid part of their food in gruel and boiled water. The more comfortably situated families have their wheat in the form of steamed bread and macaroni, and have some fresh vegetables and a small amount of fruit in season. The clothing is of coarse cotton cloth, usually blue but sometimes black or gray; and in winter they wear cotton clothing padded with cotton. This clothing has to be so thick as even to impede movement, for they cannot afford to heat their houses. They have to live in crowded quarters, often a small family to a room. The children cannot go to school, the parents cannot read, and in sickness they cannot afford proper treatment. It will require years of progress in education and industrialization before the standard of living can reach the place where workers can be fed, clothed, housed, healed, and educated in a fitting way. In Japan much progress, in this direction has been made in the last fifteen or twenty years, and it must come soon in China.

Of course, there is a small percent of the people of the city who are educated, cultured, and well provided for in food, clothing, and those conveniences of living which cultured people in China have learned to use. If we want the best in the civilization of China we find it in a small class of the people. The great majority of the people have not had the opportunity to enter into the fullness of the values that have been accumulating in the civilization of China through the centuries.

#### *Housing.*

Most of the houses of Tsinan are one-storied buildings with walls made either of sun-dried mud bricks or with regular burned bricks. Even when good bricks are used, the plaster is chiefly mud. The roofs are of gray tile. The floors are of brick or of earth. There is a minimum of wood used because timber is very expensive.

The poorest shelters, of which there are more than a thousand, are best described as mud and grass-mat houses. These are stuck against a wall here, in a corner there, on a vacant lot, or by the roadway. They afford little protection from cold and rain, for there are many cracks and a heavy rain might demolish them. Most of them might be built from mud-bricks, some second-hand beams, a few hundred tiles, and some old mats, at an expense of a few dollars. Such dwellings house several thousand of the population.

Most of the buildings that face the streets are shops. Either the shop itself, or a small room built immediately behind, serves as the dwelling for the household. There are a few streets where there are

nothing but residences. The larger number of the dwellings are to be found around courtyards which are back from the street. A courtyard may have from six to nine rooms around it. Several courtyards may have only one outlet to the street. There are usually several families in one courtyard, for over one-half of the population lives in one or two rooms per family.

In a courtyard where the poorer people live, you will find a small family to each room. The rooms are about ten by twelve feet. They are dark, for light usually can come in at only one side, though a few rooms have high windows at the back. The buildings are in a bad state of repair. The brick—or more often, earth—floors, are liable to be damp the year round, if they are near the part of the city where there are springs. In the rainy season the walls are damp to a height of several feet above the ground and the courtyard often becomes a pool of water. There is not room inside for the family to prepare their meals, so they cook outside on stoves made of earth. A draft is secured in the stove by a box-bellows. Inside the room there is a wooden table and benches which may be used for seats in the daytime and beds at night. There is also a box for storing any extra clothing the family may possess. There are few dishes and cooking utensils, and few decorations. In a majority of cases, from twenty to fifty dollars would buy all the personal property of a working family.

The monthly rent varies from eighty cents to three dollars a room, according to the condition and location of the building. The wealthier families live according to their means, but even they have not learned what comfortable housing can be.

There are two hundred inns and hotels in the city. These take care of the travellers who come to the city to buy and sell. The charge for a night's lodging, in all but a few of these, is from five to fifty cents. The few higher priced hotels are the two railroad hotels, a hotel managed by a German and one or two managed by Japanese.

#### *Philanthropy.*

All but one of the philanthropic institutions of the government are under the administration of the Board of Philanthropy. The six institutions managed by this Board are a boys' and girls' orphanage with 78 boys and 36 girls; an old folks' home with 31 men and 20 women; an aged widows' home with 157 women; a foundlings' home with seventeen babies; the Door of Hope—for girls who are ill-treated in houses of prostitution and who wish to escape—which had 45 girls during the year; and a home for young widows, with 84 women. The number in the institutions at any one time is not necessarily the number given here. On a visit to the Door of Hope there were

found to be only fourteen girls there at that time. Men seeking wives may secure them at this institution on the presentation of proper credentials. The annual expense for these institutions is \$22,500.

The other government institution is an orphanage with 280 boys. The boys have some classes and they are also employed at different kinds of work. This institution has \$22,800 a year, which is an expenditure for each boy equal to almost the full wages of an able bodied laborer.

The private institutions are the Pu Chi Orphanage with 152 boys and an annual expenditure of \$10,000; the Generous Virtue Factory with 170 boys and \$12,000 a year; the Shantung Democratic Factory, which has 26 boys and gets \$7,000 a year from a lottery in Shanghai; and the Joyous Virtue Work-yard with 46 boys and \$2,000 a year.

The Dao Yuan, an eclectic indigenous religious organization, has opened a home for defectives and cripples outside the south suburb on the way to the Thousand Buddha Mountain. There, 160 people are provided with work and a comfortable living in good buildings.

Other religious organizations do more or less philanthropic work which is too miscellaneous to record in detail. The Roman Catholic Church usually has several kinds of such work in its regular program for serving China.

In the management of these institutions there is much that is good and much that is inefficient. In most cases work and education is provided for the inmates, but both could be more effective in producing results. The sanitary arrangements often lack proper attention. Dirt, darkness, dampness and rubbish could often be avoided with little expense, if thought were given to such things. Some institutions are over-supplied with officers, so that the money which should be used for the inmates is being spent for salaries. What is being done is better than nothing. It shows that the government and private individuals are mindful of the care of needy people. The present conditions show that balm has been applied to hearts that feel that something must be done; but also that real efficiency in management has been secured in only a few places.

The two chief forms of outside relief last winter were the distribution by the Dao Yuan of one thousand suits of clothes to the needy; and the management of a porridge or gruel kitchen, where three or four hundred poor people were fed once a day during the coldest part of the winter. Two thousand dollars were collected privately for the management of the kitchen. Formerly the government and the gentry did more of this kind of work, but now the

policy is to reduce the number of paupers and beggars in the city; so little is done for those who are here. Although begging is against the law, it is not stopped by the police. Beggars often have a regular route of houses and shops at which they call at regular intervals and they usually receive a few cash, or at most as much as one or two cents at each place. If shops refuse to give to beggars, their business is liable to be injured by such a crowd of beggars on the street that customers will be driven away.

With so many people living on the edge of poverty the problem of philanthropy is a difficult one, for we cannot tell when the needy are all supplied.

#### *Educational Institutions.*

In Tsinan there are schools supported by government, private, and missionary or church agencies. The government schools are of all kinds; private schools are elementary and middle or high schools; and church schools are from kindergarten to the University.

All the elementary schools, representing usually the first seven years of study, have about five thousand pupils. From all the children of this school age in the city one boy in five and one girl in twenty starts to school. We have no statistics as to how many of these finish the seven years, but from national statistics, we conclude that only one in two of these finish the first four years and one in four finish the seven years.

At present the middle schools usually have a five-year course. The largest of these are the First Middle School, a government school with 590 students; and the Cheng I Middle School, a private school with 1390 students. The two government normal schools have 520 boys and 310 girls. The Presbyterian Boys' School has 120 students and the Girls' School has 50. Four other middle schools have from sixty to four hundred students each. In all there are 4500 students in these schools, of which number 600 are girls. Between 85% and 90% of the boys are from homes outside of Tsinan who have come here to study, but of the girls a little larger percent are from Tsinan homes. Of Tsinan-born children one boy in from 25 to 30 and one girl in from 100 to 120 start to middle school. This is higher than for the country as a whole, where one boy in about a hundred and one girl in about seven hundred go to middle school. Of these who start perhaps not more than one in four finishes the course.

The government schools above middle school grade are the Technical College with 145 students, the Agricultural College with 216, the Commercial College with 271, the Law College with 145, the

Medical College with 98, and the Mining College with 42. Most of these students, as in the middle schools, are not Tsinan-born. In the whole of China one person in about 1200 of college age goes to college but in Tsinan there may be one in a few hundred, for the students in the higher schools come chiefly from the cities. This means that from this city of 300,000 there are about fifty or sixty students in schools above the middle school. There are scarcely any Tsinan girls going to these higher schools.

Shantung Christian University has 330 students of whom 33 are women. These students come from all over China and not more than three or four are Tsinan people. The University has two years of pre-medical work and a medical course of five years. The course in the Arts and Science College is four years, and for entrance usually requires graduation from a six-year middle school course. The Theological School has a three-year course, preceded by one year of pre-theological study in the Arts and Science Department. The greatest service of the University to the city is through the Hospital and the Institute or Museum. Over half a million people visit the Museum each year. Tsinan people go frequently and the Museum attracts visitors to Tsinan. There the people can see exhibits of an educational nature dealing with all phases of a progressive society. Sixty percent of the visitors listen to a Gospel message while they are in the Museum. The University also has a social service center in the city where work of several kinds is done. In all there are over fifty special kinds or pieces of work that the University does for the community outside of class-room work.

The University property is partly inside and partly outside the South Suburb. A gate in the wall allows for direct connection between the two parts. The buildings are largely in western style modified by Chinese lines where possible. The whole property of the University is valued at something more than a million dollars. The government and private schools in the city are for the most part in old buildings, built for other purposes, but under necessity turned into school buildings. Most of them are ill-fitted for school use, but there is no money available for better buildings.

The cost of education in Tsinan in elementary schools is from five to fifteen dollars a year for each student, depending on the equipment of the school and the ability of the teacher. The annual cost for each middle school student is from fifty to one hundred dollars, and for the higher schools from one hundred dollars a year for each student in the Commercial College to three hundred twenty-five dollars a year for each student in the

Industrial College. In the University the cost is nearly a thousand dollars a year for each student. It is relatively higher for medical students because of the smaller number of students in proportion to the necessary staff, and because of the equipment that is necessary. The theological students cost considerably more than the arts and science students. In these early years of western higher education in China it requires time to make the proper adjustment between the standards of middle school and university work. At present the University finds only about one-half the number of students for which it has capacity; because of the lack of students who come up to the standard that has been thought to be necessary, and who at the same time have enough money to come. When the University reaches its teaching capacity the cost for each student will be greatly reduced. The large number of foreigners on the staff, together with some of the higher paid Chinese teachers, makes the cost of the University higher than that of the purely Chinese schools.

The cost to the middle school students themselves depends on the condition of their homes. Probably the lowest amount of money that is necessary for one year for tuition, board, room, clothing, and books is one hundred dollars. From this amount upward the students spend what they are able to get. Two hundred dollars a year would be a large amount of money for a middle school student. It is to be remembered that nearly all middle school students live away from home. In the colleges and the University one hundred and twenty dollars is probably the lowest amount that is spent and three hundred dollars is high. The University students average about \$180 a year, the lower classes spending less and the higher classes spending over \$200. In the University the student pays \$180 to come and take advantage of nearly a thousand dollars which the churches have provided. Yet there are too few students who can get even this amount. Only about 23% of the students get all their money from their families. They have practically no ways to earn money as students in America have. Over three-fourths of the students have money given to them by churches or individuals, or they borrow it in order to get what they need. From the study of the standard of living we know that probably two-thirds of the families of China live on less for a whole year than it takes to send a student to the University for nine months.

In discussing education we must also take note of the popular education movement which is beginning in a small way here; also of the Daily Vacation Bible Schools; the educational work of the Y. M. C. A. and the Y. W. C. A.; and of other special schools or classes for groups like laborers or house servants which are operated

by public-spirited individuals and organizations here and there. Such classes and schools are bringing enlargement of life to several hundreds of people.

*Other Cultural and Educational Institutions.*

There are nineteen newspapers printed in Tsinan. Nearly all of them have been started since the beginning of the Republic in China. The largest paper prints 1500 copies, of which 600 are sold in Tsinan. Altogether there are 18,000 copies printed, of which about 7,000 are sold in this city. The price is from two to three cents a copy.

There are three free lecture halls in the city. One is under the district government and two are under the Board of Education. The lectures are of popular interest and of social value. Audiences of several hundred are common. Let not the western reader picture a western lecture hall where quiet and order reigns. In Chinese social tradition there has been little that resembles our large orderly meeting of the west. Movement among the audience, drinking tea, eating, and conversation are not out of place in a theatre or public meeting in Chinese tradition. However the lecture halls are being influenced by schools and there is more or less order.

There are two libraries in the city besides the University library. One is near the lake and an admission charge of one cent is made. The chief reason for going to this library is to wander through the Chinese garden with its rockeries, plants, and artificial waterways. One has to search diligently to find any books, if he is able to find them at all. There are separate days for men and for women. The daily attendance averages about one hundred fifty. The other library is managed by the Board of Education. Anyone in the city who has a guarantor may borrow books from any of the three branches of this library. There are reading rooms with a few magazines at these branches.

The Museum at the University, which we mentioned above, is the chief institution of the city in reaching large numbers of people with new ideas.

*Religious Institutions.*

The foreign protestant religious organizations doing work in the city are the University in which thirteen denominations from the United States, Canada and Great Britain cooperate; the English Baptist Mission; the Y.W.C.A.; the American Presbyterian Mission; the American Southern Baptist Mission; the Y.M.C.A.; the Salvation Army; and the Seventh Day Adventists. These are doing the regular forms of work that are done in China. The nature of this work is too well known to need repeating here.

The Roman Catholic Church was the first Christian church to come to Tsinan. Their early work was interrupted by persecutions, but now they have work in four centers, the largest of which is outside of the East Suburb. The work is manned at present by German priests.

The Chinese Independent Church is in the settlement and has 240 members. It is not connected with any foreign organization.

The number of followers for all of these Christian churches is about 4500. This number does not represent the full effect of Christianity in Tsinan. The presence of Christian churches with their Christianized foreign and Chinese members has a strong influence on the general social and moral standards of the entire community.

The non-Christians, other than the Mohammedans, cannot be classified as belonging to any one religion, for most of them see no reason for not being Buddhists, Confucianists and Taoists at the same time. They do not regard these as being mutually exclusive. While they may profess one or all of these religions their religious worship and acts are almost nil. There are a number of temples and shrines, but there is no public worship as we have in the west and there is little even of private family worship.

The Mohammedans have regular public worship in their mosques. At the chief mosque there are priests in charge and a number of young men are studying to be priests. The five daily periods of worship are attended by from fifteen to one hundred men.

There are some new religious organizations which show the stirrings of religious life. The Moral Society and the International Religious Society are new but rather weak organizations. There is one, however, the Dao Yuan, that was started in Tsinan and has spread to many other centers in China. It chooses good from all religions. In spite of the fact that it has received its revelations through the ouiji board, it must be credited with sincerity. It has three thousand members who have contributed money to open some primary schools, to build and operate the home for cripples and do other philanthropic work. It does not receive women members but a separate organization has been formed which has three hundred women members.

*The Women's Movement in Tsinan.*

We have already mentioned several social phenomena which are evidences of the changing position of women in society. To old China, where woman's place was only in the home and women were

not expected to be educated, the present situation would seem revolutionary. To see a thousand girls going to elementary schools, six hundred more going to middle and normal schools, and to see thirty-three girls in a co-educational University, would be confusing to the scholars of a few decades ago. The fact of several thousand girls and women going to work in the factories is breaking the seclusion of women in another class of society. Women work as teachers, doctors, Bible teachers, Y. W. C. A. secretaries, and nurses. The churches through their different organizations offer many places of work to the women members. The anti-foot-binding society has been organized to oppose foot-binding among girls and women. Some classes have been opened for illiterate women. The educated women are reading the modern women's magazines and the other modern books which are being printed in Chinese. The Museum at the University has special days for women, and special lectures are prepared for them. Thousands are getting new ideas of life from this institution. The Y. W. C. A. is reaching all classes of women with high ideals of woman's place in society. Altogether there is greater freedom for visiting and shopping, for attending meetings and moving-picture shows, and for getting in touch with the modern movements of society.

From their reading western readers may have gotten an incorrect idea of woman's place in Chinese society. The older women in the large Chinese families have often been the rulers of the household. In many circumstances men have recognized the principle of "women first." During famine relief work the women were shown much consideration when crowds were dealt with. In the co-educational University the women are treated with great courtesy by the men students, and the number of offices which women students hold is many times more than their proportional representation calls for.

#### *The Family.*

The effect of the modern city on the family is not much different in Tsinan from what it is in other cities, yet we speak of it because of its social importance. The family changes faster in the city than in the country. The woman's movement is found chiefly in the cities. The city family is unnatural, in that many are living away from their native place. We find few of the large family groups containing a great number of relatives belonging to several generations, and see many smaller family units consisting only of the parents and one or two children. The fact that men have to live at their place of work keeps them from a natural family life. The great excess of unmarried men and the insufficiency of wages to support a family

make it impossible for some men to marry, whereas in old China nearly everyone married. When girls can work in a factory and earn their own support, and perhaps a little more, to help the family, the parents are not so anxious to have the girls marry early and leave them. When the girls do marry after factory work they are not so well fitted for home-making nor are they likely to be content in the restrictions of a home. The educated classes are found chiefly in the cities and they are the ones who are reading the most of western family conditions, and so are most anxious for change in the Chinese family. Many of the men students who were married when they were young to women who have not followed them in their education, would like to be free to choose a wife who is more cultured, and there is a tendency to think that freedom of divorce would be a good thing. There are no problems that are so much in the hearts of the students as those connected with the adaptation of the old family to the new ideals of life.

#### *The Concentration of Christian Work in the Cities.*

There are many people who deplore the fact that so much Christian work is centered in the cities. Although eighty-five or ninety percent of the people of China live under rural conditions, there is much to justify the large proportion of Christian work that is to be found in the cities. The cities are growing rapidly. They are certain to grow much more as the industrialization of China proceeds. One man with modern farm machinery can do the work that ten now do, and when the industries call for men, the new machinery will be used on the farms and the extra men will accept the glittering lure of the city. In the next few decades millions of people are going to have to make the adjustments in customs and attitudes that are necessary in changing from the simple life of the rural village to the complex life of the city. Never before in the history of any nation has such a great adjustment of so great a number of people been made as will have to be made here. The city will be like molten metal which may be shaped before it hardens. The rural districts have for centuries been cast into a mould which will wait for change. The urgency is with the malleable material. All the modern movements toward change in society center in the city and it is there that the Christian impact can have great influence.

## The Building of a City

Record it for the grandson of your son —

A city is not builded in a day:

Our little town cannot complete her soul

Till countless generations pass away.

Now let each child be joined as to a church

To her perpetual hopes, each man ordained:

Let every street be made a reverent aisle

Where Music grows and Beauty is unchained.

Let Science and Machinery and Trade

Be slaves of her, and make her all in all,

Building against our blatant, restless time

An unseen, skilful, medieval wall.

Let every citizen be rich toward God.

Let Christ the beggar teach divinity.

Let no man rule, who holds his money dear.

Let this, our city, be our luxury.

We must have many Lincoln-hearted men.

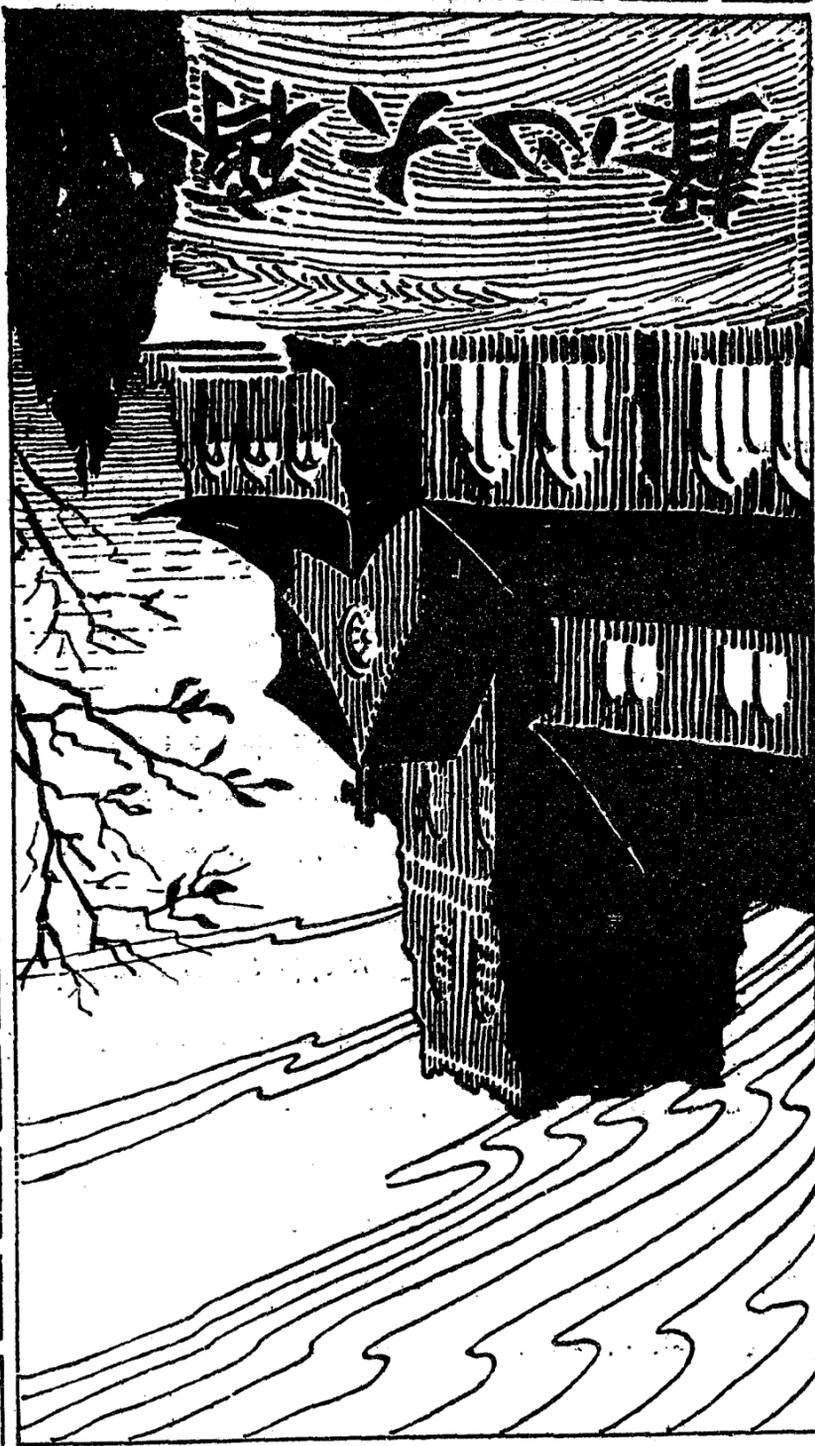
A city is not builded in a day.

And they must do their work and come and go

While countless generations pass away.

— *Vachel Lindsay*

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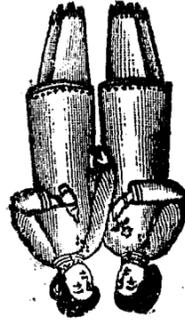
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山東基督教會同鄉對華北華運運動會宣言的回響

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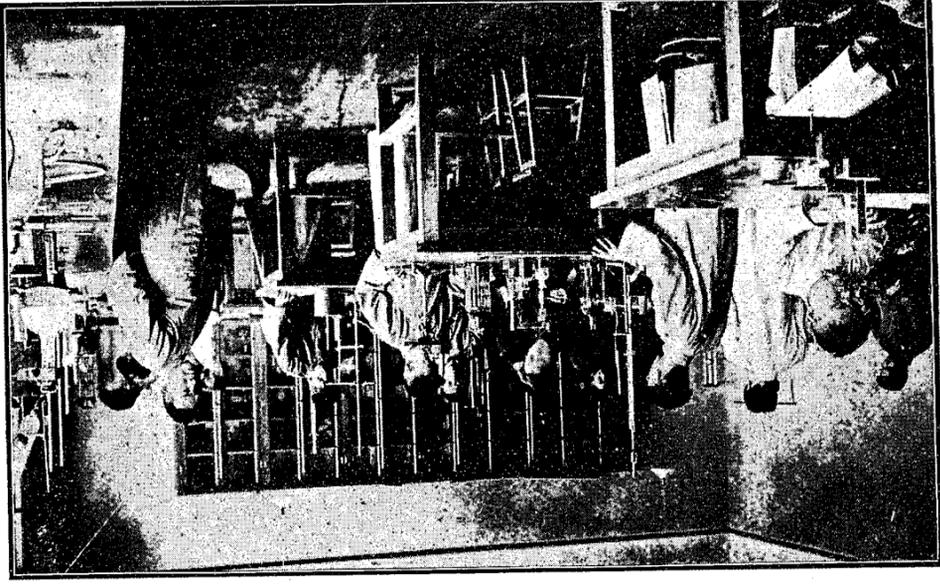
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學校	員	員	員	員

同盟「者在會場裏散佈傳單」宣言說「什麼」  
 當閉幕的那一天所謂「山東非基督教大會」  
 是：「第十二次華北運動會」美中不足  
 此位置也是中事，因在運動會中，到最高  
 多加練習的功夫，而在運動會中，到最高  
 學校既注重體育，現象呢？  
 這是一種多麼好的現象呢？  
 知道近三四年的工夫，吾校體育進步之速了。  
 本期有盧鴻君詳細報告，閱者讀後，就  
 本校此次在華北運動會中活動之情形，  
 宣言的回響

山東非基督教同盟對華北運動會

開篇語



























集所教授之材料也。乃係準備何種方法而極便實施耳。教員應

點鐘實為最少之限度。教員須多費工夫準備者。非並專為一

趨過擬令學生所準備者。方屬相宜。大約準備三點鐘。教授

任何學校中。非不事準備。即可奏效。教員準備之工夫。應

尚有一習事。應行注意者。即教員之準備是也。優良之工作。在

即係自身。不昧於成法。而為一改善提倡之人云。

屬大謬。吾人儘可於教室中。兼作實與討論也。教員之職務。

如將講義實驗討論。截分為三部。彼部不相關。此事亦殊

儘可自覺善法。合於其所教授之學生也。

各人之理想。此外尚有種種方法。可於討論班時行之。各教員

考試。倘如所選問題相宜。感發學者之興趣。且能振發

者。亦於討論班前之五分鐘。作一度。只容或對否之簡短

課程之完全部份。其不逾該課程。緊要事項中之一耳。且該

之問題。而多注意於理解之問題。且亦令學與者。觀本課為

可發問題。但勿注重記憶方面。吾人可各盡所能。去記憶

本禮拜所授之主旨。而適如吾心中所有之把握。而後可。教員

須引導至一種極有範圍之討論。且知各個學員。業經領悟

與疑問。此事必須極為敏捷。方能勝任。教員亦勿多言。但必

員仍係領袖。可指導討論。在實班時。復充分析。而揣摩之。教

可於實驗室內。為之。而於討論班時。復充分析。而揣摩之。教

三 討論。即補助實驗上之理論。所不及者。所擬之題目。概

二 邀 吾人實其贊成。能甚少。每五組。八人。似極相宜。多亦不得

最好。不同之組。亦須另派。其不同之實驗也。至實驗。每組之入

益。即各學員。作不同之實驗。是也。且為注重個人。教授起見。

為精選。且宜多附錄。有答案之問題。以便學者。解答。惟最須有

退還。以免後之習此。課者。變鈔。而用之。至所用實驗。亦須有極

離實驗室以前。回報。即須交於教員。且於每季之終。亦勿再事

學科

離實驗室後。再作回報。此事亦能防止之。注。即係於未

法。切勿採。用。施行。然。然。上。之。障。礙。不。止。此。一。端。已。也。如

知。各。學。員。仍。有。其。個。人。之。觀。察。及。其。他。人。之。回。答。外。此

如。是。兩。學。員。同。時。共。用。一。組。鐘。錶。此。實。不。便。之。點。點。非。確

報。之。結果。設。非。根據。各。人。之。實。驗。者。則。即。勿。為。之。收。受。可。也。

其。聚。互。商。至。有。雷。回。之。回。報。是。也。且。教。員。尤。應。注。意。學。生。回

尚。有。最。緊。要。者。即。務。令。學。者。各。作。其。自。己。之。實。驗。工。夫。勿。任

應。發。一。問。題。在。彼。處。作。一。提。示。與。各。個。學。生。應。切。討。論。之。惟

品。體。等。教。員。可。於。各。實。驗。期。內。到。各。學。生。之。處。往。來。巡。視。此

他。人。者。實。驗。之。問題。如。量。子。之。長。短。或。變。備。一。明。驗。之。極

人。之。目的。亦。應。令。學。者。思。其。所。遇。之。問。題。乃。係。異。於。回。班。中

共。視。每。一。實。驗。即。係。一。種。問。題。而。為。吾。人。所。必。須。解。決。者。且。吾

際。而。引。領。其。解。答。各。人。所。遇。之。種。種。問。題。是。也。教。員。與。學。員。應

教。員。乃。如。一。領。袖。其。在。實。驗。室。內。之。任。務。即。係。指。導。學。員。正

學科

已。此。實。均。非。實。驗。之。正。義。也。

教。員。不。過。如。一。監。督。按。時。派。實。驗。通。有。問。訊。即。為。之。解答。而

意。即。各。學。員。可。在。此。隨。意。操作。以。完成。其。擬。令。所。作。之。工。而

所。共。認。為。極。難。者。也。亦。有。多。人。以。實。驗。至。為。學。生。工。作。之。場。所。

因。指。導。實。驗。工。作。使。其。能。得。到。充。分。之。效。益。確。為。各。科。學。教。員

地。不。過。在。此。供。給。學。者。一。有。益。合。理。之。樂。耳。且。實。大。謬。不。然。

續。者。要。亦。非。自。然。而。致。者。也。有。多。人。誤。認。實。驗。室。如。一。遊。樂。之

作。乃。係。供。應。納。方。法。之。最佳。會。者。惟。其。能。有。此。偉。大。之。成

二 實。驗。此。實。科。學。教。授。法。之。主。腦。吾。人。已。承。認。實。驗。之。工

間。舉。行。故。各。實。驗。室。內。應。備。有。講。義。及。案。板。

數。分。鐘。之。或。教。員。有。特。別。實。驗。欲。指。示。學。生。者。亦。可。於。此。時

遇。有。教。員。欲。費。力。少。少。購。變。多。則。吾。人。可。即。介。紹。其。此。種。方。法。然

備。有。教。員。極。易。實。施。之。方。法。故。其。所。得。之。效。益。亦。極。為。低。次。

學科







本處於每禮拜六日招集不讀書或在私塾讀書之童子組織

●童子班

得性之快樂每季有一班兩班不等多請西國朋友作本班  
凡百行為以道德為主故設查察班作培養道德之基礎而使

●查察班

報室訂有本省外省新聞若干份以供衆覽既廣見聞又擴知  
所謂不出庭戶備知天下事者惟報紙是類本處設有公共閱

●閱報室

熱心女士課本採用「深入淺出」由淺入深「雖係初辦已有十人之多  
者而設乘操作之暇作半日來學之機會教員多係各教會

●婦女半日學

後務每次到五十五人以上極得靈感上快樂焉

唱詩並授以極易注意之聖經故事多由神科男女同學分任

●主日學

覺重要每日到至遊藝者亦大有人在也  
律之中而不使為無益之動作於活潑精神及強健體魄上規

遊藝為活潑精神之必要事項本處特設遊藝室納遊戲於規

●遊藝室

收良故學之數目與夫教授之成績較在昔尤覺進步也  
受教育之機會多蒙附設本處總附設本處同人等再三討論

教以量最淺顯最普通最適用之文字使一般失業兒童稍得

為利用假期時間又設立夏令兒童學校不收識字之男女兒童

●夏令兒童義務學校

設備不虛是宜急宜急改良者也

●通俗演講

時期茲將本處已往工作略述數端以告諸邦人君子

男女青年經計畫所謂羣策羣力造羣社會者是日發展

之目的亦稍有補救於萬一所有之切端端文神醫三科

日學平民夜學等工作兩年以來設備粗就雖未達改良社會

之需求遂設兩等小學開辦英文班查察班主日學婦女會

以佈道演講為服務標準後方知只斯二者不足以應付社會

見其發展也因改名為社會服務處是日成立時期初日

凡三十餘間如是男青年地點適中工作亦蒸蒸日上

為辦事業日見進步時兼會所之小後李宅後院而租之

堂此本處之醴醴地也是年十月由瑞君延張思敬牧師

科學員練習處兩相集合所謂天然技巧遂定名曰南關佈道

一所急欲捐作佈道之用時科科長瑞思培亦正籌畫設神

分以下諸時期幸蒙先生熱心基督徒也在南關新建房屋

諸女同學及熱心太太擔任教授得蒙良多惟以經費缺乏

能發展其精神又可導引其與每晚來學者達二十餘位多

而幼童班尤見發達專授于字及童子故事音樂等科既

學生之年齡不同其理想及興味自異故分為成人幼童兩班

●平民夜校

講演講者願不之入惟以地址狹隘急宜擴充耳

防傳染諸方注多講醫科同舉擔任之此外尚請各教會領袖

生之道及生理衛生等事非徒權擔任之(二)衛生演講注重

增廣民智者也以文理科學同舉擔任之(三)衛生演講注重

明社會之改造以及地理之講解國民之常識是皆開通風氣

之(二)智育演講專重古今事理文明進化與夫科學之發

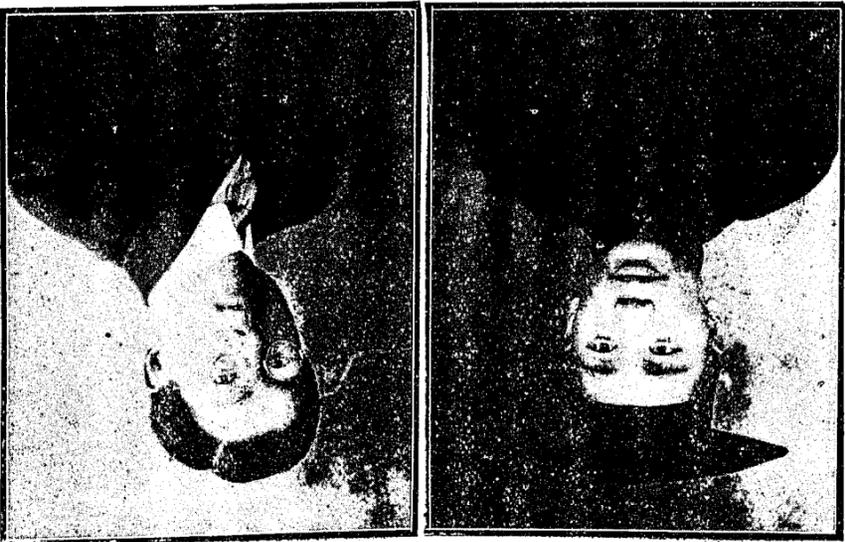
真理於社會使福音權於人心專講神科回學轉流擔任

(一)德育演講特注重於道德人心風俗習慣等事藉以廣播

因利用各界閒暇時間故多在晚間舉行演講題目總分三類







息 消 友 校

君元連宋

君銘書劉

男十一歲女五歲

十五於茲矣夫孫氏膝下男女公子四位長女十四長

校醫科後任懷遠民望醫院醫士一年副充濟南華美醫院醫

宋連元字仲三歸入垣年三十四歲一九一九年畢業於本

學專修至今一年矣

名之哈佛大學 (Harvard University) 畢業後遂在該大

位後在歐亥歐省城立大學專習德文法文副授考世界知

此美留學在烏斯特大學 (Wooster College) 畢業學士

後文理科畢業接在濟南會館專事四年於一九三三年夏

劉書銘名世傳山東省濰縣人年三十六歲一九一九年本



息 消 友 校

靈魂當仍日日繞繞於諸位之左右也。

更不敢定。故請勿再以心聲或他項信件寄賜矣。雖然我之

子計畫。將於陽曆四月底離哈城。此後吾之通信地址，

中心未嘗不敬重並感諸君子之盛意也。

間。即偶有不美賜函問者，予亦未暇作答。未免大周。但

自離母校在在十載。因逆境之我，敢與同仁通音

我者，從我之蹤，良用慨然！

自謀生活，與環境相奮，似四海無家之漂流者。使外

謝。茲寄上美金十元，為捐助心聲之用。竊孤獨如子，在外

齊大心聲 第二期





君民立韓



君秋烈吳

息消友校

友消息校

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齊大心聲 第二期

四

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英文兼音樂教員

於本校文理科接任浙江金華中學教員現充杭州蕙蘭中學

吳烈秋名廣智山東鄒縣人年二十六歲一九二二年畢業

年回國應母校之聘充醫科衛生學系教授兼校醫

於公衆衛生之各大醫院及各辦事機關於一九二二年三月...

韓立民縣人現年三十三歲一九二一年本校醫科畢業

段思賢先生	捐洋二元	孫三先生	捐洋二元	韓長林先生	捐洋二元	馬慶齋先生	捐洋二元
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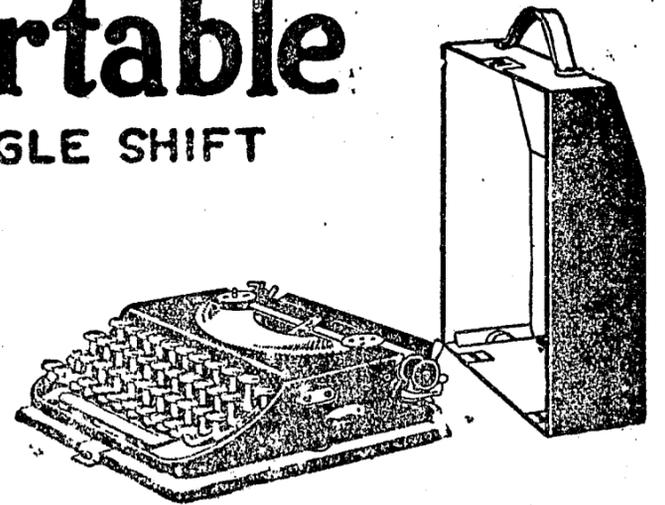
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— VIII —

## CHEELOO

The Quarterly Magazine of  
Shantung Christian University

VOL. II

JUNE, 1925.

NO. 2.

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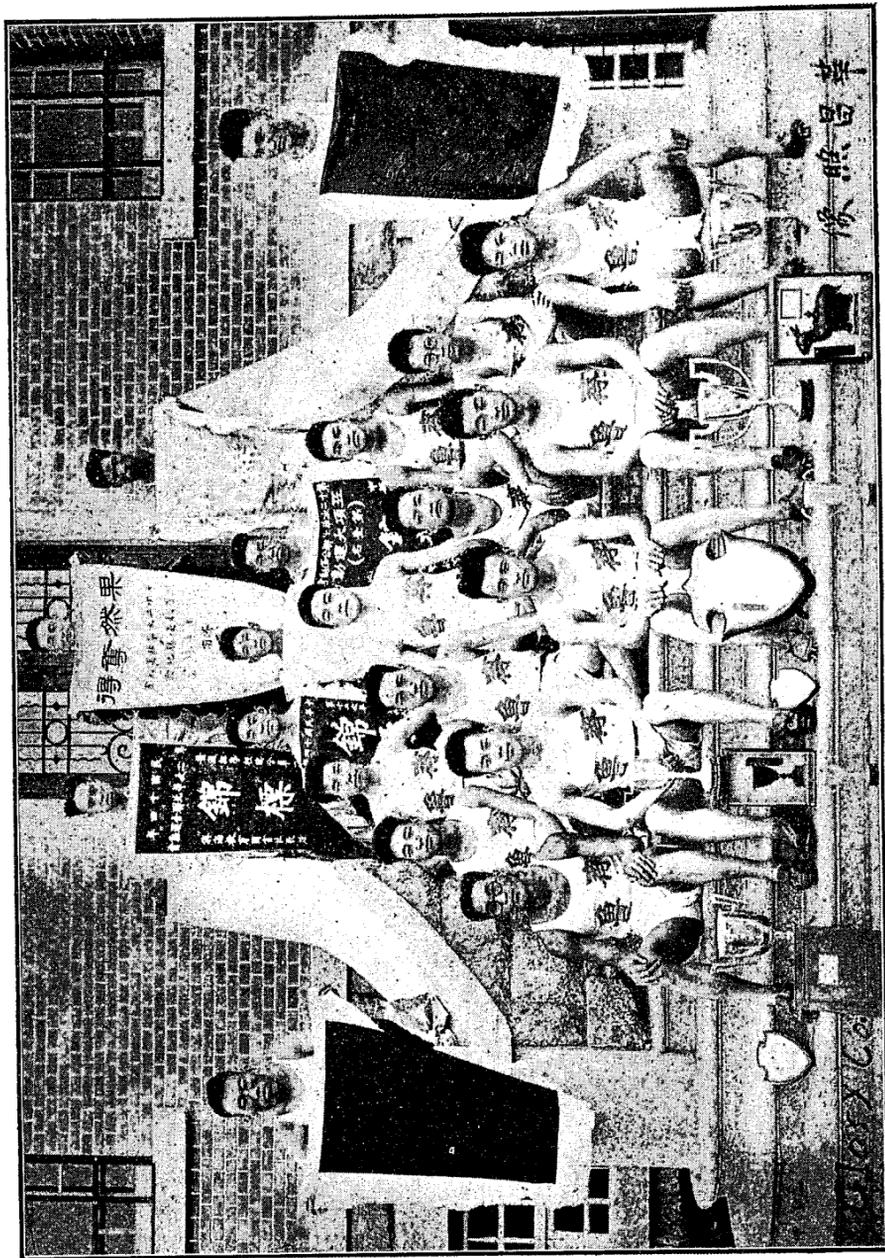
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## WITH THE EDITORS

### The North China Athletic Meet.

**I**N the memories of those members of the staff who have come from the smaller colleges in western countries probably nothing stands out in clearer perspective as a means of stimulating college spirit, and as a motive for encouraging intercollegiate friendships and mutual respect, than does the memory of the intercollegiate athletic meets and football and baseball games. To be privileged to wear on one's sweater the athletic emblem indicating that the wearer had earned a position as the representative of his school on the athletic team was an honor highly prized and, in the mind of the student body, usually far outranking honors awarded for scholarship. And there is much to be said in behalf of such an attitude, for in the free open competition of the athletic field, the best man really has a chance to win. Here all are on a common level, and inherited or acquired ideas of superiority based on family, or wealth, or previous cultural opportunities, are ruthlessly brushed aside, and each individual competitor must learn that there is but one way for him to attain the victory and that is by consistent training, and self control, and hard work, and respecting the abilities and rights of others.

Nothing brings back more clearly to the mind of the alumnus of a college, a recollection of his student days, and makes his heart beat quicker with a swelling of pride in and for his *alma mater*, than to read a report of the victorious accomplishments of the athletic team representing his school in an intercollegiate contest. And every Cheeloo alumnus has good cause to rejoice this spring in the phenomenal achievement of the University track team in the North China Meet held in Tsinan on April 24 and 25.

When we recall that it was but three years ago that Cheeloo first sent representatives to the North China Meet, and that the general opinion even then was that our athletics were of such a mediocre grade that it was hardly worth while competing with the schools recognized as vastly superior, the carrying off of first honors in this year's meet, with a lead of 29 points over the nearest competitor is an accomplishment to make us all justly proud of the rapid progress made in athletics. Not only did the total score show a marked superiority for the Cheeloo team, but first places in eleven of the twenty events were won by Cheeloo men, and in honors for the highest individual scoring our team took four of the first five places, and broke two all-China records.

While, however, we are proud of the team for so splendidly winning the meet, a greater cause for satisfaction is the spirit of good sportsmanship and fair play which prevailed throughout. In a college in the Near East not so many years ago when athletic competitions were first introduced it was not uncommon to see the student who thought he had been unjustly discriminated against in the awarding of the prizes, fighting with his more fortunate competitor in an effort to get possession of the medal which he had failed to win. While nothing of that kind has ever happened in Tsinan, there have been occasions where that spirit was all too plainly manifested and where a meet, whose chief purpose was to encourage good fellowship and fair play, has been broken up in sullen dissatisfaction and mutual distrust. The fact that this meet was carried through with such a marked spirit of friendliness and good-will is the more remarkable in view of the fact that the immense crowd which gathered to watch the sports furnished a fertile field for anti-Christian propaganda and that an effort was made to introduce discord by the distribution of literature calling on the non-Christian schools to withdraw. This was promptly stopped by the police, and the spirit of good fellowship and fair play among the contestants themselves, and the manifest fairness and capable management on the part of judges and officials of the meet, all of them Chinese, are causes for justifiable pride, and augur well for nourishing among the student classes in this land the essence of real democracy through the gospel of athletics.

H. P. L.

## Visits To The Schools.

F. S. DRAKE.

**A**T its meetings in 1924, the Shantung Board of Christian Education requested the University to set aside at least half the time of one of the staff of the Department of Education so that he might act as Board Visitor to the Christian schools of the province. In the course of time this duty fell upon me, and it has been my privilege, during the autumn of last year and the winter and spring of the present year, to make four journeys, varying from a week to ten days in length, to certain of the schools of Eastern Shantung. I say it has been a privilege, for there is nothing more welcome to a student of education, than to witness in schools of different types the action of educational principles and practices. Then it is that the work of the class-room ceases to be the study of books, and becomes what it should always be, the study of real things—to the understanding of which the books are a valuable guide. But still more, it has been a privilege to see, if only in small part, something of that quiet and unobtrusive work that is proceeding continuously in town and village throughout this province; to speak with those who are working out their problems in close contact with the people of the soil, and to gather from them suggestions, tested in practice, for the furtherance of education in China.

The first journey was to schools situated along the railway from Tsinan to Tsingtao; the second and third to country schools between the foot of the hills and the Yellow River; and the fourth to the cities of the coastal plain between the mountains of East Shantung and the sea. Every means of transit was sampled; from railway and motor car, to mule litter, mule cart, ox cart and tramping on foot. Each region had its own distinctive character, and in this character the schools of each largely shared. So that the impression left upon the mind is that of groups of schools growing up in answer to the needs of various environments, and to a large extent shaped by those needs. There are different problems facing each; and the problems are being solved in different ways. Thus it is possible to recognise a special function in each school or group of schools, and to note the manner in which the work of each school is complementary to the work of the others, so that together they form an organic whole, working in the interests of the Chinese people.

### *Education For Rural Life.*

In the middle of the plain between East and West Shantung, at the meeting of east-west and north-south routes, lies the city of Weihsien. On alighting from the train, the characteristic feature is the line of Peking carts drawn up before the station to convey passengers to the city. To the stranger, carts are the characteristic of Weihsien. They seem

to be entering at and issuing from the city gates unceasingly. They betoken a prosperous city in the midst of a fertile plain; the centre of a rural region; not however withdrawn from the main stream of life, where the minds of men grow fixed, but where all routes converge, and where ideas freely mingle.

It seems fitting therefore that the Christian schools of Weihsien should be shaping themselves especially to meet the needs of rural life, and this in so constructive and spontaneous a manner as to be providing a unique contribution to Christian Education in East Shantung.

The Christian rural schools of this area lead up to the large middle schools for boys and girls outside Weihsien city. Here in addition to the ordinary courses preparing for University work, an agricultural department is being developed, with experimental farm attached. Specific courses in agriculture are offered in the school; practical work is carried out on the farm; trees have been planted; grain has been sown; cotton of different varieties tried. To the direct vocational value of this to those who will return to the farms, is added the indirect educational value to those who will become village school teachers and country preachers. But further, the work has definite experimental value. For the department is continually trying out new kinds of grain or of cotton for the benefit of the farming population. When a definite improvement is demonstrated, the new knowledge is available throughout the country-side, and a step has been taken for the material advancement of rural life. Thus this extension work claims a large share of the attention of the department. Literature is prepared, seeds are distributed, and exhibitions of results are arranged. The consequence is that farmers are becoming awake to the possibilities of improving their condition; requests for seeds are increasing, and the new methods are being gradually adopted.

With the purely agricultural, the educational side also is pressed. For on agriculture are based the rural institutions; and with the study of the processes of agriculture is naturally linked the study of the social conditions to which it gives rise.

This is a matter of vital interest to the primary schools throughout the region; and the idea has developed of letting the study of agricultural life take a central place in the curriculum of primary schools. The school garden gives practice in the art of preparing the ground and sowing the seed; the seedlings provide the basis for the study of plants; beyond the school, the open fields, the farming village, invite to a survey of the crops, the fowls, the pigs and the teams; the school can be mapped; then the village; and last the region of which it is the centre. The distribution of crops can be inserted; and the distribution of people. The weather can be watched and bright days and rainy days

charted. The winds can be noted; and the coming of flowers and insects and birds. From these real experiences, the facts of climate can be explained and their influence upon the crops traced. The market can be studied; and the source and destination of the articles on sale. So the relation of men to the crops, and of men to one another is seen. Then the study of man commences; the village life in all its phases; the history of the village; its government; its institutions; its schools; its temples; its Christian Church; the effect of these upon the minds of the people; and upon the attitude of the people to their environment.

Thus from the school garden we come to the study of nature, and from nature to man, and from man back to nature, until human life appears, in whatever small and easily understood village, as in organic relation to its natural setting; and surely the child who has developed with this outlook, has in him the foundations of a true education, whether he remain all his days in his native village, or whether he go on to the middle school, and to the advanced work of college!

Working on these lines, the authorities of the Boys' Middle School at Weihsien have achieved more than the addition of a vocational agricultural course to their own school. They have done a piece of constructive work of great educational value, for the village primary schools of their region; and they are giving to their scholars that interest in and understanding of their natural and social environment which are a primary need for all teachers and preachers in rural districts.

#### *The Preparation of Rural Workers.*

In another way the rural problem is being handled by the workers at Hwanghsien. Hwanghsien is one of the cities on the coastal plain on north-east Shantung, between the mountains and the sea. Outside the city, on an extensive site, has grown up the Christian Institute. There is nothing pretentious in style or in aim. The Institute has developed in order to supply the actual need for teachers and preachers throughout the country-side. From Kindergarten to Junior College it is complete in itself. Nothing is attempted that would be out of keeping with the rural environment. The Kindergarten is a real kindergarten, and yet one that could be reproduced in any Chinese village: the ordinary three-division room, with the ordinary brick floor. The Boys' Primary School has between 200 and 300 boys. The classrooms are the usual Chinese rooms; in lines, facing south; but they are spotlessly clean; yet no servant is employed to sweep and to dust; the boys themselves do all the work. And the courtyards between the lines of buildings are sown with seeds, and the boys have the pleasure of seeing the flowers respond to the work of their own hands. The same desire to do only what can be reproduced elsewhere dominates

also the Girls' Primary School, where even in making models, clay is substituted for plaster—the latter though obtainable in Hwanghsien, not being easily procurable in more remote parts.

In the higher parts of the Institute—the Middle Schools, the Normal School, and the Arts and Theological Colleges—economy of strength is procured by avoiding all possible reduplication. The fewest possible elective courses are offered; co-education is practised throughout; and in the Middle School and Junior College as many classes as possible are combined. The teaching is direct, concrete and thorough. In Scripture teaching for instance, text-books are prepared giving just the salient facts necessary to the understanding of the Bible and of the progressive history of the Church, without entering upon abstract discussions that can at present have little meaning for the students, because of lack of background. The whole is combined with a good deal of map work, by means of which the events of the Bible are plotted in their setting in place and time. Each student makes his own Biblical atlas as he proceeds in the course, and exactness and thorough understanding of the Biblical narrative are emphasised.

#### *The Preparation For Home Life.*

A feature of extraordinary interest at Hwanghsien, is the organisation of the Girls' Middle School. As stated above, class-work is provided for by co-education. For the rest, the school life of the girls is of course quite separate from that of the boys. The girls' dormitories are two-storeyed buildings—of a modified Chinese type—with narrow verandahs on the south side. The buildings are divided vertically into two halves. Thus each building has four parts—two above and two below. Each part is a "home" for sixteen girls. It contains bedrooms, dining-room, and kitchen complete. The girls themselves do all the work necessary in their home, and prepare their own food. They tend their own vegetable garden. They have designed and stenciled a frieze for the walls of their rooms. They have worked their own quilts, to a pattern they like. Their dining-rooms are comfortably and tastefully arranged—with the same material, but with what a different result, from the usual school dining-room in China!

#### *Vocational Training.*

In strong contrast to the work at Hwanghsien, there has grown up a group of schools at Chefoo, in response to a different environment. On Temple Hill at Chefoo, are nearly one thousand scholars at different stages of education. Chefoo is a port, and the chief interest of the city is commercial. There is a rich hinterland in the highland valleys of the mountainous region behind; and there are the needs and the resources of developing Manchuria before. There are wealthy Chinese merchants,

and their interest for their sons is commerce. The Christian Church was first established here in Shantung, and has the momentum of sixty years. Among its adherents are men of means and of administrative ability. They are acquainted with the needs of modern life, and desire a corresponding education for their children. Thus the schools on Temple Hill have developed in keeping with the life of the port.

The Kindergarten is a charming modern building and is no longer floored with brick. The Primary School for boys and girls is managed by its own Board, of which the majority are Chinese. The Girls' Middle School—than which more beautifully kept school it were hard to find—is self-supporting and controlled entirely by Chinese. A detail illustrating the educational requirements in a port, is the fact that the piano is taught throughout the school, and is in fact one of the things most urgently desired by the Chinese managers.

It is however when one comes to the Boys' Middle School, that the response to the environment is most evident. This school is an amalgamation of two schools of earlier days: one a Chinese school of the ordinary type, and the other an English teaching commercial school that arose in answer to the desire for vocational training in the port. With the amalgamation, both schools have benefitted, and the complete institution now functions in two departments; the Chinese side, in which an ordinary middle school education is given through the medium of Chinese; and an English side, in which the subjects are taught in English, with special emphasis upon commercial subjects in the later years. A very high standard of English is attained. Typewriting is added in the fifth year and shorthand in the sixth. High fees are required, and scholars come from all parts of China. There is a large non-Christian element in the school. But this has an advantage, in that it puts the Christian boys on their mettle. Last year all the leaving year were Christians. The boys have organised and themselves maintain their own Church. They choose their pastor—who is at the present time their Dean. Morning chapel and Sunday services are conducted in English.

Thus this large Middle School, preparing for commercial life, with its strong emphasis upon English, is the dominant feature of Temple Hill. There could be no greater contrast than that between it and the Christian Institute at Hwanghsien; and yet each has arisen in answer to a definite need, and is being shaped according to that need.

#### *Industrial Work.*

A day's journey by mule litter from the railway on the south, and from the motor road on the north, lies the city of Pingtu, at the foot of the hills. It is not a wealthy district; and this perhaps may be the reason for the starting of industrial work here in the boys' school some

years ago. The making of stoves was the chief feature. For a time the work lapsed, but has been revived in recent years, and rapidly developed. A large new school building has been erected, and the number of the boys has greatly increased. The industrial department includes a printing press, fruit and vegetable canning, and the making of stoves. About one hundred boys work in the industrial department for at least one hour a day, and some for two and a half hours, being allowed in return the remission of a certain proportion of their food money. The output of the department is sold; perhaps the most interesting production being that of Christmas cards from the press, which are sold largely in America.

#### *Handwork and Art.*

The above account leads naturally to a consideration of handwork in the schools. To many this suggests a useless and trifling occupation, the lack of which is not serious in any school. Certainly the type of handwork often seen in the past was of a trifling character. And yet upon a little reflection the importance of children learning to use their hands is manifest. Upon the skill of the hand is based our material civilisation; for in the last resort both the greatest machines and the most delicate are alike dependent upon the skill of someone's hand. The brain too develops with the use of the hand, and advance in the natural sciences is dependent upon the hand as well as upon the mind; even our knowledge of history has grown as much through the touch of the archaeologist, as through the learning of the scribe. The provision therefore for adequate development of the hand should be regarded as an integral part of modern education. It should produce interest in manual labour, give insight into the way in which civilisation has developed, satisfy the creative longings of the individual, and assist the development of the brain. With so wide a function, there must be ways of achieving the desired end, and it would seem best that each school should work this out in its own way, correlating its handwork with as many subjects as possible in the curriculum.

For this reason I was interested in learning how this matter was being handled in the different schools. There appears to be a very great lack of handwork in the boys' middle schools, and in too many cases in the primary schools as well. The industrial work at Pingtu forms an exception in the case of boys' schools. Another exception is found in the Boys' Junior Middle School at Kwanglao. This school is part of a mission centre under the control of a Chinese superintendent, in a somewhat poverty-stricken region on the plain. The whole plant consists of boys' and girls' primary and junior middle schools, church and preaching hall, and kilns for making bricks. The Superintendent, in addition to the management of the city plant and work, is head of all the

Christian work throughout the whole county. In consequence he is a very much overworked man, and resources of time and money for the development of the schools are scanty. In keeping with these circumstances the handwork in the schools is all of a practical nature. The scholars make shoes, which they crochet with a stout native thread. These are both stronger and cheaper than the shoes they can buy, and the boys were mostly wearing the shoes of their own making. They also knit gloves and scarves for their own use. Two *mow* of land have been bought for a school vegetable garden.

In the girls' schools that I saw, handwork was usually present, taking the form of needlework, for sale. Very tasteful work of this character was being done at the Swedish Baptist Girls' School, Kiaochow, for sale in Sweden; at the Pingtu Girls' School; and at the Tsingtao Girls' School. At the Married Women's School, Laichow, the needlework is sold in America, and pays for half the board of the women. At Hwanghsien Girls' Primary School, amongst other forms of work, modelling is done in connection with the Geography teaching.

Art for the most part is not emphasised. In some cases it is not taught at all. In other cases arrangements are made with the art teacher in the local Government School to come across for art classes. But in either case there is a great need for the recognition of the true place of art in the development of boys and girls. Such work as that done by the girls at Hwanghsien in designing and stencilling a frieze for the walls of their rooms might well be extended, till the habit of beautifying their surroundings in simple ways be formed.

A most successful example of the practical use of art was seen at the Chih Ch'eng Middle School—a private middle school of 300 boys at Hwanghsien. Not only had this school a most beautiful collection of pictures painted by the boys from life, but their general science room was furnished with a large set of botanical and other wall charts, painted by the boys, of an artistic as well as scientific quality far exceeding anything of the kind I have seen elsewhere. It convinced me that the making of charts, pictures and maps by the boys for class-room use, was not only desirable—as I had always believed—but also practicable.

#### *The Married Women's Schools.*

Reference was made above to the needlework of the Married Women's School at Laichow, and it may be as well to explain here the character of these schools; the more so, as they illustrate once more the main theme of this paper that the Christian schools are developing in answer to the needs of their respective environments.

From the cities of the coastal plain of north-east Shantung, there is a continual exodus of men to find good commercial employment the other side of the water in Manchuria. This takes place to so great an

extent, that to hear that someone has "gone outside" is a matter of frequent occurrence. Those who in this way "go outside" leave their wives behind them, and often never come back to reclaim them. The relatives meantime grow impatient of supporting the neglected wife, and after a time arrange to sell her, usually as a concubine, to some other man. It was to help these deserted women that the Married Women's School was first started at Laichow. While their husbands are away the women are glad to enter the school. They can pay for half their board by the needlework that is sent to America, and meantime they receive the equivalent of a primary school education. While in the school they are at any rate usually safe from any sinister intentions that may be harboured by their relatives. Though this was the impulse that started the school, the school is by no means confined to such cases. Many married women are glad to avail themselves of this opportunity, and many husbands are glad also to have their wives educated in this way. At Laichow plans are being made to link up this school with the girls' primary school alongside of which a new building is to be erected, so that much of the academic work can be conducted in combined classes. A great saving will thus be effected. Such joint work is already being carried out in the Girls' Primary School at Hwanghsien.

*Chinese Control.*

I was able to witness schools of different types and in different circumstances under complete Chinese control. Reference has already been made to the schools and churches at Kwanglao, in a remote country district, entirely in the hands of a Chinese Superintendent. The financial stringency, and the strain upon the man have also been noted. But however pressed with multitudinous affairs, the Superintendent found time for cultivating personal acquaintance with his boys. He made opportunities for frequent personal talks with his boys, especially those who appeared most backward or most troublesome; so he learnt to know them, and shaped his actions accordingly. This intercourse he regarded as the most important part of his work.

A school similarly placed under a Chinese Superintendent is the Bible School at Kaomi. This school offers a six years course, but alongside of the ordinary Middle School subjects are Bible courses and Normal courses for training country preachers and teachers.

In a different environment, but likewise under the control of a Chinese Principal, is the Girls' School at Tsingtao. The school is in a house that once was the home of a German military officer; and in seeing it I for the first time realised the advantages of the modern building for schools in China. Class-rooms, dining-room and dormitories all being under one roof, the whole has the compactness and atmosphere of a home. The Chinese Principal and his wife live in the same

building. The lady has had some medical training, and is the matron and nurse combined. The whole school was spotlessly clean, and one could not but rejoice to see the Chinese Principal and his wife thus jointly caring for the mental, bodily and social welfare of their girls.

*The Silent Room.*

In the Girls' Primary and Junior Middle School at Laichow, is a small room opening off the hall of the second storey, which is set apart for quiet and prayer. It is modestly furnished with a table and a couple of chairs, a rush mat, and a few pictures, and yet it has a homelike and quiet appearance. It is a little Chapel to which any girl can go at any time; and it is often used.

For several years I have thought that such a Chapel should be in every school. Every community, including a school community, needs its quiet Chapel, with ever open door, to which people can go as they feel the need, to pray, or to meditate in silence. The young, in whom the springs of life are fresh and pure, are, I believe, particularly in need of this their sacred place, and respond whenever the opportunity is given to them. I remember, when teaching in England, taking a group of boys about 11 and 12 years of age, to Westminster Abbey; we entered the Lady Chapel, and I was interested to notice the effect of the quiet of that place upon them, and to hear the spontaneous remark: "Supposing we had a place like this at school!"

Those who deal with boys cannot but recognise and trust these instinctive religious feelings. The Government schools, I am told, are feeling the need of something to take the place of morning Chapel in our Christian schools. It takes the form, I presume, of an assembly and some kind of moral exhortation; but in one Government school I entered, I noticed on the time-table a period every day for quiet meditation. I suggest that this marks the awakening on the part of educators to the religious need in boys, because of their dealings with boys.

*The Beginnings of The University.*

Finally I must mention the Boys' Higher Primary and Junior Middle School at Tengchow, which occupies the premises of the old Tengchow College, the original Arts College of this University, and which holds also the old Temple of the Goddess of Mercy, in which Dr. Mateer first lived in Tengchow, and in which later he opened the small school, from which the University has sprung. Little did that priest, who in the days when no other dwelling could be procured, first made over his temple to Dr. Mateer—little did he dream that from that low-lying shrine, built with blocks of dark lava, not far removed from the sound of the sea, would go forth messengers of light, to the healing of the bodies and the minds and the souls of men!

## Has Religion A Place in Education ?

B. A. GARSIDE

**E**DUCATION is the process by which society deliberately undertakes to transmit to each successive generation the minimum essentials of the civilisation which mankind has produced. Out of the limitless mass of knowledge and skill and accomplishments which humanity has acquired since mankind first appeared on the earth the educator must choose the knowledge, the skill, and the ideals which are most indispensable to the welfare of the individual and of the social group. His choice must always be kept to the irreducible minimum, for at best the years in which he can guide the development of youth are all too short for the training he would give, the knowledge he would impart, and the ideals and aspirations he would nurture.

Any field of knowledge or accomplishment or idealism that asks for a place in the educational system of any progressive nation must come, therefore, expecting a rigid, searching, and coldly impartial examination at the hands of those whose duty it is to jealously guard the educational curriculum from the trivial and unimportant fads and fancies that are always clamoring for admission. It is not sufficient to show that the subject is harmless; not enough even to prove that it is desirable, for it would be all too easy to crowd our schools with innocuous or mildly desirable subject matter and in so doing force out the indispensables. To gain admission to an educational system, any subject should prove clearly that it has made, and can continue to make, a vital contribution to human society, and that its elimination would leave a chasm that could not be filled, an abyss that could not be bridged.

In these days of growth and reconstruction, the educators of the world in general, and of the Orient in particular, are most rightly taking stock of what their schools contain, examining each subject of the curriculum, judging critically the subject matter handled and the methods used, seeking everywhere for new and better materials and methods, and eliminating the things of lesser importance. It is therefore to be expected that the part which religion and the development of religious attitudes and ideals should have in the education of youth should be sharply called into question.

If religion is one of the outgrown habits or weaknesses of an earlier day, or even if it is a desirable but non-essential feature of modern society, it deserves no place in the educational system of any nation, and educators might well protest if children wasted their time in that field when they might more profitably be employed at something else. But if religion is one of the indispensable essentials on which society is based, and without which society would be seriously handicapped, or

even in danger of decay and ultimate dissolution, then indisputably religion has a very vital place in the social heritage which must be carefully transmitted to each new generation, and as such it is the educator's duty to see that youth does not grow to maturity without the proper development of this part of life. True, many elements of the social heritage may be transmitted by such other agencies as the home or the church, but as the chief educational agency of society it is the school's duty both to include within its own system all the essential elements the other agencies are not successfully transmitting, and also to encourage and cooperate with the work of other educational agencies of society.

We are then confronted, first of all, by the primary and inescapable question—is religion a vital element in society? If so, we must take account of it in our educational systems. If not, we may well reject it. Questions of subject matter, or objectives, or methods, can come later; if religion can be dispensed with they need no consideration, if it must be retained we can then set about correcting mistakes and devising improvements.

In seeking a scientific and impartial estimate of the value of religion to society, we may well turn first to the fields of social science, rather than the realm of theology. The theologian might be considered prejudiced in favor of all things religious, and apt to place too high a valuation on its service to mankind; but it is the duty of the historian, the educator, the statesman, and the sociologist to impartially judge the merits and defects of each element which goes into the complex structure of society.

If we examine, from the standpoint of history, the place of religion in human life, we cannot avoid recognizing that religious motives and ideals have been among the chief sources of human progress and control. Among primitive men it was the first crude beginnings of religion that welded fierce and uncontrolled savages into harmonious groups. Within those groups it taught them the things that benefitted themselves and their fellows; it gave them glimpses of far-off horizons which though but dimly seen at first lured them on and on along the road of progress. It has been religion that has led the way to wider group relationships, and now calls men to a universal brotherhood. True, the fields of man's religious activity, like every other phase of human life, have not been at all times and in all places equally fertile and flourishing, and there have been barren spots of lifeless ritualism, ceremonialism, and reaction, and sometimes poisonous growths of narrow fanaticism and selfish intolerance, but through the broad lapse of the ages these appear as but the unproductive spots in the all-nourishing mother soil whence society has sprung.

Whether we trace our historical descent from the Garden of Eden, or conceive of the race as having struggled gropingly upward through the countless millenia since the days of the Neanderthal man, we find that in either case man has, from his first appearance on earth, climbed ever higher with the assurance that he has been surrounded, cared for, and uplifted by the presence of Divinity. Whether he has sought God in the forms of nature about him, or has called Him by such names as Allah, Brahma, Shang-ti, or Jehovah, the inspiration of the presence of Divinity has stimulated man to his greatest achievements. Each new age has given him new visions, has revealed defects in the past, and has supplied problems for the future; but through all these changes and readjustments his religion has remained, changing perhaps with his widening viewpoint, but ever more indispensable than before.

These are facts that no historian would question or minimize. Probably there is not a historian today who would challenge the wisdom of H. G. Wells when he says that the great religious teachers of the world stand first and foremost in the list of those who have contributed most to humanity.

The preeminence of religion as a factor in social solidarity and progress is being increasingly recognized in many circles. Educators throughout the world, though they are the primary advocates of the extension of the benefits of science and education, are the first to recognize that not alone in these but also in the guidance of religion must the world seek a continuance of progress. President Nicholas Murray Butler analyses civilisation into five elements—science, literature, art, institutional life, and religion, and asserts that “to omit any one of these is to cripple education, and to make its results at best but partial.”<sup>1</sup> President Charles W. Eliot, recognizing that it is religion which holds the key to the world’s future, makes this statement: “Religion will offer an indefinite scope, or range, for progress and development.....It has the whole world for the field of the loving labor of its disciples; and its fundamental precept of serviceableness admits an infinite variety and range, both in time and space..... Working together will be one of its fundamental ideas—of men with God, of men with prophets, leaders, and teachers, of men with one another, of men’s intelligence with the forces of nature.....The religion of the future proposes as a basis of unity, first, its doctrine of an immanent and loving God, and secondly, its precept—Be serviceable to fellow-men.”<sup>2</sup>

In few places do we see such a growing emphasis on the vital necessity of religion as among the men whose duty it is to lead the

1. Butler, “Principles of Religious Education,” page 6.

2. Eliot. “The Religion of the Future,” pp. 47, 52.

nations in these times of danger and difficulty and perplexity. The catastrophe of the World War tore roughly away men’s complacent confidence in themselves and in the bulwarks of social safety in which they had put their trust. Thinking men are realizing that neither education, nor scientific knowledge, nor armed force, nor “enlightened selfishness,” nor all of these together, can furnish a secure and stable basis for the happiness and prosperity of society.

Education alone may serve merely to teach men how to get more for themselves, and in the getting they may forget their neighbours, or remember only to prey upon them.

Scientific knowledge may be a power either for limitless good or infinite evil; though it may bring healing and comforts and productiveness it may also devise high explosives, liquid flame, and poison gas, and may invent more and more efficient means for speeding destruction throughout the earth. It is not science in itself that saves or destroys, the vital factor is the soul of the scientist who wields the forces his brain has discovered and his hands have harnessed to do his bidding.

As for armed force as an efficient guarantee of peace and justice—what a tragedy of error it has repeatedly proven to those who have trusted too much in it! Preparation calls forth preparation; fortification demands counter-fortification; naval, aerial, and military programs stimulate duplicated and even more extensive plans of a similar nature; out of the whole system of manoeuvring for advantage there arise mutual distrust and suspicion, then enmity and bitter hatred; and inevitably there comes the careless match that sets the world into conflagration.

Likewise even the most carefully devised plans of “enlightened selfishness,” in which the claims and interests of all social groups are finely adjusted and balanced one against the other, to the mutual advantage of all—every such attempt is doomed to failure unless behind it are broader and worthier motives than selfishness alone. For in the striving of one group against the other such an artificial and unstable balance of interests can never be long continued, and soon the whole structure crumbles into ruins, a house built upon shifting sands.

That these truths are recognized in the East as well as in the West is shown by the statement of the head of the Chamber of Commerce of one of the greatest cities in the Orient: “Religion is the life of our country. Without religious education strong leaders will not grow up, international peace will not be possible, and pure, honest government will not exist.”<sup>1</sup>

1. Sneath, Hodges, Tweedy, “Religious Training in the School and Home,” page 3.

More and more the truly great political leaders of East and West have come to sincerely and boldly affirm that the twentieth century needs, not less but more than did the past, the directing influence of religion. It is very significant that the two outstanding leaders in America during the last difficult decade—Wilson the scholarly, idealistic statesman, and Harding the practical-minded leader—though they differed widely in many things, each in his last writings and public utterances emphasized with solemn urgency his deepest conviction that in religion lay the only hope for the world's future.

No group of men have trained themselves to look more critically and impartially at the elements that go to make up the social order than have those who have given themselves to the study of the new and important science of sociology. Theirs is the duty of fairly weighing and evaluating all the elements of the social inheritance, of encouraging the retention of what is good, and assisting with the elimination of all that is useless or evil. None dares, therefore, to minimize the importance of the fact that the great majority of leading sociologists today acknowledge the vital importance of religion in the past, and the urgent necessity of its continuance and growth in the future. E. S. Bogandus, for example, states that "the religious dynamic is the greatest social force of all time",<sup>1</sup> and Benjamin Kidd reiterates the thought with even greater force in these words: "Religious influences have been always and everywhere triumphant in the past, and it is a first principle of our social development that they must continue to be in the ascendant to the end, whatever the future may have in store for us."<sup>2</sup>

Park and Burgess acknowledge the humanitarian contribution of religion thus: "The evolution of religion has been in a humanitarian direction, and there is an intimate connection between social idealism and the higher religions. Religion in its upward evolution becomes increasingly social, until finally it comes to throw supreme emphasis upon the life of service and self-sacrifice for the sake of the group; and as the group expands religion becomes more humanitarian until the supreme object of the devotion which it inculcates must ultimately be the whole of humanity."<sup>3</sup> Todd, glimpsing the fact that however much progress in science and in knowledge the world may make, there is still the same necessity for the bonds of faith to unify all this knowledge into a related whole, says: "There will always be a place for faith and imagination to complete the circle of knowledge. That circle must be completed, but since the problem is infinite, and science, though

1. Bogandus. "Introduction to Sociology," page 286.

2. Kidd, "Social Evolution," page 265.

3. Park and Burgess, "Introduction to Science of Sociology," page 848.

mighty is limited, imagination and faith, daring and adventurous, must do it."<sup>1</sup>

Whenever we glance through books on social problems we find ourselves constantly meeting such statements as these:—"We are compelled to the admission that the essential problem of life is not material, but psychical. In a word, life needs to be religious;"<sup>2</sup> or, "If I should guess, I would say that the great need of the world, just at present, is more religion."<sup>3</sup> We might multiply such quotations endlessly, but we will add only one more, a brief extract from one of the most striking books by one of the most brilliant and influential sociologists of the day:

"We have no record of a civilization which long endured which did not have a religious setting, nor of any that endured long after this setting was dissolved.....All human history, in one sense, indeed, has been a search for a rational and social religion.... So far as we can see, the time will never come when man will not have need of religion to release fully his energies, to brace his vital feeling, and to help him face the issues of life and death with confidence in himself and in the world.....When we understand religion scientifically, we see that it is as natural to man, and almost as necessary, as sleeping, or eating, or breathing. Like language, it is not so much necessary for the life of the individual as for the life of society.....A religionless social world would be a social world of uncertainties, destitute of enthusiasm and of vision, reduced to the dead level of individual expediency. Such a civilization has never existed in the world and cannot exist."<sup>4</sup>

Such, in brief outline, is the attitude of all true students of social science. The foundations of society have always been rooted in religion, and the preservation and progress of the social order will always imperatively require that the religious heritage of the race be kept and uplifted and purified, and made to more and more fully meet the needs of men as individuals and as members of society.

It inevitably follows, then, that the whole subject of the development of the religious side of life is one that educators of the world cannot ignore without disloyalty to the duty society has placed upon them. There is a German maxim which says "What you would have appear in the life of the nation you must put into the schools." The ideals and influences which prevail in the schools of today will be the dominant note in the society of to-morrow.

1. Todd, "Theories of Social Progress," page 423.

2. Branford and Geddes, "The Coming Polity," page 242.

3. See G. Lowes Dickinson, "Religion: a Criticism and a Forecast,"

4. Ellwood, "Reconstruction of Religion," Ch. 2.

Whether an educator can proceed freely with direct efforts at the religious development of the pupils under his charge, or whether he must content himself with more indirect methods of approach, will of course depend upon the circumstances and the social customs and conditions in the midst of which he is working. Different nations of the world have developed widely different customs in the matter. In Germany there has been for many years a most elaborate and rigid system of religious instruction, probably too formal and rigid for freedom of growth and development. In Great Britain direct religious instruction is given in both government-established and subsidized schools, but the instruction is on a voluntary basis, and is on much broader and more practical lines. France and Japan have attempted courses in moral instruction along lines definitely divorced from religion, but in neither case has the result been at all satisfactory. In America education is more of a local matter, so there is a wide diversity of practice, though the general tendency throughout the country has been that in the attempt to avoid sectarian teachings in the school practically all religious instruction has been eliminated. In China the old classical education provided a most thorough system of training in a definite code of ethics, with more or less of a religious background. The new system of education under the Republic, while providing for ethical training gives little or no place to religious instruction. But whatever the practice in government-established schools, in all countries of the civilized world governments recognize and approve of privately established schools, founded and supported by individuals or groups or organizations, in which religious instruction may be freely given. The only restrictions usually placed upon such schools are that they shall maintain satisfactory educational standards and that their religious teaching shall be in accord with the best interests of society.

In the public schools of both China and America the development of the religious phase of character must be largely indirect. Yet in spite of that fact the school may still be one of the most powerful allies of religion, and may most effectively train the child in the fundamental bases on which both religion and society rest. The training that the school should give, not only through precept but through the formation of habit and inclination, in such virtues as obedience, justice, honesty, truth, courtesy, kindness, and generosity, furnishes a most requisite background for religion as well as social-mindedness.

Moreover, through the regular subject-matter of the curriculum, as well as through stories and illustrations, and discussions, the student may be stimulated to gradually and naturally develop harmonious relationships with himself, his neighbours, the universe about him, and God. The meeting in the schoolroom on a common level of students

coming from all the different strata of society does more to teach the unity of mankind than could any number of formal lessons. It is a poor teacher of chemistry, or mathematics, or physics, or biology, who does not keep service to society as the ultimate goal of all natural science. All study of history, geography, sociology, economics, and political science enforces and upholds the great religious concepts of the brotherhood of man and the social necessity of self-sacrifice for the common good. A school system that does not produce graduates who earnestly recognize that all their knowledge and skill have been given them for the betterment of the social order as well as the satisfaction of their own individual needs, is not only failing to supply the fundamental bases of true religion but is at the same time making a sorry failure of the whole educative process.

Even more direct and powerful is the influence of the personality of the teacher on his students, both in the contacts of the classroom and in the relationships that exist on the playground and the athletic field, in clubs and groups, and in individual associations of the one with the other. For, though often all unconsciously, youth little by little moulds itself in the likeness of those in whom it places its respect, confidence, and loyal affection.

All of which is extremely valuable and essential, but at some place in the life of the child this indirect influence must be supplemented by more positive and definite elements if the religious heritage of the race is to be kept and uplifted. In certain types of schools this more definite religious instruction can be provided within the regular course of study; and while this situation offers unlimited opportunities it also demands constant effort, a wide knowledge of psychology, skill and experience in the application of educational principles, sympathetic understanding of youth, and deep and earnest religious conviction, if religious instruction is to achieve the results it should. Within other types of schools the teachers must either seek the religious development of their students in ways and at times that do not conflict with the established work and procedure of the schools, or else they must be content to give their sympathy and cooperation to other organizations seeking for these ends.

But whatever be the situation that confronts the educator and whatever may be the methods that he can best adopt, this remains always his most fundamental duty and his highest privilege, to use all that he has of skill and ability and idealism in the task of giving to the generation he is leading and moulding all the inspiration to worthy character and unselfish citizenship that comes to the individual and to society through the religious heritage of the race.

Thus far religion has been spoken of in general terms, leaving room for the inclusion of any type of religion that earnestly and sincerely ministers to the individual and social needs of humanity. For the writer profoundly believes that wherever men in their lives and teachings strive, in the light of the truest knowledge they possess, to follow the will of God in applying and encouraging others to apply ideals that make for the progress and happiness of the individual and the social order, the love and blessing of an all-seeing Heavenly Father will be upon them.

Yet the true educator, approaching a study of religion from the scientific viewpoint, can do no less than to examine and evaluate with impartial mind the religious heritage, not alone of his own race and nation, but of all the great divisions of mankind throughout the world. Therefore we frankly present for the earnest and dispassionate study of the educators of China the teachings of Jesus of Nazareth as offering the only practical and permanent basis known to mankind for the organization and maintenance of an ideal social order. His teachings belong not to any age or to any race of mankind, for in His life and teachings and conception of human brotherhood, there is no distinction between classes or nationalities or races or ages in world's history. Men of all times and races have been prone to put their own interpretations on His teachings, and have unconsciously chosen their emphases in the light of the needs and convictions of their times; but you need not be bound by their explanations, you need not keep their national prejudices, you need not repeat their mistakes. Back of all these is the unchanging power and inspiration of the fundamental precepts of the relationship between God and man, and between man and his fellows, on a basis of loving, sacrificial service that recognizes the beneficent Fatherhood of God and the all-inclusive brotherhood of mankind. During the last nineteen hundred years the followers of the Teacher of Galilee have but made a beginning of the application of His teachings, and now the West calls to the East to help in the long upward struggle to realize the vision which He long ago foresaw, the creation on a religious basis of "a world-wide, ideal human society, in which justice and good-will shall be realized".<sup>1</sup>

1. Ellwood, "The Reconstruction of Religion", page 83.

## The University Upper English Club

CHEN JUI TZU

**T**HE Upper English Club in Cheeloo is different from most similar clubs in other Universities, because the members come from many different departments. The School of Arts and Science, the School of Theology, the School of Medicine, and the Pre-Medical Department, all are represented; and moreover we have both men students and women students. Everyone is much interested in the improvement of his English, and is willing to offer brain service and hand service as well as lip service, so the Club is very prosperous.

There is an executive committee of five members who plan the best methods of keeping up the attendance at the meetings every Friday evening, and who arrange the weekly programs. They use every effort to not only make the Club attractive but also to keep it full of spiritual aspiration.

Since it was felt that if the programs were simply posted as plain announcements these notices might be little read, some of the members were asked to prepare each week an attractive poster which would catch the attention of everyone belonging to the club. Their beautiful and artistic posters, placed on the bulletin boards several days before each meeting, have attracted the attention of each one passing by, and have so inspired the interest of the members that all have been regular in attendance, and at every meeting the clubroom has been well filled.

At each meeting some well-known person has been invited to give a short talk. Although such speeches have been brief, they have given us new knowledge and inspiration, or have aroused our curiosity and attention, and all in all have given us a most valuable stimulus for developing our spoken English and our ability to listen carefully. Then there have usually been one or two stories, and sometimes jokes, told by different members, which have been greatly enjoyed by everyone. Through practice in telling stories in English we have gained ability to speak English correctly and confidently. Accompanying every meeting there has also been singing, either by members of the University or by well-known musicians of the city. These musical numbers have helped us to appreciate this form of art, have made the meetings more enjoyable, and have given us an acquaintance with men and women of high intelligence and refinement. At the end of each meeting there have been games which have brought us all into action and helped us develop social tendencies both in competition and in cooperation with others.

Thus the English Club has not only helped us with our use and understanding of English, but has also brought together provided recreation, and given us a better mutual acquaintance, and understanding.

Note:—For picture of executive committee of the English Club, see facing page 14, Chinese section—Ed.

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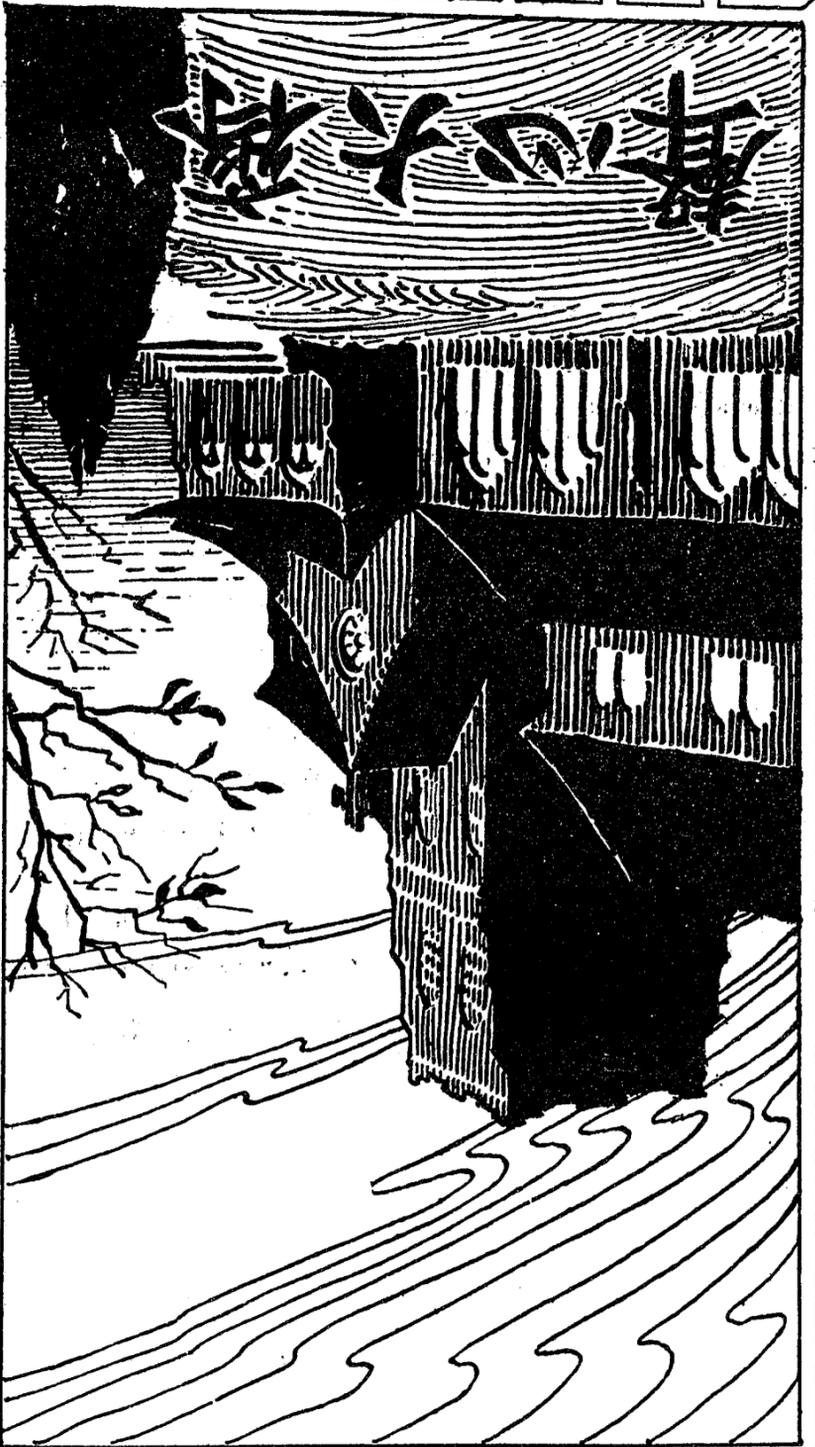
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**遊記**

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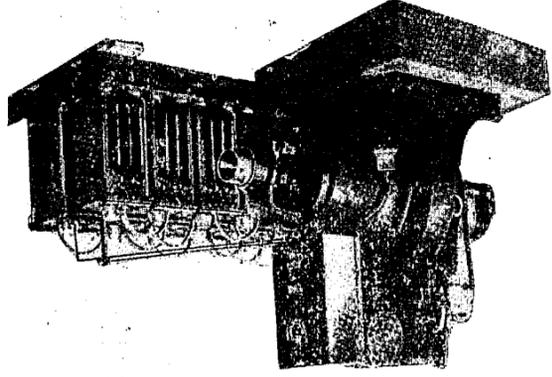
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研究之料原及法方紙製東山



山東製紙方法及原料之研究

張明

本館東省各區製紙之方法多藉友入張炳河張敬誠

張明諸先生之助。特此誌謝。

一、山東紙之概況

紙流行於我國。由來久矣。古者創竹為簡。甚為不便。後漢和帝時。製紙之法。即出。後漢書云。官傳云。古時書簡多編。以竹簡。其用。尚。者。謂之。紙。而。體。重。不。便。於。用。蔡。倫。為。和。帝。時。尚。書。令。乃。用。樹。皮。麻。頭。破。布。而。織。之。以。為。紙。……自是紙出。天下咸稱「蔡侯紙」。……又記云。古者以練帛依書之。大小長短。隨事裁之。曰「紙」。故紙從「系」。……資者。無之。或用。蒲。草。書。則。路。溫。每。蒲。是。也。至。後。漢。和。帝。時。中。常。侍。蔡。倫。與。布。機。鈔。作。紙。故。紙。從「巾」。……斯。時。之。紙。專。供。文。人。揮。洒。之。需。工。多。而。價。昂。故。多。視。為。珍。品。未。能。普。及。至。唐。宋。時。紙。之。需。工。多。而。價。昂。故。多。視。為。珍。品。未。能。普。及。至。唐。宋。時。

Table with columns for paper types (宣紙, 玻璃紙, 吃墨紙, 綢紋紙, 水紋紙) and their origins (江蘇, 浙江, 安徽, etc.).

製紙公司成立。東省紙業。始行稍振焉。……較舊。亦未見有優者。良。因。其。因。二。一。舊。法。製。紙。多。以。竹。葉。為。原。料。……

家

本館家書

王段 江慶 朱慶 江慶 朱慶

社會問題 中華大字典 正字通 說文解字

所謂兩個先決之問題者。即在業已解決。業已解決。業已解決。業已解決。

理之論。實屬於讀者諸君也。

將來時。光。尚。與。吾。人。以。研。究。之。機。會。或。許。能。以。更。精。詳。更。合。義。也。……

家者一。族。同。聚。一。屋。中。之。謂。也。……此。篇。保。留。版。權。禁。止。轉。載。……





究研之料原及法方紙製東山

塊中則成所欲要之大小於是理之成刀裁刀成打即可  
 令其過第二乾燥機即紙全行乾燥之紙再入膠  
 上來之熱蒸汽使之乾乾有時恐紙含水過多易燥故更  
 行膠輪輸出水分則紙即成再前行膠輪第一乾燥機有前  
 抽機抽出膠狀紙料使之順下流於製紙之機內網中前  
 顏料後再加明膠以救脫膠之弊膠料加入膠輪之後  
 顏料過造紙網而脫落故常加入工製之易洗膠之  
 亦加入膠漿於膠(脂)所欲用之類料并用膠。……有時所加  
 轉動之速度應與膠。……有調。……與膠輪大小之利鈍池之  
 種所應需之料搗粉時與膠輪成爲膠狀成爲膠製某  
 大搗粉機常旋動不息使原料之纖維成爲膠狀成爲膠製某  
 中再加搗粉機搗之於是抽吸機抽於較高之池中池中有  
 7. 成紙一漂白之類狀原料由池底之管流於地下之池  
 無臭味而止。

發售於膠卷。

8. 產量及種類——

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B. 種類——該公司之紙多屬定製故其甚殊異計其要者  
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- 藍色連史紙 黃色連史紙 財源連史紙 財源連史紙
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(註) 美列各產地及其產地由南上市之紙源  
 註(一) 美列各產地及其產地由南上市之紙源  
 註(二) 美列各產地及其產地由南上市之紙源  
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(註) 美列各產地及其產地由南上市之紙源

究研之料原及法方紙製東山

出之紙不易吸膠供印刷之需。……故該公司所製之紙，製  
 亦多如僅餘少數劣劣與脂起作用成不膠之洗膠，使  
 之纖維之硬性加強，則製出之紙，實則用石灰之製  
 者，因石灰(一)價廉易購。(二)能除掉多量之雜料  
 其微生菌。該公司所以用石灰而不使用苛性蘇打及蘇打  
 小爲準，均計之約蒸十小時，使原料之除色，并洗膠  
 亂原爲宜。後以熱蒸汽蒸，并旋轉之所需時，以蒸膠  
 鍋內加入石灰之量約百分之十左右，使原料之除色，并  
 蒸所用之機，爲歐洲式之圓形，將已割之原料移於  
 色膠漿……(b)使原料之纖維，硬便於洗膠。……蒸  
 4. 蒸一蒸之目的(二)除去原料之油渣。……蒸上  
 特別注意，于扣鈕并夾帶之金類物。……  
 3. 切一類之注，不依顏色而按品質分爲棉布、毛織、三類。宜  
 上其分類之注，不依顏色而按品質分爲棉布、毛織、三類。宜

10. 許之苛性蘇打及蘇打灰爲善。  
 5. 洗膠——移蒸之原料於攪拌池中，使水流不過攪拌  
 機，亦旋轉，機輪有利，轉動則使原料碎，且去盡膠  
 垢及脂膠。……所用之時間，因攪拌池之容量、機輪之重量、每  
 分鐘轉動之次數、機輪之利鈍、水之多寡及性質及原料  
 之性質而異。  
 6. 漂白——經洗膠之原料移於大池中，加攪使之成糊狀。  
 此時由筒中自上噴白粉於池中，同時常用攪動之令  
 其均。白粉不可過重，亦可過輕，則損傷原料，膠則不  
 發生效力。大抵以百分之八左右爲適宜。漂白粉所含之鹼之  
 多寡亦關係甚鉅，至少含有百分之三十以上。應用之度，不  
 可高或低於華氏表三十二度或法倫表九十九度。池旁有槽，約  
 十二至二十四小時，將所餘之漂白粉取出，再以清水洗之，



靈巖寺遊記

古木仰首山光掩映。水清得這樣的一個境地。纔可說那的船了。風過處，綠波萬頃。波瀾日間，威嚴肅肅。長林中的船，桅下綠波，那那約約攢攢，約約攢攢，古剎宮殿，就是高株，我生以來所創見。綠叢裏，塔高塔高，成了碧海。西口，見峻嶺四面包圍中，巒巒疊疊，蒼柏樹，不知幾千里。形勢，山形似臥龍，自北折東，而西，抱成「塔」環，周六十，羣龍無首，一團圓散沙。

總方丈，一也不過有名。自前年總方丈死後，至今別入，大陪小，四陪百，同平常莊村住戶，不兩分。同入家子孫，傳的一樣。時人說，百則只有四十分。方的僧人，都可以來任。現方丈，改爲子孫制度，徒相傳授。如以前的住持僧人，是「十方」他們的稱謂（謂「意思是無論何處，從元明出的名僧，很多，經歷興衰，如今是衰殘不堪的。」）

第一神聖

「神聖」中西人名遊的甚多，多半爲看羅漢尤以日表「意」據「聖題碑」說，宋朝的羅漢，是「海內羅漢」四時新。羅漢四十四尊，在千佛殿內，殿內，都是坐像，都是代其餘的。就是些僧舍，也倒院宇，懸一天淨花木修齊。有天王殿，五花殿，大佛殿，月殿，白殿，支塔，猶巍然立。建大，都額所，除者，一片瓦，礙今存者，梅在前，清初年所建。殿宇，參差，下山望，好像鳳凰展翅飛的樣子。前朝是個人，也不能強馬飲水。『就是這種意思了。』

記命，何曾甘心修道？『文藝』說：『一個入能牽馬入水，但極生，是很不自然的。這些僧人，不過爲飢寒所迫，藉撞鐘以懺悔，片婦女，自尋，可見，憐憫，不忍，身作到的，獨，真性，何難，成仙，快極了。不想他，倒是不學無術，酒肉，是別有天地呢！那些僧侶們，在這應一個脫離紅塵的世界，

靈巖寺遊記

給讀者一個對於靈巖的概念罷了。

到，難切，很難，這不過將那日記本上擇幾件寫下來，本報轉先生的督促，自然是不想作的。因爲觀察不周，只因時日太少，未克流連，連興，引爲遺憾。作這幾遊記，是受了這鄰近，必須去看一看。今年清明，天技巧，目的，達到，界上，不可多得的美術作品，學上，很重要的價值。我們世會去一次。（聽得許多，人說：靈巖，有名，的羅漢，塑像，是過泰山以後，就時時刻刻不忘。靈巖，下靈巖，總想着，合，互的，機然，遊了泰山，也等於沒遊過。」的。所以自從去年清明去過，山，景，一個，清幽的，所，在，遊，泰，山，的，必，須，也，到，靈，巖，去。我們遊靈巖寺，有兩種動機：（一）常聽見遊客們說：「靈巖，是



靈巖寺遊記

第三卷

又改名皇帝的錫號（景）寺。那五花殿，千佛殿，都是彼時建隋及唐，殿宇，齊整，日新，月異。到了宋朝，太平興國，景德，景德，間，元，年，梵僧，定，禪，師，始，建，道，場，爲『中土四絕之』。『正石，有靈的，意思。這不過，形，容，說，法，僧，說，力，之，到，後，魏，崇善，寺，通，叫，他，殿，寺，是，因，而，名。相，傳，東，晉，時，候，僧，朗，降，沿，山，靈巖，山，古，方，山，是，像，形，而，名，的，也。叫，玉，符，山，寺，名。二，山，在，清，晴，日，拿，鏡，去，望，遠，去，那，就，更，清，更，明，了。山，靈，山，是，能，彼，此，相望，的，這，山，頂，可，以，望，到，其，餘，的，山，的，車，站，是，萬，德，靈，巖，尚，有，十，餘，里，步，行，一，小，時，可，達，與，隆，津，浦，車，自，濟，南，去，三，等，車，價，銀，七，角，自，泰，安，去，車，價，銀，三，角，下，山，離，濟，南，省，城，有，一，百，一，十，一，里，大，道，可，通，步，行，一，日，可，達。若，隆，餘，里，圍，繞，起，伏，東，南，接，連，泰，山，東，北，接，連，濟，南，的，千，佛，山，與，隆，位，置，靈巖，是，泰，山，西，北，麓，的，一，處，地，馬，長，帶，離，泰，山，三，十，











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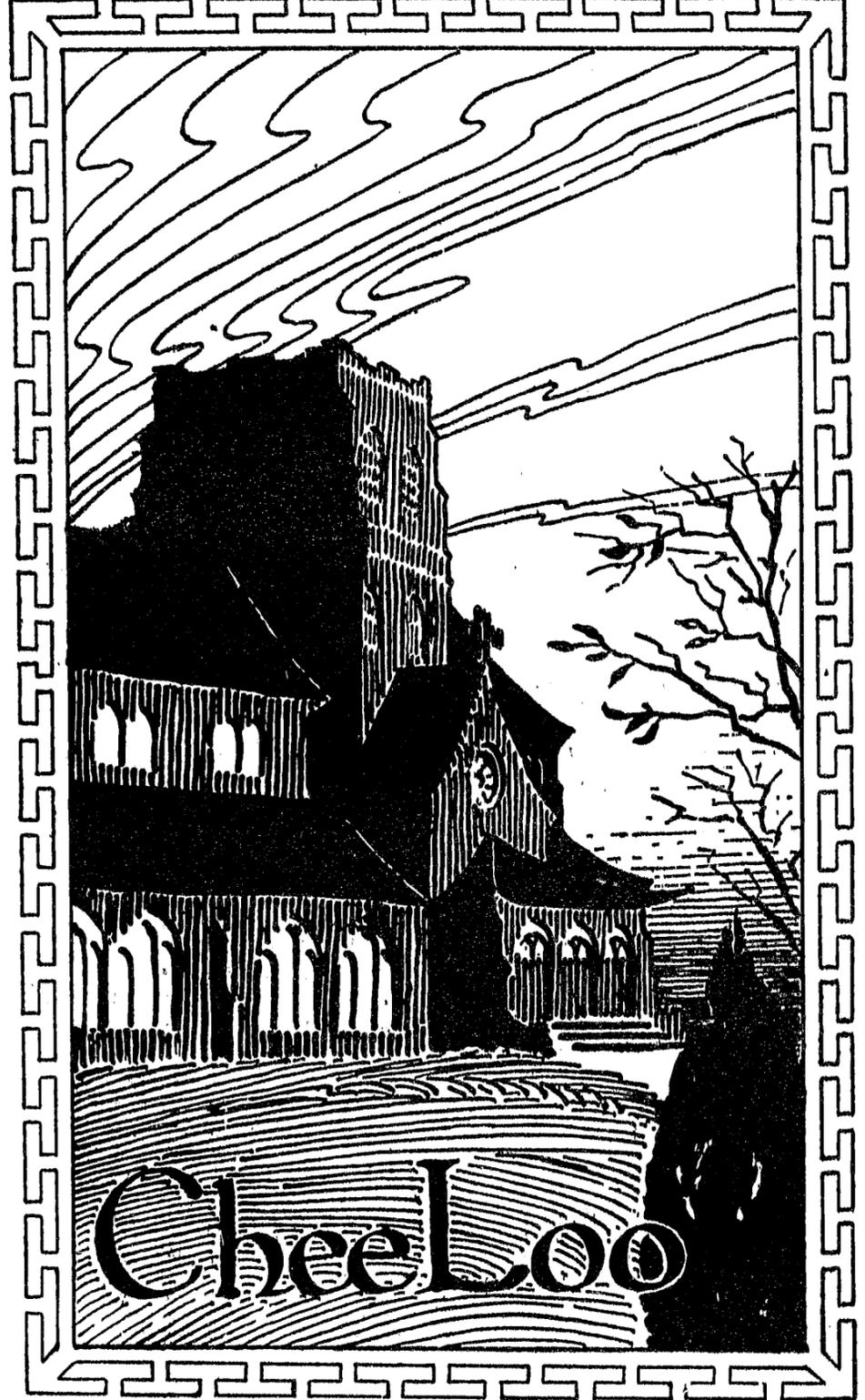
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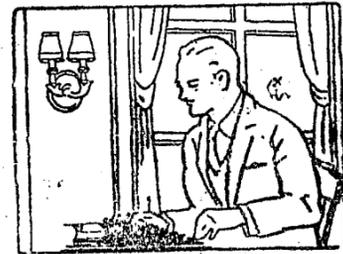
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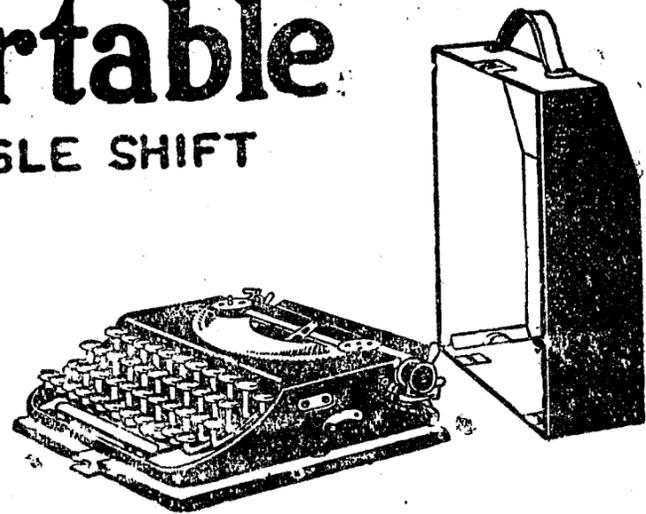
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# CHEELOO

The Quarterly Magazine of  
Shantung Christian University

VOL. II

SEPTEMBER, 1925.

NO. 3.

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是書爲林亨理先生編以俄珥 O.H.S. 氏聖經百科全書爲底本並參以戴威士氏 David 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冊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

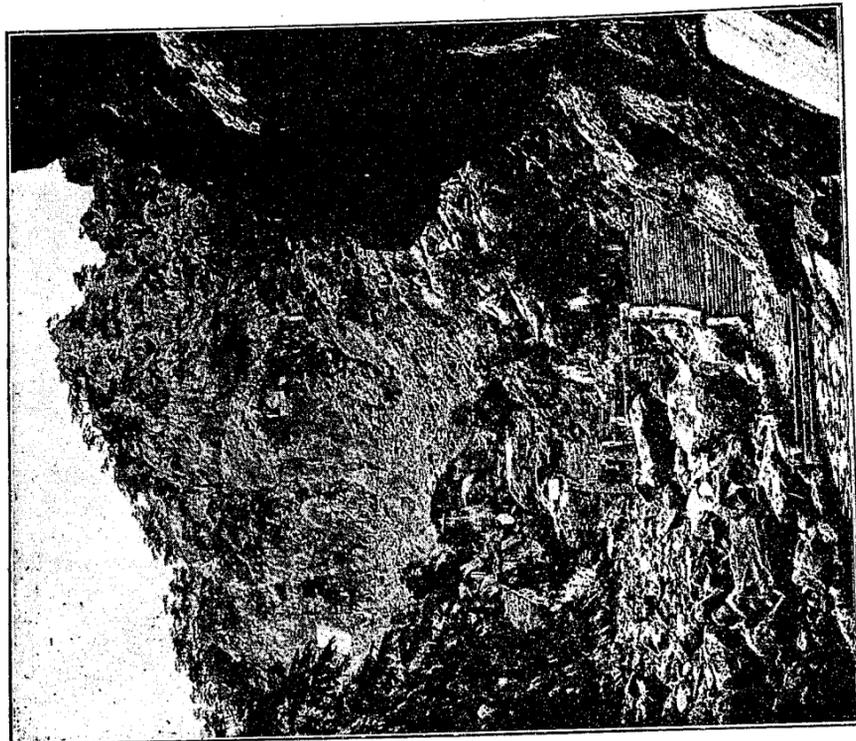
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VOL. II

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No. 3

## WITH THE EDITORS

### Unity in Diversity.

**O**UR 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

**T**HE 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 way—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

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ABOUT TEACHERS

5.

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 persuasive-ness 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 revered.

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

**T**HIS 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，此冊既非課本，亦非實驗手冊；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冊，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，是冊得供諸頗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。

此冊擬議之實驗課程，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尚不知其名辭然。

未建議所用之課本，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，作為參攷，或作為課本，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為有益。伊之任務為置「生氣」於是冊枯骨之上。

儀器表所建議者，為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，即能作好。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為至極單簡者。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。為不升學者計，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。意以此為一年課程分配略如下：(分與實驗之時間為最小之限度)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。* 竊意學生自備二記簿，任何種類皆可，惟須各生所用者式樣相同。一為實驗室內作實驗時記錄一切觀察所得，雖非為作終結回報；但亦須至極整潔，此為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。至好用鋼筆陰寫，如用毛筆亦可，但如畫圖須規矩方圓者，則鋼筆尚焉。

*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。* 學員自起始即須認明此功課為物理而非算學，一切計算數碼，須依據實在計量數量。教員一見即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。割棄無用之小數，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,

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

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4.85與6.78須乘之以得實驗之結果。吾有。

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

此第一位小數即為不甚可靠者，故無由存留其以後者，而結果自然為32.9。此為準對結果，如錄32.8830則為十分錯誤，而其算學亦為錯誤矣。

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。作者亦不以為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冊中,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,即必具有恆比數,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。

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冊中，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，即必具有恆比數，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 192 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。兩支須要板底有攔板，兩支勿須。先於壁上安插大木樑，後將壁板用螺絲牢結於樑上，壁板下端幾與實驗桌同高。此等壁板可用以懸掛擺，簧平，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 balance 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厘米長5厘米徑。

木平行立方體約10厘米長8厘米寬，4厘米厚。

實驗室木塊為支舉實驗儀器之用，各式俱備，最有用者，為10厘米長10厘米寬5厘米厚。

半打小圖畫板，約40厘米長40厘米寬。

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;然而教員不可以此為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衡觀察之點之線上,觀察其鏡中之像便妥.

雖視差法能引出如此之煩瑣差誤,然往往甚為有用,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,以其確為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,

參攷於敘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.....
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
<i>Apparatus Made Locally According to Working Drawings Shown</i>	
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，實即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，因為我們所觀察的乃是指針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，長的單位是厘，即巴黎城中所藏的標準長度尺的百分之

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 parallax 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。研究方糎與立方糎，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:* 糎桿。

*方法:* 將糎桿任一點準對桌之一邊，安定糎桿之一邊於桌上，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。注意此兩點不必且也不必是糎桿端點。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， 示度糎數、長度。	第二計量， 示度糎數、長度。	第三計量， 示度糎數、長度。
0.56 96.43	95.87	
1.42 98.75	97.33	
1.02 10.65	9.63	

共合 202.83 .....  
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，糎桿。

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, 但木塊之邊較稜桿尚短, 所以只須對好稜桿於塊邊, 觀察兩端對河分度便妥, 重作此試, 每邊三次, 每次更換木塊對稜桿分度之部位。為何? 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, 在二端彼此恰相掩壓之處, 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。

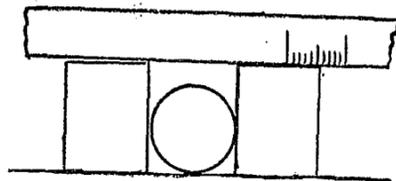


Figure No. 1 第一圖

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, 即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个計量, 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——立方呎一物質的引力, 叫作物體的密度。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呎有若干克的密度。

*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,

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

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.

If 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:

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

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.		
Density = .....	weight		
	11.99 × 4.62 × 7.15 = 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		
密度 .....	重		
	11.99 × 4.62 × 7.15 = .....克/立厘		

**實驗二•**

**目的:** 求石灰石的密度.

**儀器:** 標模石灰石,(無定形)簧平,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,將石懸於原用之平簧稱之;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?

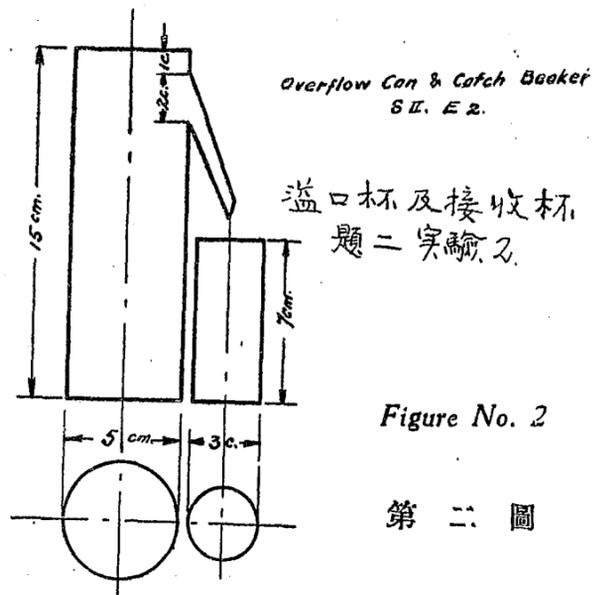


Figure No. 2

第二圖

記錄:

石在空氣內重.....克  
 石在水內重.....克  
 失重.....克  
 小玻璃杯內水(自溢口杯溢出)重.....克  
 自溢口杯實驗  
 得石之體積.....立厘

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.何為阿基米的公理?

From data calculate the density. What is your percentage 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 percentage 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/立厘,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,簧平.

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).....立厘  
 瓶火酒共重.....克  
 所以火酒密度..... 克/立厘  
 火酒平均密度為 0.80 克/立厘

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,為何?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,此物如為靜體,必要啓動;如為動體,必要停止,如所施總力反對他的運動.

類此一舟子以恆速度推舟溯運河行,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

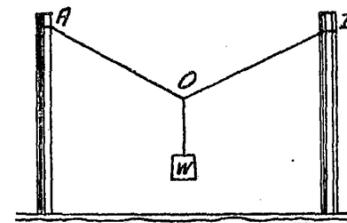


Figure No. 3 第三圖

### 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,名此向力為負,與此向力相反的為正,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,方向為 $OA, OB, OW$ .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:* 稜桿,彈簧平四,釘子,線.

*方法:* 安置三彈簧平與稜如圖所示,較準線長直到他們正與稜作

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.

題三實驗

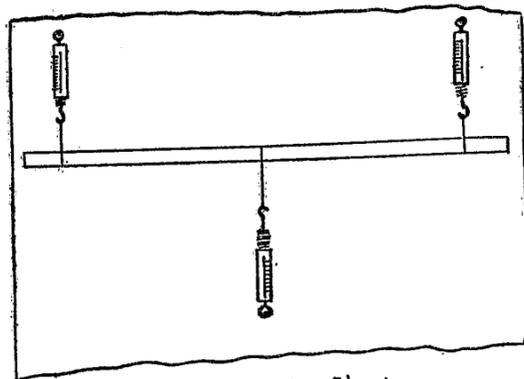


Figure No. 4

第四圖

加平行諸力

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 readings 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: 帶木槓之方木板, 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, 規定若干厘米代表若干克數, 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.

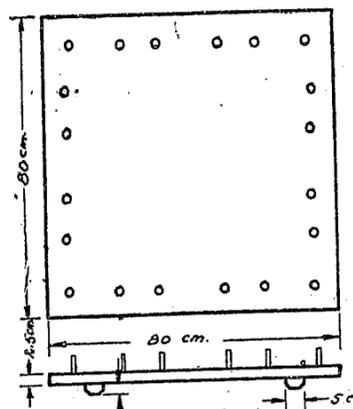
Draw the two forces OD and DA, parallel to and perpendicular to OB respectively, also draw the two forces OE and EC parallel to and perpendicular to OB. Add the forces OD and OE. These can be added algebraically since they are parallel. How do they compare with OF or OB? What is the sum of the forces 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, 按規定厘米克數二者互抵之數, 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?

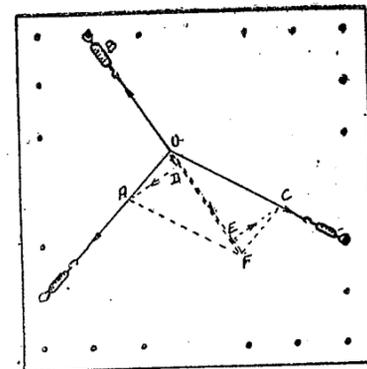
從此結果可以看出來, 我們可以用OD與DA二力代表OA力, 也可

題三實驗之



Board with Pegs  
30 cm.  
5 cm.  
帶槓之木板  
題三實驗之  
需二紙

Figure No. 5 第五圖



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 AB. With OA and EC two forces represent OC force, in every fact, these two small forces are named OA and OC, direction with OB or parallel or perpendicular.

If we wish to add forces at a point which are not parallel, the most important is to first determine their components in two directions, then add them algebraically, using different forces at different points, repeat this experiment.

**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, 一尺長之木桿, 法碼,

*方法:* 將起重機安置如圖, 記錄彈簧平之示度與重W。將彈簧平擊於A, 向外牽AB, 以至B端離壁, 記彈簧平之示度, 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, 以三長為邊於紙上作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.

其長為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。此為有用之結果, 須記之, 但尤須記其如何得到如此之結果。

第七圖

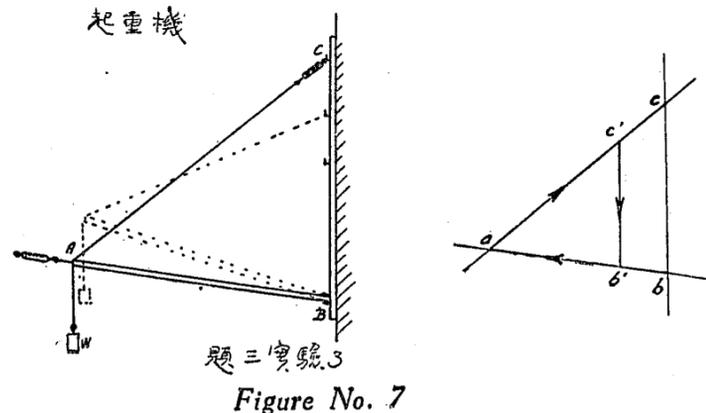


Figure No. 7

第八圖

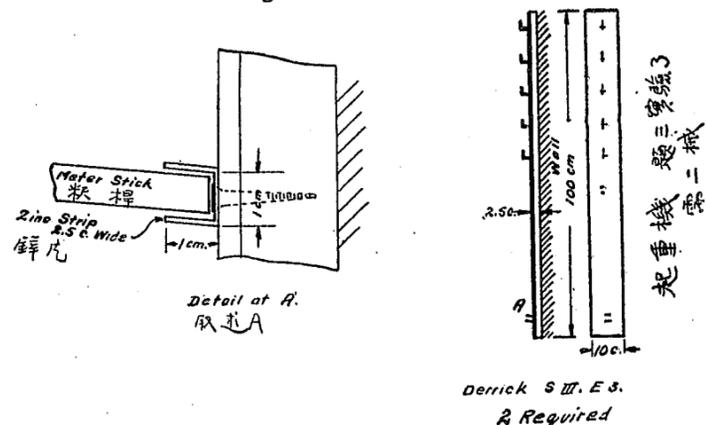


Figure No. 8

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 scale 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。

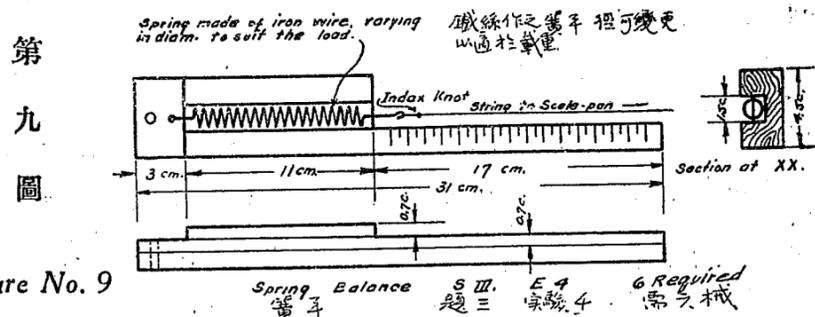
**手續：**懸簧平於壁板上如圖，移去度分盤，置於天平盤上，加彈丸於盤上，以至彈丸與盤共重十克。再放盤及彈丸於簧平上，用線上B結作表號讀分度，此即十克重所抵分度，按每次十克加重至百克，每次記對B結之度分份數。

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.



#### 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。

注意此曲線為直線。即伸長與引伸力為正比例。

#### 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 rickshaw, 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°.

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為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.

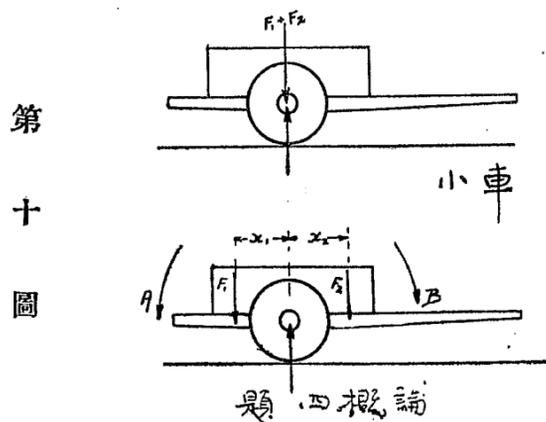


Figure No. 10

第十圖

In the illustration of the cart, the moments are  $F_1x_1$ ,  $F_2x_2$  and  $F_0x_0$ . 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 algebraically all the three moments about the axle of the cart, and they will appear as follows,

$$\text{moments in one direction} = \text{moments in the other direction}$$

$$F_2x_2 + F_0x_0 = F_1x_1$$

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,若是以此力為正,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:

$$\text{此向轉矩} = \text{彼向轉矩}$$

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

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:* 秤桿, 鋒刃與支架, 天平法碼,

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



*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.

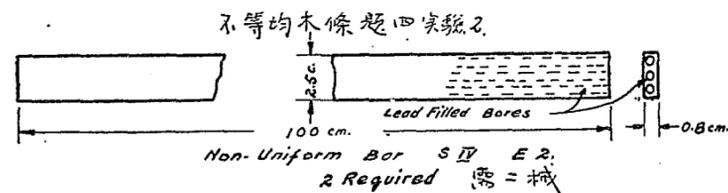


Figure No. 12 第十二圖

**方法:** 支起木棒中點，兩端各懸法碼以至於平衡，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.

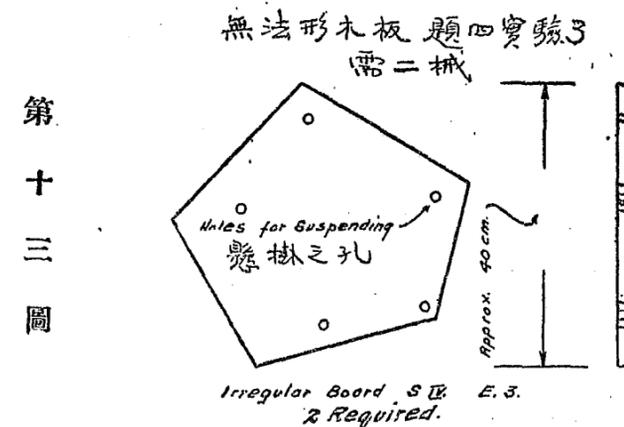


Figure No. 13

**儀器:** 平面木板，或金類板，垂線球，鐵釘。

**方法:** 懸平面木板於木槓上，又懸垂線球於同一木槓上，既至平面穩定。木槓上牽之力與地球下引之力相平衡。則下引之力必通過木槓，否則木板必轉動。力不但須通過木槓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。為何？

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:** 槓桿有針孔在中心點與50厘米度分處, 與小木釘在每十分之一厘米之點。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厘米長之微管套於針上, (見圖) 以此作軸, 按槓桿於上, 此槓桿即成槓桿, 以針為支點, 能旋轉於水平面內。穩定槓桿近與槓桿平行, 順其下邊用尖鉛筆畫線; 並與20厘米與80厘米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厘米小孔, 引伸之, 保持槓桿與原畫之線平行, 以至簧平指針約指其度分之半, 看簧平度分邊和線與所畫槓桿垂線相合時。釘簧平於此地位。如此較正第二簧平, 勾於80厘米點小孔, 以至槓桿與原來位置平行。(即下端順原畫之線)

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

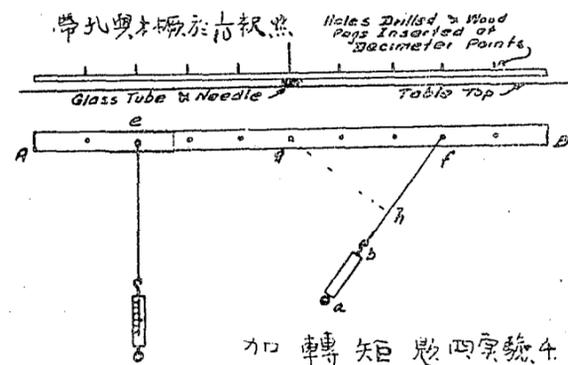


Figure No. 14

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槓桿切簧平之點, 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, 即支點與施於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	

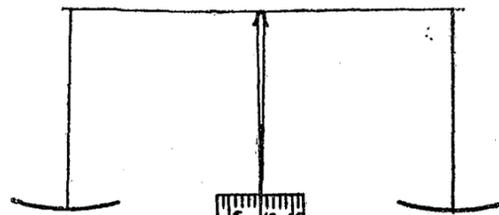


Figure No. 15 第十五圖

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。轉扭下備槓桿, 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	14.2
6.2	

是顯然止點為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, i.e. 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, 如所加法碼為30.5克, 再求此時之恰切止點, 如為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, 如為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為正使指針過往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0.06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。為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。如所加法碼為56.3克, 止點為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2.5度分。所以我們必須加法碼  $0.1 \times \frac{2.5}{3.7}$  即0.07克, 確對重量必為

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)



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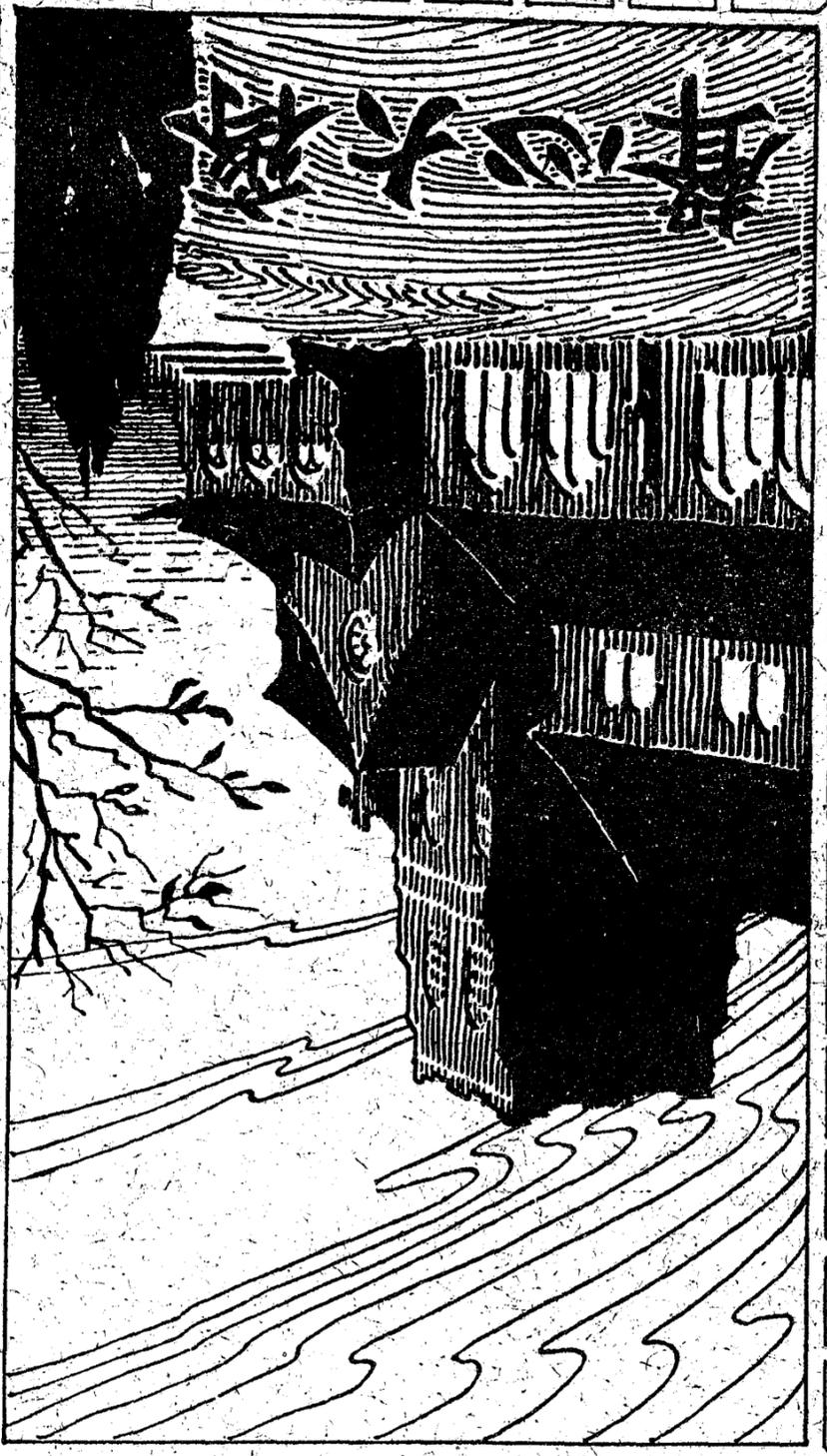
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etc.

### WASHING AND LAUNDRY

Easy and hard ways

Soaps and powders, etc.

### CLEANING

Long vs. short handed

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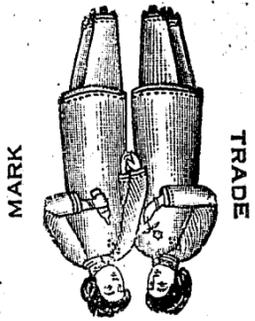
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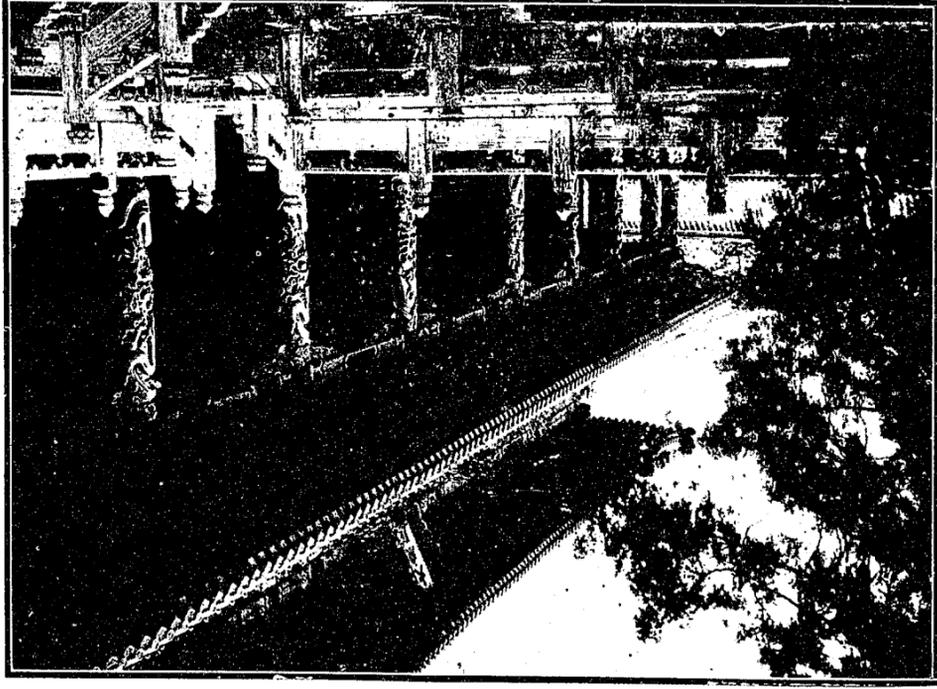
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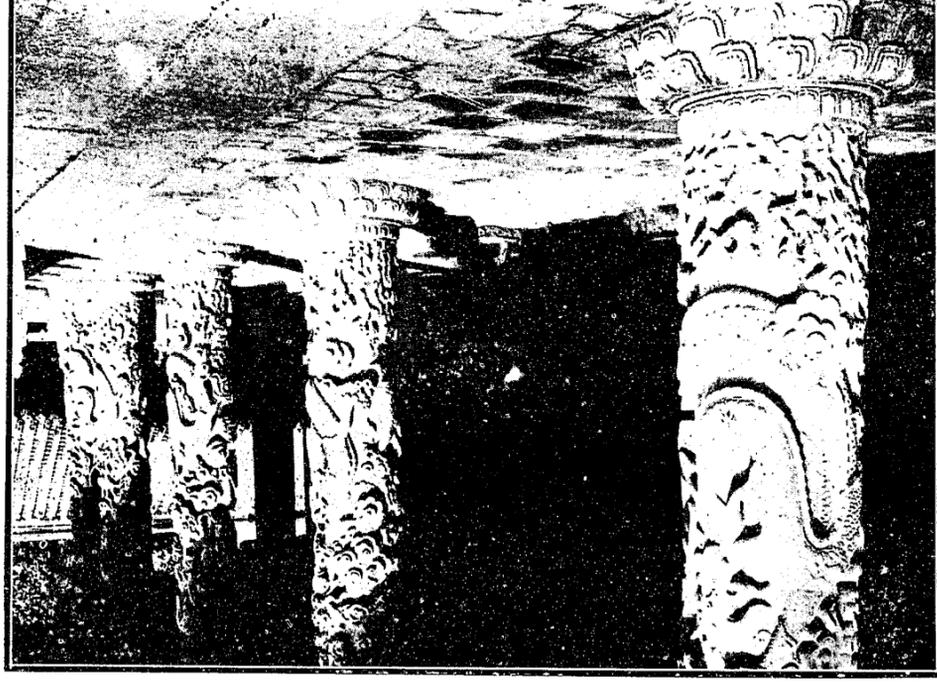








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## 開篇語

限量吾人已抵日待之矣。各校會其勉旃！  
幸也。將來校會事業之進步，一日千里，正未可  
開成。而結果亦屬圓滿。此吾人所不能不引為慶  
但青年校會事業，業經今討論大會已如期  
孰！  
意亦至良。乃今因受時局影響，不克如願，可惜  
可提倡體育，又能作友誼上交歡之機會，法至善  
之日，召集會各中學，在濟開一聯合運動會。既  
齊大自巴慕德長校以來，例於雙十節國慶









濟南之交通與山東境內他大城相較可稱最爲便利城北即

皮山水環繞之勢。

登王國山、佛山大、佛山、馬鞍山在坡之南山水相接以構  
濟南之四、周、非、山、水、華、山、及小清河與黃河在城北

南

公、司、及、各、國、領、事、署、皆、在、焉。  
地、及、地、參、其、間、城、西、城、蓋、山、東、商、務、之、中、心、大、工、場、  
東、西、南、三、關、亦、有、城、環、繞、內、多、宅、及、小、商、店、亦、有、千、空、  
央、爲、府、所、在、北、部、有、大、湖、積、約、抵、本、城、面、積、四、分、之、一、  
一、部、本、城、環、以、壯、嚴、之、城、牆、略、作、正、方、形、面、積、約、九、里、中、  
自、一、部、東、關、西、關、合、成、一、部、城、西、之、商、埠、又、自、城、  
較、北、望、可、見、南、三、大、部、份、構、成、東、北、部、爲、濟、南、本、城、  
濟、南、城、全、市、西、北、南、平、均、約、四、里、南、北、平、均、約、四、里、或、馬、  
較、高、七、度、濟、南、每、年、最、冷、最、熱、之、時、期、僅、足、兩、星、期、之、  
年、均、溫、度、爲、法、倫、表、五、七、七、度、較、北、京、之、平、均、溫、度、高、四、度、

濟

載貨小車 一百四十四輛

洋車 九百三十三輛

步行者 一千零八十八人

量於下：

寬度約自十五至二十五英尺之譜。茲列其每小時之運輸數  
他小街道無論單軌或自城內通達商埠之西門大街而論其  
濟南街道除商埠外，多不完善，且過窄，故難免擁擠之患。其

發。

三年後當能告竣也。其他郵電各政，濟南與他大城略同，茲不  
運輸皆藉馬達。山東西部者有汽車道，近今尙在建設中。  
外，直達山東之東北部者，則有小清河。凡米鹽菓草及肥料之  
十萬四千噸。運出之貨物，凡四十四萬六千噸。除兩鐵道之  
以達青島。計民國十三年全年兩鐵道載入濟南之貨物，凡四  
津浦、膠濟兩鐵道之交接點。北京、天津、濟南、滬杭、東、膠、濟、鐵、道、

### 形勢及地理

濟南

春季多風，乾旱，秋季多雨。全年雨量約在二十英寸以上。全  
百一十七度五分。北去三百里，海約四百四十里。  
濟南適當山東西部之中央，北緯三十六度四十分，東經一

濟南

府。稱濟南府。金元之改，屬濟南府。明、清復爲府。至民國改稱  
悼。惠王爲濟南王。晉改爲郡。齊郡。東郡。爲州。宋改州爲  
稱。歷下。屬齊。秦漢爲郡。而歷下乃屬齊郡。漢建濟南封。齊  
濟南。城之歷代沿革，述之於下。唐虞夏三代屬兗州。青州。周  
間。始於平。陵。移治於現在之濟南。

於此。濟南國之都。城曰東平。或曰。即今之龍山。晉永嘉  
南。蓋小清河又名濟水。濟水。濟南。者。言其在濟水之南也。濟之名  
其郡。當即今日之歷城縣。晉。謂之東七十五里。有小國曰。濟。  
諸志。所載。於馬王時代。現在現代的濟南城附近。有小國曰。濟。

### 歷史

南

濟

請。直接。接。國。達。濟。南。濟。南。大。學。社。會。學。系。可。也。  
「特誌於此以表謝忱。閱者對於篇內記載如有疑問，  
之。報告。及。濟。南。大。學。社。會。學。系。所。著。之。濟。南。社。會。學。一  
本。篇。料。半。根。據。濟。南。大。學。社。會。學。系。所。著。之。濟。南。社。會。學。一

九月一日起。會期以二月為限。若遇特別事故。得延長之。省長一人。副會長二人。由全體議員互選之。每年開會一次。自各議員由全省人民間接法選出。任期三年。省議會置議員二十五日。參議院決定山東省議會議員額數為一百三十二人。於此。民國成立。遂改議政局為省議會。按民國元年九月二日。預備立憲。上諭各省設議政局。以為挾納輿論之機關。遂即設省議會。依次略述其大概於下。

政府

齊南為山東全省之都會。所有政治機關。與他省都會大。致相。茲依次略述其大概於下。

省長公署。在小布政司街。舊籌備內。依民國三年五月公布。齊南所駐軍隊。常駐之師一旅。外實數。確難調查。茲不錄。軍法四課。各課課長一人。課員數人。

南

方里之密度。則為一萬六千有奇。較之北京尤大。北京每方里。密度約一萬一千。而齊南每方里。密度約一萬三千。略在三十萬以上。以每方里之密度而論。齊南之內。人口略在三十萬。齊南人口為二十萬三千。若加軍人在。據國十三年調查。齊南人口為二十萬三千。若加軍人在。此。尚有汽車。馬車。及轎子之通。但為數寥寥。無庸計較。此外。尚有汽車。馬車。及轎子之通。但為數寥寥。無庸計較。此外。尚有汽車。馬車。及轎子之通。但為數寥寥。無庸計較。

人口

不但齊南。北京。二城。為我國最大。城。亦無不如是。蓋我國。每百人中。男六十三。女三十七。南每百人中。男六十四。女三十六。接性別而論。齊南之情況。與北京相似。蓋男多於女。也。北京每。警商樂。

Table with 2 columns: Nationality (外國人, 意國人, 法國人, 俄國人, 德國人, 美國人, 日本) and Count (九, 十一, 二十二, 五十八, 六十五, 七十五, 一千六百七十八).

按民族而論。回。族。一萬二千八百人。外。其餘。總。完。全。為。漢。人。外。國。人。所。佔。數。目。極。少。據。十。三。年。調。查。一。千。六。百。七。十。八。人。

啓 公 友 校

啓 照 無 誤

友 欲 索 閱 者 希 將 地 址 來 函 通 知

友 二 百 餘 份 現 尚 餘 十 若 校

友 大 學 圖 說 冊 若 千 本 已 分 寄

諸 位 友 友 鈞 鑒 本 校 宣 傳 部 印 有

齊魯大學啓

署內分四科即總務民政財政及司法是也

(未完)

歷城縣公署在本城之中心縣長韓屬道尹統治一縣事務

業屬濟南道者凡二十七縣

署內分二科第一科掌總內務財政第二科掌司法教育

其權限與省長略同惟所轄之區域較小耳

濟南道公署在貢院牆道尹學省長之指揮掌管全道事

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入年始設專署署長由中央外交部特派承外交總長之命

交涉署從前山東外交事宜係由濟南道尹兼任迨至民國

切市政均歸市政廳內分總工程收支三科

政公所呈報中央合組今日政廳自設組後城關商埠一

見發達城內與商埠必須連絡一氣於是遂將商埠總局及市

南

濟

城關馬路始置市政公所民國九年一月四日濟南商務日

開辦即設商埠總局專管商埠發展事宜民國三年六月修築

市政廳在商埠膠濟車站西濟南自清光緒三十年商埠

清道六隊輔助之

總務科行政科司法科衛生科保安游緝偵緝馬備消防

任命省長之指揮監督管理警察事務廳長以下四科即

九日總司令設廳長一人由省長陳陳內務部薦請大總統

警察廳在府門本廳之設立依據民國三年八月二十二

務分民刑事三種高等檢察廳檢察長一人檢察官二

地方審判廳置廳長一人總理全廳事務高等審判廳所理事

審判廳地方審判廳高等審判廳及檢察廳均在普利門外

所皆為該廳之附屬機關

本城之礦業專門工業試驗所農林試驗場森林局商品陳列

漁牧工商各項第三科掌礦務

委任與他廳同內部分三科第一科掌總第二科掌農林

實業廳在新東門內該廳於民國八年九月一日成立職員

總務權制用三科每科置科長一人

財政廳在大明湖岸掌理全省財政出入一切事宜內分

科置科長一人

部廳長一人執行全省教育行政事務廳長以下共三分科每

教育廳在新東門內該廳係民國六年設置北京教育

實業科

教育科

內務科

總務科

省長

秘書處

圖下

省長稱雖異其內部分之組織則同也省長公署組織大略如

之為制各省之民政長官稱巡按使民國五年六月又改為

南

濟

















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## 河南教會學校停課

河南省各教會學校因受時局影響，停止上課。吾校友在該  
 省各校授課者亦因停課之故，多生辭職，且賦閒矣。

## 畢業生姓名錄(續)

姓名	籍貫	通信處
徐道興	濰縣	濰光侯鎮濟生藥房
宋學鵬	濰縣	已故
蕭雲鵬	安邱	黃縣崇實學校
秦錫範	濰光	濟南三馬路進德中學
羅東都	樂安	膠州瑞華女校
周德昌	濰縣	青州博物室
趙鵬慶	濰光	濰縣北神學
趙華堂	益都	已故
張懷道	益都	青州守善中學
張景和	昌樂	青州鄭母轉家河
張泰德	濰縣	濟南東關濟美中學

姓名錄

## 一九四一年文理科畢業者

姓名	籍貫	通信處
王守愛	濰川	周村教會
張惠亭	濰縣	山西汾州欽賢學校
徐道昌	益都	新城教室
王修理	濰縣	台莊縣教室
衣興林	濟南	濟南東關教室
王錫昌	沂州	郟城福音堂
王錫昌	沂州	江蘇豐楊家口教室
王信主	濰光	濰縣本邑鎮福音堂
劉順道	高密	濰縣毛街教室
楊鴻勳	昌邑	九一四一年神科畢業者
王文會	濰縣	臨濰大夫店
曹幸田	濰縣	濰江浦敬業中學
薛望獎	濰泉	太原國民師範學校

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李湧泉先生	濰泉	捐洋四元	捐洋十元
吳金鼎先生	濰泉	捐洋一元	捐洋十元
王炳燾先生	濰文	捐洋三元	捐洋二元
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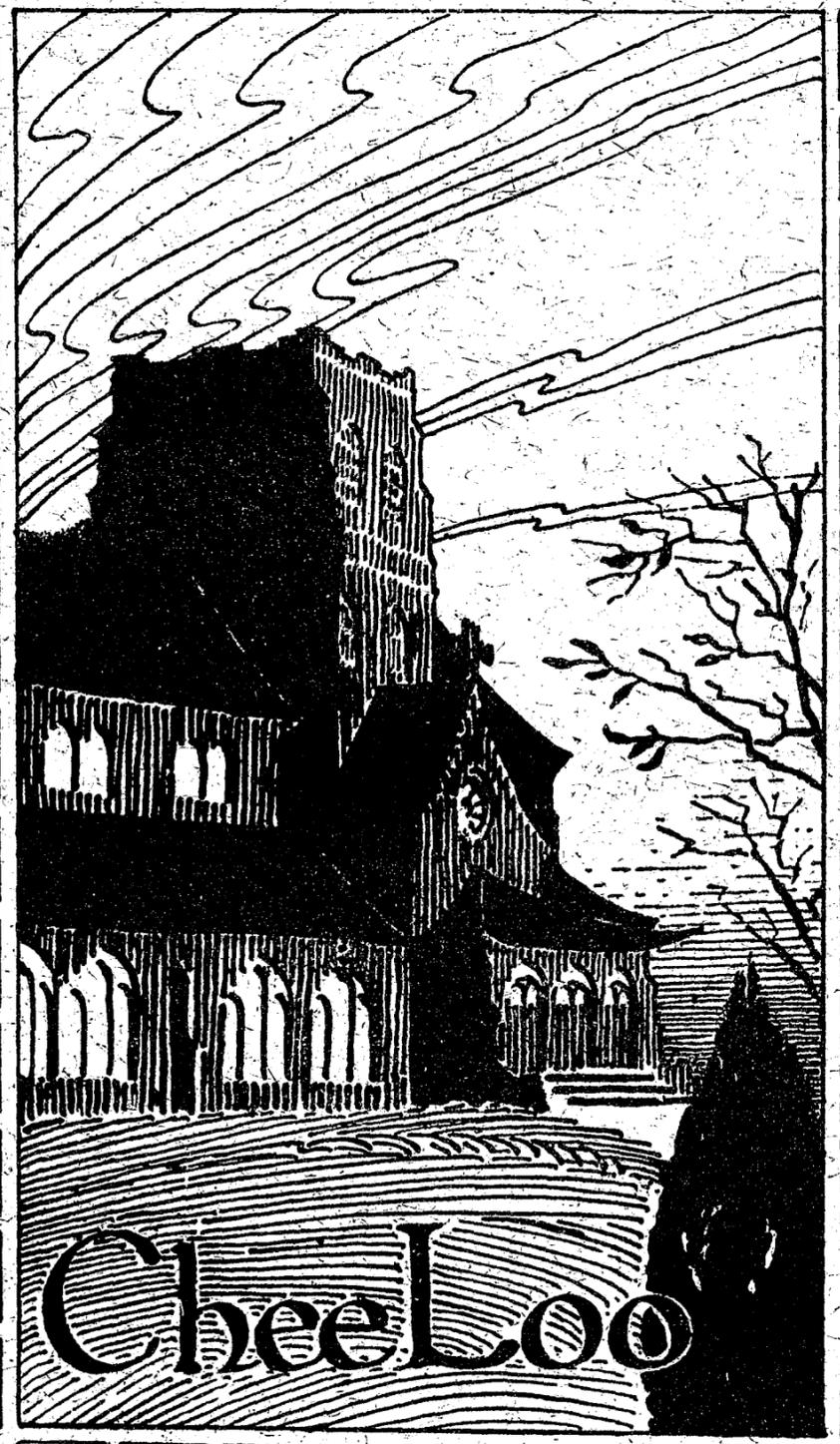
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# CHEELOO

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DECEMBER, 1925.

No. 4

## WITH THE EDITORS

### The New Term.

**O**NE of the difficulties of editors, is that by the time a number of the magazine is published, the editorial is out of date. At the time of writing we are all in the rapture of a new term. The first flush of excitement has passed, but we are settling down to the steady joy of progressive work; with the satisfaction of a few things done, with the expectation of more to follow. By the time this editorial is published, the term will be no longer new; hopes will have been partially realised, and that end-of-the-term feeling will be upon us, to be evaporated we hope in the renewing power of Christmas.

At the beginning of this new session, we miss the presence of a number of characteristic figures that were with us last term; the University is incomplete without them. We welcome, however, a number of others, who have come to join us, some for longer, some for shorter, periods. And especially we welcome the new students who have come to us to the number of 152, coming from 13 provinces. We

are glad of the gifts of mind and spirit they have brought to us, and we hope that in this new fellowship they will enter a larger life, in preparation for a still larger service.

The hopes of the summer have been fully realised. The term opened peacefully, and with a larger enrolment than we have had since the coming of the University to Tsinan. The student body now numbers 392; an increase of 63 over last term's figure. The spirit is excellent. There seems to be a new spirit of brotherhood abroad. Also a spirit of service. There seems to be a new seriousness of purpose. Perhaps it is the realisation that nothing less than the steady application to the fundamental principles of character-building and of nation-building will save the country from foes within and without. Perhaps too the lurid environment of ever increasing preparations for civil war has had a sobering effect. But whatever the cause, there seems to be a devotion to study, a willingness to serve, a response to friendship, that mark another step in advance in the progress of the University life.

The usual retreats for staff and for student leaders have been held; and each has marked progress. There has been a feeling of power in the University Chapel Services. A conference on Religious Life in Middle Schools has been held in the University for representatives of Middle School staff and students. This has reacted upon the University and much thought is being given to develop further the religious life of the institution. The extent to which these plans succeed depends upon the manner in which each individual opens his life to the spirit of faith, love and service that is at work amongst us.

But such fellowship as we enjoy can only continue and grow if it issues in some wider service. From the nature of the case all the work of the University is of the nature of public service. But there is need to focus more clearly upon the definite objects of our service; both in order that we may realise ourselves—staff and students—as existing in a compelling mission; and that keeping closely in view the objects of our work, we may hold to the main issue, cut off all hampering excrescences, and spend our energies in the most effective way. During the last few years there has been a steady move in this direction. The Medical School of course has always been much bound up with the needs of the hospitals for whom it is preparing doctors. The Theological School is pressing its extension work in the country, in order to train its students in the kind of practical work to which it is hoped many of them will go. The School of Arts and Science is continually becoming more concerned with the needs of the Middle Schools, and even of the Village Schools, throughout the province.

Members of the staff have published manuals and helps for the use of teachers of Middle School Chemistry and Physics; the Education Department grows daily in strength in its work of training teachers for the schools; a good deal of time is given by various members of the staff to the work of the Shantung Board of Christian Education; and a number serve at Vacation Schools arranged by the Missions for Village School Teachers. The development of these and similar activities helps to increase our sense of direct service to the people of China; and this growing sense of a common service is more powerful than the differences of race, temperament and degree.

As the bells of Christmas sound around the world—ringing through the depth of Winter, the promise of the Spring— may we hear above the clamour of the market, the clash of colour, and the raging of the creeds, the appeal of the people from the plain and mountain valleys—the peasants and the workmen, the merchants and the rulers, the students and the teachers, to labour with and for them in the power of the Prince of Peace.

F.S.D.

### The Search

Fresh-trodden prints of bare and bleeding feet,  
Turned to the heedless city whence I came,  
Hard by I saw, and springs of worship sweet  
Gushed from my cleft heart smitten by the same;  
Love looked me in the face and spake no words,  
But straight I knew those footprints were the Lord's.

I followed where they led,  
And in a hovel rude,  
With naught to fence the weather from His head,  
The King I sought for meekly stood;  
A naked, hungry child  
Clung round His gracious knee,  
And a poor hunted slave looked up and smiled  
To bless the smile that set him free;  
New miracles I saw His presence do,—  
No more I knew the hovel bare and poor,  
The gathered chips into a woodpile grew,  
The broken morsel swelled to goodly store;  
I knelt and wept: my Christ no more I seek,  
His throne is with the outcast and the weak.

Lowell

## An Experiment in Social Studies in the Yih Wen School, Chefoo.

STANTON LAUTENSCHLAGER

### *The New Christian Conscience.*

**T**HE Christian Church is developing a new conscience on social and economic questions. Everywhere Christians are stirred by the realisation of great social inequalities, economic injustices, national animosities and race prejudices. These unchristlike attitudes and conditions create fierce conflicts, which at any time may blaze into civil and international war. A new moral conscience, however, is quickening the awakened Church. As the higher Christian ethics of a century ago conquered slavery, so the new Christian conscience of the twentieth century has set its face against social injustice, economic exploitation and militarism.

### *Our Unique Opportunity.*

In the Yih Wen School we have a unique opportunity for work along this line, owing to the special character of our school, both as to the pupils and also as to the courses of study. Although we rank as a Middle School, yet many of our students are already graduates of Middle Schools when they come to us; and some are even college men. Most of them come to take the Business and English courses. We graduate more than sixty students a year. Nearly all of them go into business: some as clerks, book-keepers, stenographers or agents for Chinese or Foreign firms; others as interpreters for Chinese officials or Foreign consuls. Some enter the Postal or Telegraph Services. Still others go into the Customs, or into banks. Many of these eventually take up business for themselves, or enter one of the many industries that are everywhere springing up. This gives us an unparalleled opportunity to train the Christian leaders that are so much needed to Christianize the social and industrial order. The new Christian conscience makes the right use of this opportunity an imperative duty.

### *Beginning the Experiment.*

With this in view we were waiting for favourable auspices under which to begin the elective courses in "Christian Ideals for Society," when in the Fall term of 1924, Mr. J. A. Elliot (better known as "Dad" Elliot), who represents the Youth Movement of America, appeared in our midst. His program was right along the lines of our plans and his meetings were the real beginning of our experiment.

With us, "Dad" Elliot's work was limited to our Senior High School and Commercial School, where the students were sufficiently

1925

AN EXPERIMENT IN SOCIAL STUDIES

5

up in English to understand his messages, and so needed no interpretation. He gave us five addresses on the work, methods and ideals of the Youth Movement in America. That movement has two purposes: (1) it aims to re-discover Jesus, and in so far, it is a *Back-to-Christ movement*; (2) it strives to realise the ideals of Christ, not only in the life of the individual, but also in all the contacts of life, as group touches group. It is determined that at all costs the principles of Jesus shall be given expression in the realisation of the Kingdom; and in so far, it is a *Forward-with-Christ Movement*.

The Movement sets itself to reach three goals. The first is individual Christian character; the second is related to the school, where the immediate contacts are made; and the third to the wider field of the whole social order. The first has as its basis what Mr. Elliot calls the Principles of the Movement; but in our school we like to call it the "Jesus Way". These principles are human rights as against property rights; brotherhood as against strife, co-operation as against competition; justice as against injustice; purity as against impurity; honesty as against dishonesty; democracy as against autocracy; love as against hate; and the Golden Rule instead of the Rule of Gold.

These principles, we believe, must become a part of one's life and character, if one wishes to walk the Jesus Way. This, the Youth Movement believes, can only be done by laying hold of a Higher Power which makes for Righteousness. To walk this way means a changed life with changed ideals and purposes. Only such changed lives can change society.

After "Dad" Elliot had given his messages, had met the outstanding leaders of the school and had emphasised the need of personal courage, and the absolute necessity of a life linked with Christ, we made definite propositions for the student body to act upon, with the following result:—Seven made a definite decision to become Christians; twenty-five expressed the desire to follow the Jesus Way, but were unable at once to accept Christ openly because of special difficulties; twenty-nine expressed the determination to follow Christ more perfectly; eleven dedicated their lives to special Christian work; twenty-five decided to enter a study group to study the Social Ideals of the Youth Movement; and forty made the following pledge:—

"Realising that clean and honest government and a truly Christian world depend upon the character of the men that come from our schools; we wish to organise a student movement to make the Yih Wen school student life more clean and honest".

This group of forty soon grew to seventy, and they organised to fight gambling, cheating and other evils, as well as to enforce the rules

of hygiene, and to encourage our voluntary religious services. Perfection was not reached, but the effort was worth while.

The study group also grew until we had a group of forty studying the four great ideals for society, namely:—

1. Abolition of race hatred and prejudice.
2. A Christian basis for industry.
3. Christian internationalism.
4. Abolition of war as a method for settling international disputes.

This group invited Mr. John Nipps of the Chinese Y.M.C.A. to lead weekly discussions on international problems; and together, in a very elementary way of course, we wrestled with the problems of race hatred and war. Though this class was purely voluntary, there was an average attendance of about fifty students. When the term ended our students were unanimous concerning three things;—First, class conflicts and race hatred threaten the whole world with war. Second, modern warfare threatens to annihilate civilisation. Third, it is imperative that we find solutions to these problems.

Our Bible Study Group, even when not studying along social lines, received a new impetus. We are trying to follow the method of such men as Bruce Currie of the White Bible School of New York. We take a chapter and ask, what does it say; what does it mean; what problem does it raise; what are the solutions and what are the applications? In this way we discover again that the spiritual truths of the Bible are towers of strength, and that the teachings of Jesus are sure guide posts to the new civilisation which needeth not the Light of the Sun.

One of the things which inspired our students more than anything else to develop this line of social work in our school, was the letter of greeting sent by the Student Christian Movement of the Middle West to the students of the East. Our students drafted an appropriate reply. In doing this they received no help from any of the teachers, Chinese or Foreign. In their reply our students emphasized the necessity of a new life in Christ, in order to apply the doctrine to the present social problem. The fraternal greetings are as follows:—

COMMISSION TO THE DELEGATE FROM LAKE GENEVA  
CONFERENCE BEARING GREETINGS TO THE  
YOUTH OF THE FAR EAST.

“We, the delegates of the Student Christian Movements in nine Middle Western States, young men assembled in conference at Lake Geneva, Wisconsin, send through our representative, our beloved “Dad” Elliot, this message to the students of the Far East.

We believe, as many of you do, that youth has too long failed to accept its fair responsibility for the great issues of the day and has left

exclusively to the older generation decisions that would be far more vital to us than to them. Decisions affecting our futures as individuals and as nations have been made with too little thought as to our wishes and convictions.

We are working, as you are, for the establishment of a real, personal feeling of international friendship; as partial means towards this end, we are also working to break down the barriers of extreme nationalism; race hatred; distrust of other peoples, with its expression in armaments; and economic and political imperialism. We are resolved that lack of agreement as to method, so far as to any peaceful means of adjusting international relationships are concerned, shall not blind our eyes to the goal we have in common world brotherhood.

We acknowledge thankfully the good influence of the clear thinking, internationally-minded youth of the Far East, with whom we have come in contact through their presence in our colleges and universities. Especially have we been impressed by the sacrificial, consecrated lives of those young men of your countries, who are preparing to serve you, inspired by that spirit of love which we see in Jesus.

We assure the students of China, our brothers, that we condemn unreservedly the exploitation of their country by the “great powers”, and by the factions within China that disregard the lives and welfare of the people. We strongly disapprove the exploitation, from whatever source, of the labor of Chinese men, women and children. Our endeavor shall be to help to alleviate this evil of Western industrialism. We welcome the constructive efforts of your Renaissance Movement, and desire to cooperate where we may in applying its principle to the development of character and service among the students of the world. We have observed with deep interest your efforts to overcome prejudice by popular education. Your campaigns against illiteracy have appealed to us strongly. Such efforts help to build the body of constructive opinion which is needed to establish and maintain stable government.

We believe that the spirit of love as disclosed in Jesus can work through and change all human relationships; industry, politics, and international life; that it is the only power that can overcome evil and call forth the undiscovered good in man.

There are those who say that this realisation of the Kingdom of God for which we strive, will rob life of romance and adventure for us, the youth of to-day. We reply, that the building of that new world upon the ruins of the old; the reshaping of social relations between the classes, races and nations; the conquest of disease; the resurrection of art, poetry and lovely handicraft; the joy of flight made safe from death; and the reconciliation of life and death by faith re-established in the soul

of the world—all these are adventures enough to last, let us say, until we see that (new heaven and new earth, wherein dwelleth righteousness). Let us together fight the good fight, make the great adventure and take the chance."

GREETINGS FROM THE CHRISTIAN STUDENTS OF THE  
YIH WEN SCHOOL TO THE AMERICAN CHRISTIAN  
STUDENTS OF THE MIDDLE WEST.

"Several meetings of the students of the Yih Wen School in Chefoo have recently been held to consider the question of starting a Youth Movement in our school also; for the good news of what you have been doing in your country and have been trying to spread over the world, has come to our ears. These good Christlike principles have been given to us by your representative the beloved "Dad" Elliot.

We are very much impressed with the importance of the Christian principles which you stated in your message, and we consider that these truly are the important responsibilities which we must carry out and live for in order to improve the conditions of our Chinese men, women and children, who are working in the factories; as well as to help to lessen the evils of "Western Industrialism", which is now being established in China.

In order to try to form a new feeling of international friendship, to bridge the gap between nations and to settle international disputes, we must surely adopt the spirit of the love of Jesus; then there will be no race hatred, no prejudice, no quarrelling and no war between nations.

We assure the students, our brothers in America, that we understand that only Jesus has the power to change the evil things of the people and to give the new birth and the new life to men. Not only that, but if we follow the Jesus Way, then the implements of peace will take the place of the weapons of war; justice will be substituted for rivalry; love will take the place of hate, and wars will be abolished forever. Let us work and hope for that great day."

*Our Experiment during the Spring Term of 1925.*

In the spring term, about twenty Seniors invited Mr. John Nipps of the Y.M.C.A. to lead a discussion group once a week. They studied international politics, with special reference to the League of Nations, as an attempt to use peaceful methods for the settling of international conflicts.

Besides this, we had another class (elective) which met three times a week and which was open only to Juniors and Seniors. Twelve entered this class for credit (that is as a regular part of their school work), while twenty others chose it as an extra. We spent the whole time in studying the problem of a Christian basis for industry. The

texts we used were a series of most excellent pamphlets put out by the National Christian Council of China. We only had time to study six or seven of these, as our class work was supplemented by visits to the filatures and other factories of Chefoo. The pamphlets we chose to study were as follows; and were used in the following order:

1. Modern Industry in China.
2. The Church in China and the Industrial Problem.
3. The Church's Labor Standard.
4. Brief History of Factory Legislation in the United Kingdom.
5. Report of the Child Labor Commission of Shanghai.
6. An Industrial Program for a Chinese City.
7. The International Labor Organisation and the East.

This last pamphlet is put out by the International Labor Organisation of the League of Nations, and gives a brief summary of what that organisation has been able to do by way of legislation to improve the labor conditions of China, India, Japan and Persia.

The outstanding things which impressed the students in the class work of this term seemed to be: (1) the fact that the First Industrial Revolution of one hundred years ago, by which production by hand in the home was changed to production by machine in the shop; and the Second Industrial Revolution of to-day, by which industry for profit alone is giving place to industry for service, have come to China at the same time. (2) That the Second Industrial Revolution promises to make industry a blessing to millions of people, instead of simply exploitation of people and resources. (3) The different ways by which nations have dealt with the problem of industry: the United States working more along the line of selling shares in industry to the workmen, profit sharing and high wages; Germany and Italy giving the workers a larger share in the control of the administration and conditions of industry; England setting up Trade Boards representing employers and employed, empowered to determine minimum wages, and by giving government help to the unemployed; Russia trying to solve both the economic and political problems by creating a government of and for the Proletariat. (4) That the nations who formed the Covenant of the League of Nations considered that the unjust conditions of labor were such a prolific cause of war that they created by the Peace Treaty an International Labor Organisation as a necessary measure for the establishment of universal peace, which they recognised could be established "only as it was based upon social justice." (5) That the Christian Church is the only organised force which has a definite standard for industry and a program in operation for reaching that ideal.

Our visits to the factories were conducted by the industrial secretary of the Chinese Y.M.C.A. Each student receiving credit was required to hand in a written report concerning his visit. These reports were the best evidence of the deep impression the work of the term made on these students; as the following quotations testify:

"The workers in this factory work about sixteen hours a day. I asked one young worker's age. He told me he was fourteen years old. He said he had already worked in the factory four years. He said every year he gets not more than \$20.00. How cruel the master of this factory is! How can China be strong if her industrial conditions do not change? We are the young men of China. If we want to reform society, we must reform the industrial conditions, otherwise China can never become a strong country."

"Now if we do not rise up and try to change these conditions, I say we are not human beings." (This by a descendent of Confucius.)

"I am sorry to say, that the strong always has the right, and the weak has no right at all. I hope some day the world will be better. We should not say too much and do nothing. I will do as much as I can to reform these conditions."

"We should do as Jesus Christ, who devoted much of His strength to help people physically, seeking to overcome evil wherever it appeared and to establish the reign of righteousness. Therefore I will say in my life, I will not do only what is good for myself, but will do what is good for the world."

"Before closing my report I wish to say, I hope that God will give us energy and bravery, and will help us and all the young men in China and in Foreign countries also, to rise up and reform the factories, which are old and corrupt, and change them into modern and progressive ones by reform and not by destruction."

This last quotation is from a most excellent student who became a Christian during the term and who has since written to us that he has persuaded his mother to believe in Jesus, and that he will return to our school, in order to learn more about the doctrine of Jesus concerning the individual and society.

### *Plans and Ideas.*

Our Plan for next term is to have a class dealing with industrial problems once a week for Juniors, and to have a course on race problems for Seniors. When at the end of the term, we asked the Senior class whether they preferred to study the regular Bible Course, which was based on an excellent book on the Life and Work of the Early

Disciples, or study the Bible and other books with reference to the Abolition of War and Race Hatred; the whole class of fifty, with the exception of three, chose the latter. We had hoped that about half of the class would chose the regular course. But as we wish to introduce the principle of election into our Bible work, we have arranged the following course for our next term. Outside of the Bible our text books will be "Christianity and Race Problems" by G. H. Oldham; "Causes, Consequences and Cure of War" by Kirby Page; and "Jesus and His Program of Reform" by Arthur Rugh.

Our school has been specially requested by our Mission to work out some method by which Elective Bible Courses can be made so practical and attractive that compulsory courses may be abolished—if that should become desirable—for Middle Schools. We believe that this method points the way to a solution. These courses can be made so vital and gripping, that students will choose them, not only in preference to ordinary Bible courses, which are so often both perfunctory, and badly taught, but also in preference to ordinary courses in economics, sociology and history.

We do not mean to say that the whole of the Gospel is embraced in "Christian Sociology." The Bible deals with character first, and society second. Perhaps in the Junior Middle School the facts concerning the heroes and prophets of the Old Testament, the life and work of Jesus and the early disciples, should be taught as history; and perhaps in the first year of the Senior Middle School the Bible could be taught with more definite reference and application to the individual character. This when done along the lines of what we called in the beginning of this paper "the Principles of the Youth Movement" or the "Jesus Way", could no doubt be made even more immediately practical and vital than the social studies.

A report of our experiment in the Yih Wen School resulted in the Shantung Presbyterian Mission, in their regular session of 1925, discussing and giving to the Educational Committee of the Mission for further consideration, the following question:—

"Should we not work out for our Mission Schools some course of Bible Study suitably graded, emphasizing the teaching of Jesus with reference to world problems?"

Our work is only the beginning of an experiment, both as to methods and material; but it seems to us that it points the way to great possibilities not only for better Bible work in our schools, but also for the advancement of the Kingdom of God in China.

## What we Students Should do for China

TS'UI CH'ING-HSIU

I am sure that the Student Movement of China now offers more hope for the future integrity and prosperity of the land than any other movement observable. Of course, our deep love for the nation has caused us to sacrifice valuable time, and to give up our studies in order successfully to reach our goal of serving the country, which we believe is on the verge of extinction. But we all agree that anybody who is at the bottom of his heart patriotic, must first of all know how to show his patriotism. If patriotism is not manifested in accord with right principles, the result will be harmful to the nation.

It goes without saying that our grief and our apprehension for the losses of the past, and for the dangers of the future, are right; but let us also ask ourselves, what will prevent future calamities? We must furthermore understand that no man can blot out the disgrace of the past, and the disrespect shown to our nation without first a serious purpose and a long preparation. If every citizen has a certain amount of education, and a definite occupation, sufficient to enable him or her to be of some service to the nation, we shall be able to serve the country by united effort.

It is equally true, that when the young members of a family are bright and studious, no outsider will show them disrespect, or fail to admire the family as a whole. In other words the success of our work coincides with our ability; and the earlier we complete our preparation, the quicker we shall be able to help the nation escape oppression. If we all do this, there is no need either to seek Foreign assistance, or to exclude all that is Foreign.

It is especially important that we students should understand that the reason why China has fallen into her present miserable condition, is largely lack of virtue. The people have only cared for their own good, and have not cared for the good of others. Those who have reached high positions in the Government have robbed the people.

If we want to save China, first of all we must make up our minds to blot out the wicked deeds which have been done in time past. We must devote ourselves to study in order to make new men of China; then we shall preserve the good reputation of having wide territories, a dense population, rich products, and the world's longest history and oldest civilisation.

In conclusion, we should examine the condition of affairs, determine the proper method of procedure, and understand the present situation and our future responsibility. I do not say that the Student Movement is wrong; but what I do mean is that we should enlarge the scope of our Movement.

## A Laboratory Guide For Middle School Teachers of Physics

DWAN REN DEH

and

HAROLD W. HARKNESS

### Part II

### Subject V. Uniformly Accelerated Motion

*Introduction.* If I hold a stone above the ground and then let it go, what, in general, happens? Why does it not move upwards? Smoke moves up when it is free to move. Why? A ball thrown forward keeps moving after it has left your hand. Why? Is a stone dropped from a high point going as quickly when it reaches the ground as one dropped from a lower point?

Which goes farther, a tennis ball struck with a sharp blow or one struck very lightly? Will two stones of different weights dropped from the same point reach the ground at the same time? If you applied the same force in throwing a heavy and a light stone, which would go the farther? If I hold a stone suspended upon a string and the earth pulls the stone with a force of 1000 grams, i. e. the stone weighs 1000 grams, with how much force must I pull up on the string?

If I suddenly increase my pull upon the string, does the pull of the stone upon the string increase? Why?

## 等均加速運動 題 五

概論：若是我舉一塊石頭離開地面，然後捨之，大概要生什麼現象？

為何石頭不往上去，烟若聽其自由動必往上去？

你向前拋一球，球離開你的手還繼續前行為何？

從高處下落的一塊石頭與從低處下落的一塊石頭，當落到地面的時候，速度一般快麼？

重拍網球與輕拍網球，那個能使網球走的遠些？

不同重量的兩塊石頭從同一之處下落，同時到地麼？

你用等大的力量，拋一重物與一輕物，那個走得快些？

若是我用線懸起一塊石頭來，地球引他的力 1000 克，（也就是石頭重 1000 克）我必須用多少力牽線才能提起他來？

若是我驟然猛力去牽線，那石頭牽線的力量也加增麼？為何？

These questions are intended, in general, to bring out in an unorganized form the ideas of Newton's Laws of Motion as observed in common phenomena.

To a weight of about 3 Kg. fasten a light cotton string which will just support the weight. Try to suddenly lift the weight by means of the string. What is it that breaks the string?

Fix a hammer head loosely upon the handle. Strike the handle a sharp blow upon the table and note what happens to the head. Account for what happens. Wet a broom with water, and then whisk it sharply through the air. Account for the water leaving the broom when it is suddenly stopped.

Mark a spot on the floor with a small square of paper. Stand on the paper and using a very light ball, say one of cotton yarn, simultaneously throw this upward and walk forward. Now, starting back from the paper about ten feet, walk briskly forward and as you pass over the paper, throw the ball upwards. What is the difference in the flight of the ball in these two cases? What makes the difference?

Roll a ball along a perfectly horizontal surface. Does gravity effect a horizontal motion? What stops the ball? Throw a very light ball, a wad of tissue paper, forward quite forcibly. What force opposes its motion? Would this same force tend to stop other things moving through the air? Lay a ball upon a slight incline. Does the ball move? Does it start moving itself? What gives it its motion?

這些問題的宗旨，大概是要代表出牛頓運動定律顯在普通現象的意義來，但不是一個有組織的式樣。

用細棉花線繫三荳重，剛剛担住，猛提之，是什麼把線弄斷了？

把斧頭鬆安柄上，猛把斧柄對桌子上一擊，看斧頭出什麼現象。說明他那現象。

把掃帚蘸水，猛向空際一灑，隨即停止，說明此時水離開掃帚的現象。

用小方紙一塊在地板上記好一個地方，站在小紙上，手拿棉花球，上拋此球同時向前進走；再從小紙後退十步，猛力向前跑，跑過小紙的時候上拋棉花球，在這兩樣狀況裏，花球上升有什麼不同的地方？是什麼使他如此的不同？

一個球輾在完全水平線上，地球的引力影響他的水平運動麼？末了是什麼停止住這球？

猛力前拋一塊很輕的紗紙球，是什麼力反抵他的進行呢？這種力也阻止別的運動在空氣裏的東西麼？

*General Summary.* Bodies which are at rest stay at rest and bodies in motion maintain their motion unless they are acted upon by external forces.

Lay a ball upon the table and strike it two equal and opposite blows simultaneously. What is their effect upon the ball?

Refer to the results obtained in experiments under subjects III and IV.

Make a weather vane as in the illustration. Weight the head by wrapping it with lead foil until the whole is balanced. Place this in the wind. Which end, *a* or *b*, receives the greatest force from the wind? Why? Which end moves with the wind? Does the arrow point in the direction from which or toward which the wind is blowing?

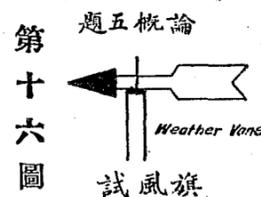


Figure No. 16

Make a small windmill of wood or paper. Blow upon this from the front. How does its direction of motion compare with the direction in which the wind blows? Why not make the blades perpendicular to the plane of its motion?

*General Summary.* A change of motion in a body takes place in the direction of the force which causes the motion and is proportional to the amount of the force and to the time during which the force acts.

把一個小球放在微斜的面上，這球運動麼？他自己就開頭運動麼？是什麼加給他這運動呢？

總結。若非受有外來的力量，靜的物體是常靜的，動的物體是常動的。

放一個球在桌子上，對他施行相等反向的兩個打擊，球要受什麼影響。

對照題三題四諸實驗所得的結果。

作一個試風旗如圖。用鉛箔包裹他的首端，加重他，以至全體平衡，放在風道裏，是那端（*a* 端或 *b* 端）接受風的力量大些？為何？是那端隨風轉動？矢向是順風向或是逆風向？

用紙或木作一個風磨，從前頭吹他，他轉動的方向與風吹的方向比較如何？為何不把葉片作的和運動面成正交？

總結。物體動向改變是順着使他改變的施力；並且是和施力的大小，施力的時間有正比例。

Strike the table with the hand. In what direction do you act upon the table? Is there also a force exerted against your hand at the same moment? In what direction? What evidence have you of this reaction? Again strike the table more forcibly. Does the reaction seem to be more forcible? Upon what then does the intensity of any reaction depend?

Bend about three inches of glass tubing to a right angle, the bend being about one inch from one end. Insert the long end into about fifty centimeters of rubber tubing. Suspend the glass tube by the rubber tube and blow into the rubber tubing. What happens?

Make a propeller of wood or metal. Study its action in order to see clearly how a ship, or an air ship is driven forward by the reaction of the air against the propeller. Reference may be made here to the sculling oar as used by Chinese fishermen.

Strike the table with your fist as forcibly as is comfortable, then strike a pillow or cushion with equal force. Could you comfortably strike the pillow or cushion more forcibly? State a good reason for the difference.

*General Summary.* To every action there is an equal reaction in the opposite direction.

Let one student roll a ball upon the floor and another student stop it. Then repeat the experiment but increase the speed with which the ball is rolled. Make a mental comparison of the force required to stop the ball in the two cases. (It is preferable to use a large metal ball,

用手擊打桌子，你施在桌子上的力是什麼方向？同時也有反抗你手的力麼？這力是什麼方向？這反動力有什麼證據？再猛力擊打桌子，那反動力好似更猛麼？那末反動力的強弱靠着什麼規定？

彎三吋長的玻管，使距一端一吋遠的部位或直角。將長端安於五十釐長的橡皮管上。拿橡皮管將玻管懸起，往橡皮管內吹，出什麼現象？

用木或金屬作一個推進器，仔細研究他如何的動作藉着水或空氣抵對他的反動力去驅輪船或飛機前進。可以參攷我國漁人划槳。

猛力用拳擊桌子，(以拳受得住為度)再擊枕頭或坐褥，你能加猛擊枕頭或坐褥還仍然受得住麼？用合宜的理論來講明他的不同。

**總結。**每有動力必有相等反向的反動力。

令一生在地板上擲球，令他生止之。再加增球的速度重作實驗。將這兩種止球的力量在你心裏比較一下。(至好用大金類球，但用足球

but a foot-ball or basket ball will serve quite well.) Now use two different balls of different weight (and hence of different mass) and roll them with equal speeds. How does the force required to stop them compare?

*General Summary.* The force necessary to stop a body depends upon both the velocity\* and the mass\* of the body.

By repeating the above two experiments it will be found that it is possible to stop both the heavy and the light ball, or the ball travelling with high speed and the one travelling slowly, with the same force but in the case where the mass and speed is large the time during which the force acts will need to be increased.

Collecting these ideas we may write them in the form of a proportionality,  $F = k m v/t$ , and this relation is used to define what we mean by mass (m). It is the mathematical statement of our second general summary above. The first three general summaries of our experiences relative to the motions of bodies are called Newton's Laws of Motion, since he first stated them in an organized form.

*Definitions of ideas involved in the above introduction.* \*Velocity is the time rate of change of position of a body. \*Acceleration is the time rate of change of velocity. \*Momentum is the product of the mass and the velocity. (或籃球亦可。)再用兩個不同重量的球。(即質量不同)用同速度轉他們，去停止他們需要的力量比較如何？

**總結。**停止動體所用的力量，靠着物體的速度與質量規定。

重作以上的兩個實驗，得知用同大的力量能止重球，也能止輕球；能止速度大的球，也能止速度小的球；不過對於質量和速度大的，必須加長時間去止他。

總集以上的意思我們可以開列以上的比例。

$$F = K m v/t$$

F是力， $K_1$ 是恆數  
m是質量 v是速度  
t是時間

這是解說質量 (m) 常用的方式，是我們以上第二結論的算學標式，以上我們經驗中關係運動的頭三個結論，是牛頓運動定律第一次用這樣的方式來解明。

以上概論裏幾個重要名詞界說。

**速度。**是物體改變位置的時間度。

**加速度。**是速度改變的時間度。

**動量。**是物體質量乘速度的積數。

velocity of a body. \*Mass is the property of a body by which it opposes any change in its motion. (Because of the units which we have chosen the same number represents mass which represents the weight of the body). *Uniform Motion* describes the motion of a body whose acceleration is zero. *Uniformly Accelerated Motion* describes the motion of a body whose acceleration is constant. (Note that Uniform Motion is a particular case of this).

### Experiment 1.

**Object:** To Study the Motion of a Body Moving Freely on an Inclined Plane.

**Materials:** Smooth board, about 2 meters long and 15 to 20 cm. wide, wedge about 8 cm. thick at one end, metal cylinder, pendulum arranged to beat seconds, and meter stick.

**Method:** Place the wedge under one end of the board, (See Fig. 17) so that this end is 2.5 cm. higher than the other. About 5 cm. from the higher end, draw a line across the board at right angles to the length. Place the metal cylinder so as to touch the board along this line, holding it in place with a small block of wood resting on the inclined plane. Set the pendulum to tick seconds, (as nearly as possible), and start the cylinder rolling by removing the block exactly on a tick. Set matches as markers upon the board, putting them roughly in place first, then, as the cylinder rolls down, note whether

質量。是物體所具反抗改變其運動的任何力的性質。(因為我們所選的單位的緣故,代表物體量質的和代表物體重量的數目相同,乃是遇和的)。

等均運動。謂一物體運動的加速度是0。

等均加速運動。謂一物體運動的加速度是恆數,(注意等均運動乃此中特別之一種。)

實驗一。

**目的:** 研究斜面上自由動體之運動。

**儀器:** 約二呎長十五到二十呎寬之平光板,木楔一端厚八呎,金屬圓柱,一秒鐘擊一次之擺,呎桿。

**方法:** 用木楔支起板之一端,使較彼端高2.5呎。(見十七圖)離高端五呎處畫線於板上,與板長作正交。放金屬柱於板上,使切此線,用小木塊塞住,使之停在斜面上。放擺擊秒。(較準至愈對愈好)恰在擺響第一次的時候,移去木塞,放柱下轉,在下轉的時候,放一個

at the moment of each tick it is exactly opposite a match; if not, move the matches in the proper direction, and again allow the cylinder to roll down. After a little practice, if the matches are always laid at right angles to the length of the board, and as the cylinder passes you look along the match, you will soon find that you can adjust the positions with considerable accuracy. Measure the distances from the starting point through which the cylinder has passed at the end of each second. It will be noticed that the space passed over in a second increases, so that the motion of the cylinder is accelerated. Divide the distance passed through at the end of 1, 2, 3, 4, etc. seconds from the start by the squares of the corresponding times, that is by 1, 4, 9, etc. and enter the quotients, together with the time ( $t$ ) and the space ( $s$ ) passed over, in three columns, as in the following example:—

$t$	$s$	$s/t^2$
1 sec.	6.5 cm.	6.5
2 "	24.9 "	6.0
3 "	55.5 "	6.3
4 "	95.6 "	6.0
5 "	147.0 "	5.9

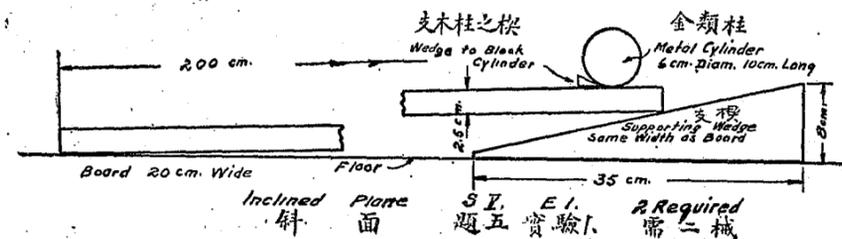


Figure No. 17 第十七圖

對碰的東西,(木,金之屬)使他與金柱相碰的聲音,恰合第二擺擊的聲音相符,連試數次以至準確。試好後令金柱繼續下轉,移放對碰的東西,使他們碰的聲音,恰與第三擺相合,如此繼續下試,與第四擺聲,第五擺聲恰相合。然後計量每秒鐘金柱經行的路程。從此看出:第二秒比較第一秒行的遠,第三秒比較第二秒行的遠,如此類推。那末,金柱是加速動了!第一秒二秒三秒四秒時間內行的路程,用秒數的平方一,四,九,十六,來除他,所得的餘數與時間( $t$ ),空間即路程( $s$ ),列作三行如下:—

$t$	$s$	$s/t^2$
1	6.5 cm.	6.5
2	24.9 cm.	6.0
3	55.5 cm.	6.3
4	95.6 cm.	6.0
5	147.0 cm.	5.9

It will be found that the quotient  $s/t^2$  is constant. We thus see that the spaces passed over increase as the square of the time, so that in 2 seconds the cylinder moves 4 times as far as in the first second.

Repeat the experiment with the plank inclined at greater angles—say with the higher end raised 5 cm. and 8 cm.

### Experiment 2.

*Object:* To Study Momentum.

*Apparatus:* A cube of wood about 7.5 cm. edge suspended as a pendulum, two lead spheres 100 and 50 grams, two meter scales.

*Method:* Drive four small nails into the corners of the cube of wood, and suspend it by strong threads in the manner shown, in Fig. 18. The suspending threads ought to be from 120 to 150 cm. long, and are fixed to a bracket in the wall or to the ceiling. The lead spheres are suspended as two pendulums of the same length as the wooden block pendulum and when at rest they just touch the center of the wooden block. The block should be so suspended that the lead balls will strike the end of the grain of the wood. Support two meter scales as in the figure, so that the cube will just swing between them without touching. Lay a piece of split straw, against the face of the cube so that it will slide along the meter sticks when pushed by the block.

這裏可以看出來  $S/t^2$  所得的餘數是常數。(略說)我們因此知道所經過的路程(空間),隨着時間的平方增加,就如第二秒金柱經過的路程有第一秒的四倍。

重作此實驗用傾斜角較大的板子,如使高端高於低端 5 厘米與 8 厘米。  
實驗二。

**目的:** 研究動量。

**儀器:** 邊長 7.5 厘米的方木塊自邊上擺樣懸起來,兩個鉛球;一個 100 克,一個 50 克。兩支尺桿。

**方法:** 方木塊四角上釘上四個小釘子,用壯絲懸起(如 18 圖)絲應當有 120 到 150 厘米長,繫在牆壁或天花板的托架上。兩個鉛球擺樣的懸起來,一般長,安定的時候,正切對方木塊的中心。木塊懸的正好,使鉛球能碰對他的端。支起兩支尺桿來,(如圖)使木塊只能搖擺在當中而不切着。對方木塊的面放一挺草芥,木塊前擺的時候,推着他前走。作表號。

Having brought the cube to rest, and placed the 50-gram ball on one side, draw the other back through 10 cm. and let it go. It will strike the cube, which will be driven back, the distance through which it is driven being indicated by the straw. Repeat the experiment several times, in each case starting with the cube at rest, and take the mean distances through which the cube has been driven.

Next repeat, using the 50-gram ball in place of the 100-gram ball. It will be found that the cube is now driven back through a smaller distance than before. The velocity with which the ball strikes the cube is the same as before, since the two balls are suspended by strings of equal length. The blow struck the block is, however, less than before, so that the mass of the moving body evidently effects the intensity of the blow. Gradually increase the distance through which the 50-gram ball is deflected, till the cube is driven through the same distance as it was when the 100-gram ball had been deflected through 10 cm, and let the distance be  $x$ .

From experiments to be made on the simple pendulum See (Subj. VIII) it follows that the time which elapses between the release of the ball and the instant when it strikes the cube is the same whatever the

再用 50 克球代替 100 克球重試,可以尋見方木後退一個較小的距離,既然球懸的一般高,他擊方木的速度定是同前的;但是擊方木的力量比較前小;這樣看來,動體擊打的強度定是受着質量的影響了。

再增加 50 克球提起的高度,直到方木被擊後退的距離與 100 克球提起 10 厘米時方木被擊後退的距離相等,將此距離用  $x$  代表。

先使方木靜停,將 50 克的球放在他一邊,牽起那球 10 厘米,放他下落。他去擊方木,方木後退,退的遠近有草芥表明。重試數次,每次必須方木靜止,取方木後退的平均數。

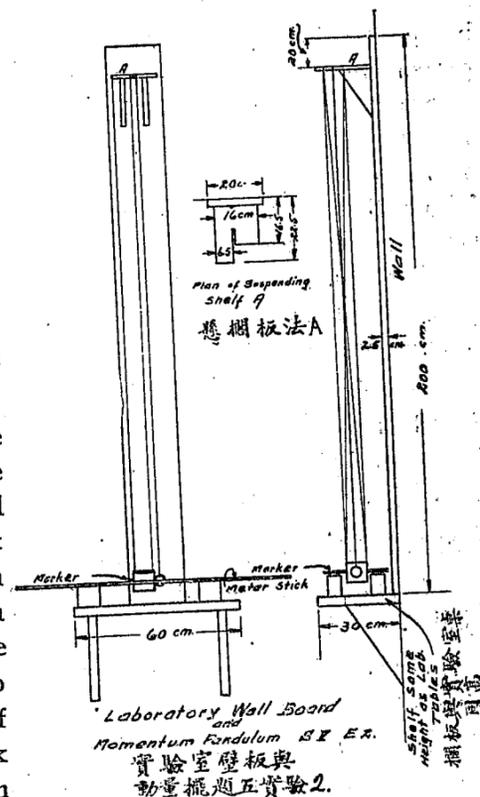


Figure No. 18 第十八圖

amount of deflection, so long as this is not too great. From this it can be proved that the velocity with which the ball strikes the cube is proportional to the distance through which the former has been displaced. Hence we may take the displacements as representing the velocity with which the ball strikes the cube. Also since the time of oscillation of a pendulum is independent of the mass of the bob, it follows that the velocity with which the two balls strike the cube is the same if the displacements are equal. Therefore a mass of 100 grams, moving with a velocity represented by 10, strikes the cube a blow which produces the same effect as that struck by a mass of 50 grams, moving with a velocity represented by  $v$ .

Repeat the experiment using different displacements. Arrange the results in order to show, that for a given force of blow, (as measured by the displacement of the wooden pendulum) the product of mass and velocity is constant.

### Experiment 3.

**Object:** To Make Some General Observations upon Freely Falling Bodies.

**Materials:** Two wooden blocks and board as shown in the illustration, several stones of different sizes and weights.

**Method:** It is first required to study the relation between the time it takes a body to fall a certain height and the mass of the body. Let the student go to any high point, as the second story window of the school and simultaneously drop stones varying in weight while his partner on the ground tries to judge whether they strike the ground at the same instant.

按照單簡擺的實驗，(見題八)球從放落到擊方木的時間是相同，不管他提高的數。(若是不太大)從此證明球擊方木的速度，與球提起的數是有正比例。所以我們可以拿他提起的數代表球擊方木的速度。既然擺的擺動時間不依靠擺錘的質量，因此當提起的數相等的時候二球擊方木的速度是相等的。

所以 100 克質量用 10 的速度衝擊方木，與 50 克質量用  $x$  速度運動衝擊他的效果同。

重作此試用不同提起之數，將所得的效果依次例出來。顯明擊力(如以木擺位變所計量)就是質量與速度的乘積是常數。

### 實驗三。

**目的:** 一個墜體的普通觀察。

**儀器:** 兩木塊並木板如圖所示，幾塊大小不同重量不等的石子。

Next, it is required to study what effect a horizontal motion has upon the rate at which a body falls. To do this arrange the board as shown (Fig. 19) upon a table so that from either side (A or B) of the board the blocks C & D may fall to the floor freely, and place upon it, the two blocks shown. The blocks should be placed so that the moving stick will hit D a sharp blow and at the same instant gently push C over the edge. The object is to project D some distance, while C simply falls directly downward, both starting at the same time. With the blocks and the stick in position, as in the illustration, hold the whole with its upper face exactly horizontal, and then with the finger snap the stick towards D. Listen for the sound of the blocks striking the floor. Repeat several times and allow for the possible error in not holding the block horizontally. Do the blocks fall through the same vertical distance in the same time? Is the effect of gravity upon D affected by the other force that acted upon it at the same time?

第  
十  
九  
圖

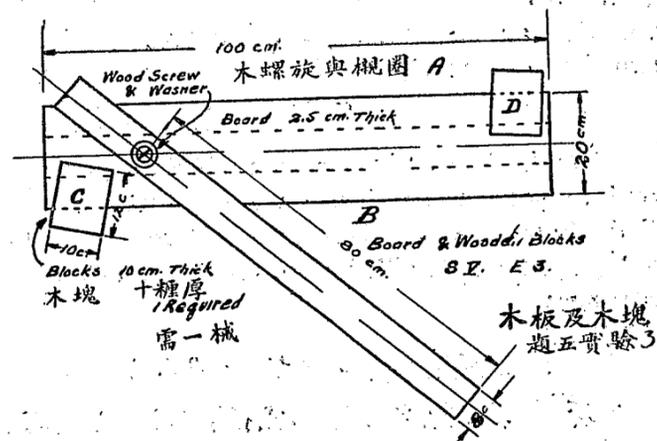


Figure No. 19

**方法:** 第一必須先研究物體某高度下墜用的時間與質量的關係。令一生站在一個高的地方，比方二層樓窗上，同時下撒兩塊不同重的石子。令他生在樓下看着是一同落地否。

第二步必須研究水平運動有何影響物體下墜之度。安置木板於桌上並置二木塊如 19 圖所示，木塊 C 與 D 可以從木板每邊 (A 邊或 B 邊) 自由下墜於地板。木塊如此安置，於運動棒猛擊 D 的時候，順邊靜推 C。目的是同時放動 D 於幾何遠，而 C 只直接下墜，安木塊與木棒於同一位置如圖，使木塊與木棒前面水平，用指撥木棒向 D。聽木塊擊地板之聲。重試數次，允許他因為舉木塊不水平所生之錯誤。木塊降落同一之垂距用同一之時間麼？施用於 D 之引力效果同時受施於他的他的力的影響麼？

**Experiment 4.**

**Object:** To test the Law of Centrifugal Force ( $F = mv^2/gr$ .)

**Apparatus:** Iron ball or stone of about 2 kg. weight, spring balance, square, fine wire, and meter scale.

**Method:** Hang the ball from the ceiling by means of the fine wire, so that it hangs just over a table with the bottom of the ball just touching the table. Draw, with chalk a circle of 20 cm. radius with its center just under the ball. Now by taking the wire near the ceiling the ball can be set swinging in a larger and larger circle. When it just swings over the circle which has been drawn on the table measure its period. Now draw the ball to one side of its central position when at rest, a distance of 20 cm., by means of the spring balance held horizontally and record the pull on the balance. This must be the force which kept it in the circle when it was swinging as a conical pendulum. (That is this is the centrifugal force in grams) From the period the velocity can be found and the above equation tested. Repeat the experiment using 25, 30, 35, and 40 cm. as radius.

**Subject VI. WORK.**

**Introduction:** When a man wheels a barrow of coal from a coal yard to your school house we say that the man has done work. Similarly when a man plays a very active game of football, we say that he "played very hard", i.e. we really mean that he *worked* very hard.

**實驗四。**

**目的:** 試驗離心力定律 ( $F = mv^2/gr$ )

**儀器:** 約 2 磅重之鐵球, 或石簧平; 矩尺, 細絲, 枱。

**方法:** 用細絲懸鐵球於天花板上, 下對一桌, 球底僅切桌面。用粉筆畫一圈徑 20 吋, 圈心正在球底, 若於近天花板處扯絲可使之繞擺一由小漸大之圈, 當他所繞之圈恰合我們桌上所畫的圈的時候, 計量他的週期。靜止此球於圈心, 以簧平水平旁牽 20 吋遠, 記簧平之示度。此必為保持他搖擺如圓錐之力, (即為離心力克數) 從此週期能求速度, 能試驗以上程式 ( $F = mv^2/gr$ ) 重作此試用 25, 30, 35, 與 40 吋作半徑。

**工 作  
題 六**

**概論:** 一人推一小車煤從煤場送到你的學堂, 我們說此人作工了。類此若一人玩一很活潑之足球鬪戲, 我們說他「玩的很出力」, 就

If a man holds a carrying pole with two pails of water we should also say that he was working. In all the relations above we recognize that there was a force involved. The man pushes the barrow, the football player keeps constantly pushing against the ground, and thus changing his state of rest or motion, and the man pushes up on the carrying pole. The last case, however, differs from the first two in that the force was stationary, while in the first two the push on the barrow moves it from the coal yard to the school, and the football player moved himself with the push through varying distances. In science we say, that in the first two cases, the force did work but in the third it did not work. Work, then, in science, involves both the force and the distance through which the force moves. The work is then the product of these two factors. What then will be a unit of work?

To put the same language into abbreviated form we say,  $W$  (work) =  $F$  (force)  $\times$   $S$  (displacement of the force) Notice that it follows from the definition that the direction of both the force and the displacement must be the same.

**Friction.** It will be observed that when things such as vehicles move, the moving parts when rubbing against each other experience a force which tends to prevent their relative motion. This force we call friction. Since it is a force which opposes motions by which we are doing work, then a part of the work which we do must be done to overcome the friction, and this work is all lost; that is we do not accomplish anything by it. (Here let the teacher demonstrate any frictional process and show that heat results.)

是我們實在以為他工作的很出力的意思。若一人担着兩桶水, (不動) 我們也說他是作工。在以上的一切關係裏, 我們承認都包含着一個力量在內。如車夫推車, 足球員往來推抵地力, 改變狀態, 時動時靜, 担夫舉担; 但末者為靜止之力, 與首二者, (推車自煤場運到學堂, 玩足球推進自己遠近更變,) 不同, 在科學上我們說首二者力成工作, 但末者力未成工作, 工作在科學上包含力與力運動經行的距離二者, 工作是此二因素之乘積, 那末, 工作單位是什麼?

變作簡單的話:

$$W \text{ (工作)} = F \text{ (力)} \times S \text{ (力移轉之距)}$$

注意。依從界說, 力的方向與力移轉的方向必須是相同的。

**摩擦。** 觀察運動物體如車輛等能看出運動諸部份彼此相摩生出力來阻擋他的相對運動。此力我們叫作摩擦, 既然此力反對工作之運動, 所以我們工作的一部份力必須去克勝摩擦, 而此一部份力乃白白消耗, 不能成半點之功。此處請教員引任何摩擦作示例並顯明熱效。

*Efficiency.* Because of friction it will be seen that we never get the work out of a system, which we put into it. The ratio,

$$\frac{\text{useful work gained from a system}}{\text{work put into the system}}$$

we call the efficiency of the system.

### Experiment 1.

*Object:* To Study the Laws of Friction.

*Materials:* Smooth wooden board, spring balance, block of wood, and weights.

*Method:* Set the board on a table and on it place the block of wood to which is attached a string. (See Fig. 20) Now pull the block along the board at a constant rate, and read the balance. This will be the friction. Now add .5 Kg. to the block and repeat. Continue to add weights of about .5 Kg. until there is a weight of 4 or 5 Kg. on the block. Keep a record of weights, which will of course include the weight of the block.

Do the tabulated results suggest any relation between the weight on the block and the friction? (Notice that in this case the weight of the block represents the normal force pushing the two surfaces, whose friction is being studied, together.)

效率。因為有摩擦，所以一個機械所成的功，決不能等於所施之功下比例。

$$\frac{\text{機械所成有用之功}}{\text{施於機械的總功}}$$

我們叫他為機械的效率。

### 實驗一。

*目的:* 研究摩擦定律。

*儀器:* 平滑木板, 簧平, 木塊, 法碼一組。

*方法:* 將木板放在桌子上, 上面放上木塊繫着線(如2圖)用簧平牽木塊順着木板極均前行, 看簧平之示度, 此即為摩擦, 加0.5法碼於木塊上重試之, 再續加法碼每次0.5法碼以至有4法碼, 或5法碼, 在木塊上。列表記錄重量與示度, 木塊重量也算在內。這表暗示木塊重量與摩擦二者間的關係麼?(留意在這種事實上木塊的重量代表我們所研究的二平面間的常壓力,)

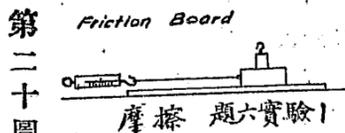


Figure No. 20

*Coefficient of Friction.* The ratio,

$$\frac{\text{Force necessary to keep the surfaces moving without acceleration}}{\text{Normal force pressing the surfaces together}}$$

is called the coefficient of friction.

Now turn the block upon another side, of larger or smaller area than the first. Repeat the experiment. Has the friction anything to do with the area of the surfaces in contact?

Using the same block and the same side in contact, pull the block at different rates. (The block must not be accelerated of course during the reading of the pull.) Has the friction anything to do with the velocity with which two surfaces rub together?

Calculate the coefficient of friction for the two surfaces which you are using.

### Experiment 2.

*Object:* To Determine the Efficiency of an Inclined Plane.

*Materials:* Inclined plane with wood or glass surface, block of wood or car with wheels, spring balance.

*Method:* Set up the inclined plane (Fig. 21) at a given angle and on it lay the block of wood or car. Weight the block, (Let it be  $w$  grs.) Let  $h$  be the height of the plane. The useful work accomplished by the plane in this case is  $hw$  gram-cm. Now by means of the spring

摩擦係數。下比例  $\frac{\text{物面不加速動所需之力}}{\text{擠壓物面之常力}}$

叫作摩擦係數。

用同一木塊同一切面, 不相同的速度去牽他(當記速度的時候必須無加速度) 摩擦與二面摩擦的速度有關係麼?

計算你所用二面的摩擦係數。

再反轉物於比前較大或較小之面, 重試之, 摩擦有關於切着面的面積麼?

### 實驗二。

*目的:* 定斜面之效率。

*儀器:* 帶木面或玻璃面的斜面, 木塊, 或有輪小車, 簧平。

見二十一圖

*方法:* 安置斜面使傾斜某定角度, 上置木塊或小車, 稱車重(如為  $w$  克) 如  $h$  為斜面之高, 在此事實上, 斜面所成有用之功為  $hw$

balance draw the block slowly up the plane, being sure that the direction of the pull is parallel to the plane. Calculate the work. The ratio of this to the useful work is the efficiency.

Find the efficiency for at least eight different angles of inclination, from,  $0^\circ$  to  $90^\circ$ . Plot a curve showing the relation between efficiency and angle.

Note that, though the efficiency approaches one as the angle of the plane increases, yet at these large angles the *mechanical advantage* of the plane disappears.

### Experiment 3.

**Object:** To Find the Efficiency of a System of Pulleys.

**Materials:** Any system of pulleys, spring balance, weights.

**Method:** Set up the pulleys. (It is suggested that they be suspended from one of the laboratory wall boards. Hang a weight on the pulleys and by means of the spring balance pull the weight up a measured distance without acceleration. Measure also the distance through which the spring balance moves. Calculate the efficiency from this data. Draw a curve of efficiency against load. (Say from 1 to 5 Kg. in steps of about .5 Kg.) Explain the variation of efficiency with load. 克。再用簧平牽  $w$  上斜面，確知牽的方向與斜面平行，計算其功，這工力與有用工力的比例就叫作效率。找出至少八個不同傾斜角斜面的效率來，如自  $0^\circ$  到  $90^\circ$

作一個曲線現明效率與傾斜角的關係。

**注意:** 雖然當傾角加大的時候，效率能增到一；但到角度很大的時候，這斜面的機械利率就消失了。

### 實驗三.

**目的:** 求一組滑車的效率。

**儀器:** 任何組滑車，簧平，法碼。

**方法:** 安好滑車(如懸於實驗室壁板之一釘)懸重於滑車上，用簧平牽之，無加速的上升一定距離，也量計簧平運動經行的路程從。

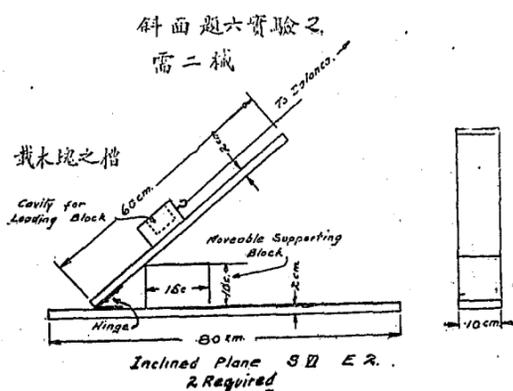


Figure No. 21 第二十一圖

## Subject VII. Fluids

**Introduction:** Ordinarily we think of air as being "soft" and as exerting practically no opposition to bodies moving through it. But a bicycle or a rickshaw tire is not soft but is quite hard. Both contain nothing but air. Why then are they hard and the air ordinarily is "soft"?

It appears that the density and volume of a gas varies with pressure. Today our experiments are arranged so that we may learn exactly what the relations between pressure and volume are.

**Note:** Temperature has not yet been referred to, nor need it be, but the teacher will, where necessary take necessary precautions against changes of temperature.

### Experiment 1.

**Object:** To Determine the Relation between Volume and Pressure of a Given Volume of Gas.

**Materials:** Capillary tube about one meter long, closed at one end and containing a column of mercury about 30 cm. long, confining when horizontal, a column of air of about 30 cm., retort stand, and condenser clamp.

**Method:** Support the tube vertically with open end up. With the meter stick measure the distance from the table top to the bottom of the 此諸數計算效率，以效率對載重畫一曲線，(如從 1 到 5 按 0.5 級數，)解釋效率隨載重更變。

## 流 質 題 七

**概論:** 我們常想空氣是「柔軟」的東西，好像對於運行其中的物體，不呈甚麼反對的抵力；但是那腳踏車或是人力車輪上的橡皮袋却不是柔軟的，乃是堅硬的東西，裏面盛的沒有別的，不過是空氣，這個就堅硬，平常的空氣就「柔軟」，是什麼道理呢？

**注意:** 尚未題及溫度，因為不必須，但教員必須謹防必要時溫度之變化。

### 實驗一.

**目的:** 定某體積氣體，體積和壓力的關係。

**儀器:** 約一呎長之微管，一端嚴封盛約 30 厘米長之水銀柱，水平時內封約 30 厘米長之空氣柱，曲架，凝縮器夾。 如二十二圖

tube, bottom of the mercury column, and the top of the mercury column. The first two readings give the length of the air column, which is proportional to the volume of the enclosed air, since the bore is assumed uniform. The second and third readings give the length of the mercury column, from which, with the barometric height, the pressure upon the gas can be determined. Now rotate the tube through about ten degrees and repeat the experiment. Continue, step by step rotating the tube about ten degrees each time, until the tube is completely inverted.

## SUGGESTED FORM OF RECORD

	H	h	H-h	L	B+(H-h)

第二十二圖

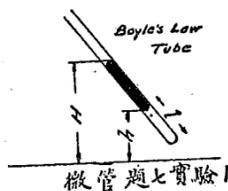


Figure No. 22

Draw a curve showing the relation between pressure and volume. (i.e. between  $[B + (H-h)]$  and  $L$ ).

This relation is referred to as Boyle's Law.

Note: If condenser clamps are not available, support tube upon inclined plane of Subject VI Experiment 2.

方法：支管直立，開端向上。用尺量自桌面至(一)管底，(二)水銀柱底，(三)水銀柱頂之長，由首二者能定空氣柱之長，此長與內封之空氣成正比例，因為管徑等均的緣故，自第(二)第(三)可得水銀柱之長，此長與氣壓計之高校對，能定內封氣體所受的壓力，再轉管十度，重試之，每次轉十度，繼續下試，直至管倒為止。

擬定之記錄式：

	H	h	(H-h)	L	B+(H-h)

畫曲線表示壓力與體積的關係(即  $B + H - h$  和  $L$  的關係)

此關係可看作波尼耳定律。

注意：如無凝縮器夾，可用題六實驗二之斜面支管。

## Experiment 2.

Object: To Find how the Pressure beneath the Free Surface of a Liquid Varies with Depth.

Apparatus: Meter stick, manometer with one short arm to be attached to meter stick; glass tube about 1 meter long and 4 or 5 cm. diameter with cork at bottom.

Method: Immerse the manometer to the greatest depth possible in the long glass tube filled with water. Record the surface reading A (See Fig. 23) where the level of the liquid touches the meter stick. Then record the level of the mercury in both the open arm B and the arm C in which the liquid pressure is exerted. The depth will be the difference between the first and third readings, and the pressure in centimeters of mercury is the difference between the second and third readings.

Raise the manometer about 10 cm. at a time until a depth of 10 to 15 cm. is reached.

Repeat the experiment using alcohol or kerosene.

Record the results graphically as well as in a neat table. See the introduction on "Analytic and Graphic Representation of Direct Proportion."

## Experiment 3.

Object: To Determine how much Lung Pressure you Can Exert.

## 實驗二。

目的：求自由表面下液體壓力如何隨深度改變。

儀器：尺桿，氣壓力計，一短股接以尺桿，玻璃管一尺長四或五厘米，底端有軟木塞。

方法：浸氣壓力計於盛水之長玻璃管內，(見二十三圖)愈深愈妙，記液體平面切桿表面之示度，記水銀在二股管——一股開，一股受液體壓力——之平面，深度即第一與第三二示度之差較；壓力論極水銀，即第二與第三二示度之差較。

上提氣壓力計每次10厘米，直到深10到15厘米，

重作此試用火酒或火油。

記錄結果用圖表，如用整齊之線表參攷正比例之分析與圖表表示法概論。



Figure No. 23

第二十三圖

*Apparatus:* Mercury manometer, meter stick, piece of rubber and glass tube.

*Method:* Arrange a manometer as shown in Fig. 24. Record the level of the mercury in arm A of the manometer. Now blow steadily for two or three seconds in the mouthpiece M, and while doing so observe again the level of the mercury in arm A, reading both times at the upper edge of the curved mercury surface in the tube.

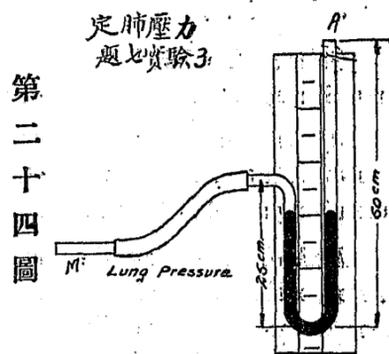


Figure No. 24

Avoid taking a reading due to a quick, hard blow at M, as the inertia of the mercury in the tube will carry it higher than your lung-pressure will sustain.

Your lung pressure in cm. of mercury is twice the difference between the two observed readings. Why? Compute the pressure in grams per sq. cm., Kg. per sq. cm., and in atmospheres. Density of mercury is 13.6 grs/cu. cm.

#### Experiment 4.

*Object:* To Study the Construction and Action of the Mercury Barometer.

#### 實驗三:

**目的:** 定你所有的肺壓力。

**儀器:** 水銀氣壓力計, 稜桿, 橡皮管, 玻璃管。

**方法:** 安置氣壓力計如圖所示, 記水銀在氣壓力計A股之平面。再穩吹氣壓力計管嘴M二三秒鐘, 此時觀察A股內水銀之平面, 看管內水銀曲面之上邊二次。

避免猛吹M所得之示度, 因水銀之惰性將使之上升高於你肺壓所能支持者。

你肺壓力以厘水銀計, 二倍於兩次觀察之示度, 為何? 計算每方厘克壓數, 每方厘鈞壓數, 大氣壓數。

水銀之密度為13.6克厘。

#### 實驗四:

**目的:** 研究水銀氣壓力計的構造和作用。

*Method:* Construct a simple cystem barometer with a piece of 6 to 8 mm. glass tubing and an ordinary bottle for cystem. Set this up in the laboratory and arrange to have all the class observe the difference of level between the cystem and the column of mercury during the days of a whole school week at periods of about one hour during school hours. Let these results be plotted in the final report. Have students make calculations of the total force upon the surface of the table, or upon the school foot-ball, exerted by the air at any of the observed periods. At the same time a study should be made of the laboratory aneroid barometer. The teacher will need to be prepared to explain why the aneroid differs from the reading on the home-made mercury barometer,

#### Experiment 5.

*Object:* To measure the Vertical Distance from the Floor of the basement of the School Building to the Highest Accessible Point of the Building.

*Apparatus:* Aneroid Barometer.

*Method:* Place the barometer face upwards upon the floor of the basement, tap the frame gently and note the reading. Then obtain the reading at the highest accessible point. The difference of these readings, expressed in millimeters, multiplied by 10.8 will be the vertical distance between these two points expressed in meters, since a difference in elevation of 10.8 meters produces a change of 1 mm. in barometric pressure. \* Why this change in pressure?

\* A qualitative answer only need be required.

**方法:** 作一簡單杯氣壓計用6到8毫米玻璃管為柱, 平常玻璃盆作杯。安置此物在實驗室內, 使全班都看杯內水銀與管。水銀平面之差在, 一星期內課時上班下班空閒時連記一星期, 結果畫表回報。(最好作曲線)

令學生計算在某期桌面或足球所受空氣全力, 同時也須研究實驗室內之空盒氣壓計, 教員須講明空盒氣壓計示度, 何以與自製水銀氣壓計不甚相同。

#### 實驗五.

**目的:** 量從校樓最下層基底到最高頂之垂距。

**儀器:** 空盒氣壓計。

**方法:** 置氣壓計於樓下層基底上, 面向上, 看他的示度, 照樣置於樓之最高頂看其示度, 二示度所差之數用10.8乘之, 就得二點之

### Subject VIII. Periodic Motion.

*Introduction.* Let the teacher take this opportunity to review ideas which were studied under the subject of uniformly accelerated motion being sure to leave a clear idea in the students' minds of the outstanding characteristics of this type of motion.

Draw out from the students by means of questions any other type of familiar motion. Examples suggested are:—the motion of the pendulum of a clock, the spring of a watch, the motion of a man sculling or rowing a boat, the motion of the balance when in use, the springs of a rickshaw or bicycle when going over a rough road, the motion of the *particles* of water as a wave passes over them.

What is characteristic of these motions? It may be noted that:—  
(a) The body passes a given point at definite intervals of time, (b) it moves between two extreme points, where it momentarily stops. What can we observe about its velocity at various points in its path? Is the velocity ever zero? Where is the velocity greatest? What can we observe about its acceleration? When is this greatest? Is it ever zero and where? (When these questions are being discussed, there should be a vibrating system, simple pendulum, or preferably a weighted suspended spring, vibrating before the class).

垂距狀數，因為每升高10.8 呎，得氣壓計變1 毫壓力，為何壓力如此變？

只要一質性上之回答。

## 週 期 運 動 題 八

**概論。**請教員此時先與學生溫習已學過之單諧運動，確使學生心目中清楚了解此種運動之顯著特性。

用問題提醒學生其他習見之運動，設想之示範如：鐘擺之擺動，表擺之擺動，舟子撥船運動，簧平用時之擺動，人力車或腳踏車經行不平之路時之彈簧跳動，波浪經過時水點之運動。

此諸種之運動特性是什麼？可以看出兩件事來：(一)物體經過一定點在有限之時間，(二)物體運動在兩個極點間，每到極點即停止前進。

在他經行路的各點上，看出速度有什麼不同？有時速度為0麼？何處速度最大？

論加速度看出什麼來？何時加速度最大？加速度有時也成0麼？何處？

The teacher having brought out these ideas about this type of motion may proceed to introduce the following terms, showing the necessity for each.

*Period* of a vibratory motion is the time which elapses between two consecutive passages of the body past a given point, and going in the same direction. *Frequency* of a vibratory motion is the number of times the body passes a given point per second going in the same direction. *Phase* refers to the instantaneous state of the system, i.e. if two pendulums were vibrating and at a given instant both were at the same proportionate distance from the central point and going in the same direction, we say that they are in the same phase. *Amplitude* is the maximum distance which the body moves from its natural position of rest. Illustrate with pendulum or spring. *Displacement* is the distance which the body is from its position of rest at any instant.

*Waves.* Stretch a stout string across the laboratory and set up waves in the string. With this illustration show that though the wave form moves forward, the particles of the string are vibrating about a natural point of rest. Show that this is a necessary condition for the setting up of a wave. Point out points of the wave which are in phase. Discuss the term, *wave length*, which is the distance between two consecutive points which are in the same phase.

(此等問題討論過以後，可以表現一個振動機械：如簡單擺，或懸簧平牽重於班衆)

教員將此種運動之意義表完後，可進而介紹以下諸名詞並顯明各名詞之緊要。

**週期。**一個振動的週期是二相連之同向運動經過某定點二次相隔之時間。

**振次。**一個振體的振次是物體每秒鐘經過某定點同一方向之次數。

**相。**指明機械同時內之狀態。例如：二擺擺動在某定時間同距其中點有同一之比例距，且係同向，我們就說他們是同相。

**幅。**為物體運動自止點至極點之距，可用擺或簧平表顯之。

**位變。**為物體自某任何點至止點之距。

**波。**橫伸一堅韌彈簧於實驗室中，使其波動，用此表顯雖波之動向係前向，但彈簧之質點則各運動繞其自然止點，指明此為撥發波動之緊要狀況，指出波之諸點在何相，研究諸名詞。

Show how the relation,  $V = n \lambda$  where  $V$  = velocity of propagation of wave form,  $n$  = frequency, and  $\lambda$  = wave length, necessarily follows from the definition of wave length. Make use of wave demonstration apparatus, as illustrated here. (Fig. 25).

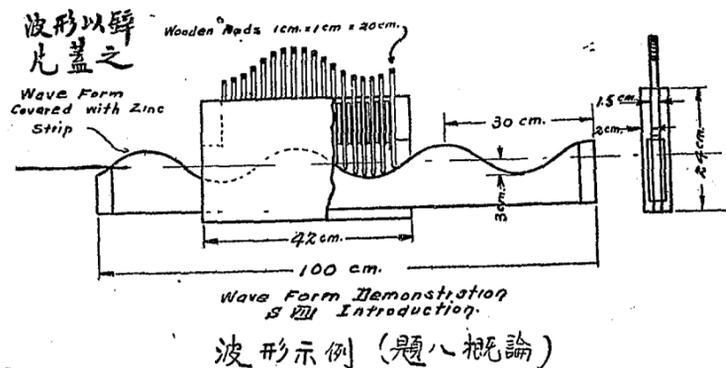


Figure No. 25 第二十五圖

**Experiment 1.**

**Object:** To Determine the Laws of the Simple Pendulum.

**Apparatus:** Bob of any material and weighing about 50 grams at least, fine string and a nail, timing pendulum.

**Method:** Hang the bob up on a nail driven into the laboratory wall, making the pendulum at least a meter long. First test the relation between amplitude and period by drawing the bob aside distances such as 5 cm., 10 cm., 15 cm., 20 cm. and measuring the period each time. Note that the length is constant and so does not effect the result.

**波長。** 即每相連之二同相點之距。

指明如何

$V = n\lambda$  關係自波長界說看為必要，式內  $V$  為波形進行速度， $n$  為振次， $\lambda$  為波長。 見二十五圖

**實驗一。**

**目的:** 定單簡擺的定律。

**儀器:** 垂線球或任何重50克之物質，細線，釘，時準擺。

**手續:** 實驗室壁上釘釘，懸掛垂線球，使擺至少一呎長，先試週期與擺幅之關係，旁牽垂球5呎，10呎，15呎，20呎等處，計他各次的週期，注意長是恒數，所以不影響他的結果。

Next test the relation between length and period. Since it will have been found that the amplitude does not affect the period, it is not necessary to adhere to a very constant amplitude; but in case students should use too large an amplitude, it is better to select an amplitude, such as 10 cm., for the rest of the experiment. Reduce the length of the pendulum in steps of about 10 cm. and take a reading of the number of vibrations in, say two minutes, until the length has been reduced to 20 cm. While doing this it is well in the interests of clearness, to take one length exactly one quarter the original length, since this period will be found to be one half the original period.

Make a record as shown below.

Amplitude	Length	No./Vibs. per Min.	Vibs./Sec.

The results should also be shown graphically.

**Experiment 2.**

**Object:** To Determine the Period of a Tuning Fork.

**Apparatus:** Tuning Fork, clamp, glass plate, pendulum, oil lamp for smoking glass, smooth board. (Fig. 27)

再試擺長與週期的關係，既知擺幅大小與週期無關，所以擺幅不必須持恆，但恐學生用太大之擺幅所以最好限制其長10呎，為實驗準則，減短擺長每次十呎試之，到擺長為20呎。為清楚得力起見，作此實驗最好減長至原長四分之一，如是他的週期必為原來週期之半。

作記錄如下

振幅長。	每方振數。	每秒振數。
.....	.....	.....
.....	.....	.....
.....	.....	.....

結果也當用圖表顯明(見概論)

**實驗二。**

**目的:** 定音叉之週期。

**儀器:** 音叉，夾子，玻片，擺，油燈，(燻玻璃之用)，平光板。

**Method:** Smoke the glass plate by holding it over the lamp and gently moving it to and fro in order that it will not become overheated at any one point. Then place it upon the board under the pendulum and tuning fork and adjust the stylus upon each of these until they just scratch the blackened glass. Now set the pendulum into vibration and also the tuning fork by bowing it or by striking it with a wooden mallet. Quickly draw the glass plate past the pendulum and tuning fork thus obtaining a simultaneous trace of pendulum and tuning fork, as in Fig. 26.

After this, with a watch, determine the period of the pendulum by counting the number of vibrations in one or two minutes or by counting up to 50 vibrations and recording the time. From the trace obtained and the data upon the period of the pendulum the period of the tuning fork can easily be obtained.

(It is suggested that the teacher obtain the trace and then allow the students to complete the observations and calculations, since the technique is rather difficult for the average student).

The average of at least three traces should be taken, or three groups of students might each get the results upon one trace and calculate the final results as the average of these three traces.

Record	1st. Trace	2nd. Trace	3rd. Trace	No./Vibs. of Bob.
Vibs. bet. & A C =				
„ „ B D =				
„ „ C E =				
„ „ D F =				
Means =				

**手續:** 平舉玻璃片在油燈焰上過來過去移動, 使烟食燻於玻璃面上一薄層, 要均勻無太厚處, 放此玻片於平光板上置於音叉下, 較準叉針與擺針, 使之恆畫黑玻面, 發動擺, 同時也吸動音叉或用木錘擊之, 速拖玻璃經過擺與音叉, 同時得擺與音叉所畫之二線迹,

如二十六圖

此後用表定擺之週期, 或數其一二分鐘所有之振數, 或數其每五十振所用之時間, 從所畫之線迹與所得擺之週期數至易得音叉之週期。

(意以請教員先試得線迹, 只令學生完成其觀察與計算, 因此項技藝較難, 恐非中才學生所能作)

Final Mean =  
No. of Vibs./Bob./Sec. =  
Therefore Rate of Fork =

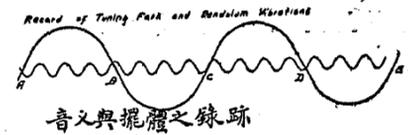


Figure No. 26 第二十六圖

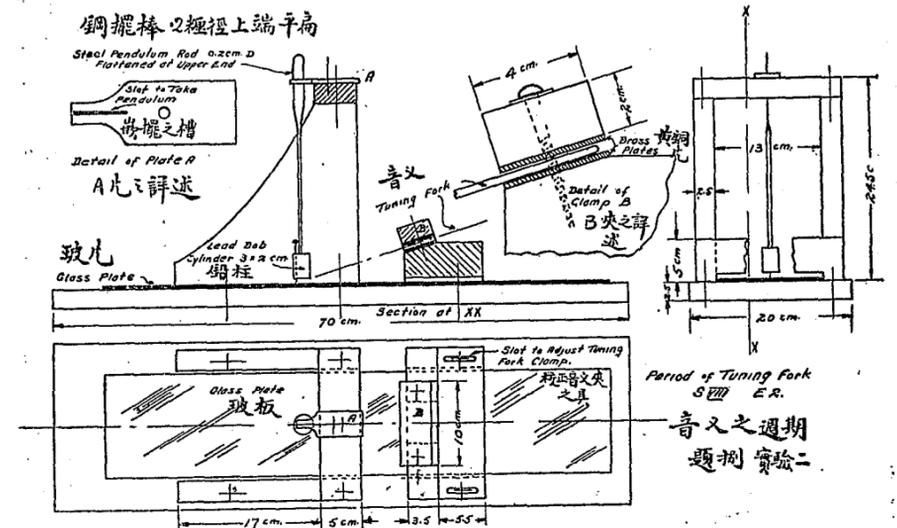


Figure No. 27 第二十七圖

**Experiment 3.**

**Object:** To Determine the Relation between the Frequency of a Vibrating System and the Restoring Force.

至少須得三線迹之均數, 或三組學生各得其線迹之結果, 計其末了結果為三線迹之均數。

記錄: 第一線 第二線 第三線 擺之振數。

振數自 A 到 C =

„ B 到 D =

„ C 到 E =

„ D 到 F =

平均 =

總均 =

每秒擺錘之振數 =

所以音叉振數 =

實驗三。

目的: 定振動機械振次與其復原力之關係。

**Materials:** Weights, stove-pipe wire, meter stick, small mirror.

**Procedure:** Upon a nail in one of the laboratory wall boards suspend a spring, which has been made up in the following way: Using ordinary stove pipe wire (about 0.5 mm. diam.) wind about 170 cm. upon an iron rod of about 1 cm. diameter, so as to form a close helix. When this is completely wound and released it is ready for use. Behind the spring fix a meter stick. Suspend from the spring a small weight, say 20 grs. merely to straighten it out to hang parallel with the meter stick. Now fix upon some part of the spring, say the hook at the end of the spring to which the 20 gram weight is attached, as a point from which to take measurements. Hold a small mirror beside the scale, so that this point can be seen in the mirror. Read the scale division which is just in line with the hook and its image in the mirror, and record the reading. Now add 50 grams to the spring, making all told 70 grams, and in a similar way record the point where the hook rests, again add 50 grams and read the scale. Now remove the two fifty-gram weights, one by one, observing the resting points in the reverse direction. If these seriously differ from the resting points when the weights were being added, the spring has been stretched beyond its elastic limit and the readings are useless. In this case the experiment must be repeated.

From these readings calculate the stretch of the spring per gram of stretching force. This is called the force constant of the spring.

Replace the 50 gram weight upon the spring and just under the weight make a chalk mark upon the scale. Draw the weight down

**儀器:** 法碼, 爐管絲, 稭桿, 小鏡。

**手續:** 釘一釘於實驗室壁板上, 懸一簧平於上, 此簧平按下法作之: 用平常爐管絲 (約0.5厘米徑) 纏於約一寸徑之鐵棍上至170厘米長, 如此作成一密擠螺圈, 完成後, 抽出鐵棍, 螺圈即開放成爲有用之簧平, 於簧平身後釘一稭桿, 懸掛微重, 如20克於簧平上以引伸之與稭桿平行, 於是在簧平下端, 即懸20克重勾上之任揀定點作試量之起點, 度分旁舉一小鏡, 藉以觀察某定點看鏡內與勾在一線上之稭桿分度像記之, 加重50克於簧平上與前20克共湊70克如上法記其勾之止點度分, 再加50克如此記之, 後將此兩個50克一一移下, 看簧平縮回之止點。

如其止點太異於加重時之止點, 乃係簧平已伸過其彈力限, 歸於無用, 故此試須另作。

從所讀諸數計算每克重使簧平伸長若干, 此爲簧平之力恆數。

about three centimeters below the chalk mark and let it go. The system now vibrates and with the aid of an ordinary watch count the vibrations in one minute.

Now make a spring of a little over twice the length of wire which was used in the above spring and suspend as before with the 20 gram weight hanging. Test the stretch when the 50 gram weight is added. If it is more than twice the stretch of the first spring cut off a coil and try again. Proceed in this way until this second spring has just twice the stretch for fifty grams force, which the first had. Now repeat the experiment to find its force constant. This should not differ by more than 1% from one-half the value for the first spring.

With 70 grams suspended from this second spring again find the number of vibrations per minute.

Now both vibrating systems were the same, i.e. same mass vibrating, but in the second case the restoring force was just one half the first. This will enable us to find the relation between frequency and restoring force, and we may apply the result to any such vibrating system.

Record.

First Spring			Second Spring		
d	Scale	F	d	Scale	F
5.8	69.0	0	11.4	37.6	0
5.6	63.2	50	11.5	26.2	50
5.5	57.6	100	10.9	14.7	100
5.6	63.1	50	11.5	25.6	50
	68.7	0		37.1	0

重懸50克重於簧平上, 恰於重下用粉筆畫記之, 下引其重約去粉筆畫3厘米遠捨之, 此械遂振動, 如用一平常表, 可數他每分鐘之振數。

再作一簧平較上用者長二倍有奇, 懸掛如前, 先掛20克重, 再掛50克重, 看其伸長, 如其伸長較前用者多於二倍, 可割去一圈試之, 再多再割, 直至其伸長正抵前者之二倍, 再求其力恆數, 此數不得較前力恆數之半差過百分之一。

共用70克重懸於此簧平上求其每分鐘之振數,

二振動機械是相同的, 同是質振, 但第二者之復力正抵第一者之半, 此足使我們能求振次與復原力之關係, 並且也可以實施此於任何此種振動機械。

Av'g. 'd'/50 grams. = 5.6 cm.

(F/d)<sub>1</sub> = 8.9 grams. per cm.

Vibrations/min. = 109

Vibs./sec. = n<sub>1</sub> = 1.82

Av'g. 'd'/50 grams. = 11.3 cm.

(F/d)<sub>2</sub> = 4.4 grams. per cm.

Vibrations/min. = 76

Vibs./sec. = n<sub>2</sub> = 1.26

$$n_1/n_2 = 1.82/1.26 = 1.4$$

$$\sqrt{(F/d)_1} / \sqrt{(F/d)_2} = \sqrt{8.9} / \sqrt{4.4} = 1.4$$

The frequency is therefore proportional to the square root of the restoring force.

It is suggested that at least two groups of students work at this experiment, the second group working with two springs whose restoring forces are in the ratio 1/3. The results may then be compared.

The experiment affords an excellent test of Hooke's Law, and reference should be made to this.

The teacher should prepare the springs before the class period but the students should test the ratio of the restoring forces.

### 記錄

第一簧平			第二簧平		
d	Scale	F	d	Scale	F
5.8	6.90	0	11.4	37.6	0
5.6	63.2	50	11.5	26.2	50
5.5	57.6	100	10.9	14.7	100
5.6	63.1	50	11.5	25.6	50
	68.7	0		37.1	0
平均 'd'/50 克 = 5.6 厘			平均 'd'/50 克 = 11.3 厘		
F/d = 8.9 克每厘			F/d = 4.4 克每厘		
每分振數 = 109			每分振數 = 76		
每秒振數 = n <sub>1</sub> = 1.82			每秒振數 = n <sub>2</sub> = 1.26		
n <sub>1</sub> /n <sub>2</sub> = 1.82/1.26 = 1.4					

$$\sqrt{(F/d)_1} / \sqrt{(F/d)_2} = \sqrt{8.9} / \sqrt{4.4} = 1.4$$

所以振次與復原力之方根成正比。

意者。至少兩組學生作此實驗，第二組學生可用復原力比例為1/3之簧平。未將所得結果與第一組比較之。此實驗作成最好之機會以援引虎克定律。

(至好教員預先作成此兩種簧平使學生只作此試，不須自作簧平)

### Experiment 4.

**Object:** To Test the Laws of Vibrating Strings; the Relation between Length and Frequency.

**Materials:** Sonometer, can, and shot or sand.

**Procedure:** Suspend the sonometer upon one of the laboratory wall boards (see Fig. 28) and by means of the can and shot, or sand, weight the cords to a suitable tension. Set the movable bridge to make the cords as long as possible, and of equal length. Now adjust the tensions until both cords give the same note, i.e. frequency is the same. Now by means of the movable bridge shorten one of the cords until the note which it emits is just one octave above that of the other. Measure the new length and record.

Repeat the experiment at least three times, or until consistent results are obtained, using different tensions and original lengths each time.

Make a clear record which will show what relation exists between the length and frequency of a vibrating string.

Note: Strings should be of same mass per cm. in this experiment and in Experiment 5.

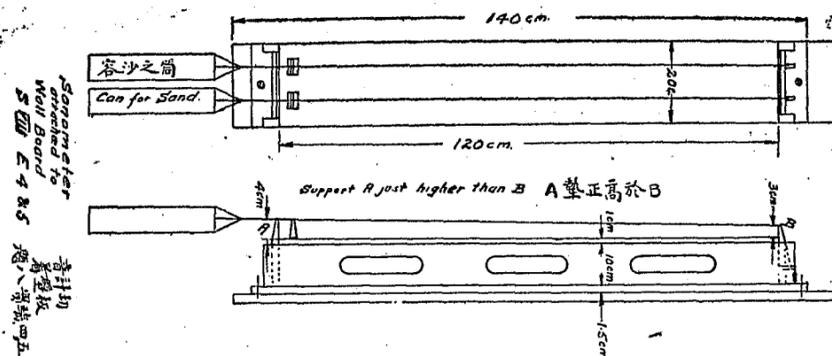


Figure No. 28 第二十八圖

### 實驗四。

**目的:** 試驗振弦定律，長度與振次之關係。

**儀器:** 音計，筒，彈丸或沙， (見圖二十八)

**手續:** 懸起一音計，於實驗室壁板上，用筒與彈丸或沙墜於弦上，使其有適宜張力，安置可移動之支橋，使其至極長且二者同長。於是較正張力，使二弦發同一之音，即振次相同。用移動支橋縮短一弦以至其發音正較餘一弦發音高一階。計量弦長記之。

**Experiment 5.**

**Object:** To Test the Laws of Vibrating Strings; the Relation between Tension and Frequency.

**Materials:** Same as in 4.

**Procedure:** Adjust as in 4. Then add sand to one of the pails until the cord upon which it hangs emits a note one octave above the cord whose tension remains constant. Now weigh the two pails with their contained sand. How do the weights compare? Repeat using different length of cord and different original tensions. Repeat at least three times, until consistent results are obtained.

**Note:** As a seminar class exercise the teacher might devise and demonstrate an experiment to find the relation between frequency and mass of the vibrating string. The result may not be so convincing since it will be difficult to select two cords having their mass per cm. in the ratio 2:1.

Any stringed musical instrument may be used to adjust the period of the strings.

**Subject IX. Temperature and Expansion.**

**Introduction.** Let the teacher refer to such familiar facts as these:—The air in a bicycle, or rickshaw tire, or in a football, or basketball bladder, will expand when these are left in the sun. A kettle filled with cold water from a well, will over-flow when it becomes heated.

重作此試至少三次或以至得到一致效果。每次用原有之長與不同之張力。

作一清楚記錄。顯明振弦之長度與振次間之關係。

**注意:** 此試與實驗五之弦必須每繩皆等重。

**實驗五。**

**目的:** 試驗振弦定律;張力與振次間之關係。

**儀器:** 同實驗四。

**手續:** 安置如上試。將一筒內加沙以至於其弦所發出之音較餘一張力持恆者高一階,於是稱二筒(帶沙)重量比較如何?用不等長不等原張力重作實驗。重作至少三次。以至得一致之結果。

**注意:** 爲使高級生練習起見。教員可授意或示例一實驗,求振弦質量與振數之關係。結果將不至如此之恰切因所選之弦每繩長質量比例極難恰爲 $\frac{1}{2}$

**溫度與膨脹  
題 九**

**概論.** 請教員援引習見之事實如下:

空氣在腳踏車,人力車皮袋內,足球內,籃球內之膨脹,如置於太陽下曬之。

Any simple demonstrations may be set up and shown here in order to show that this is, in general, a common property of substances. This being so, we might use this property to measure the "hotness" or "coldness" of bodies. This is actually what we do, and the condition which we measure we call temperature.

Here introduce the mercury in glass thermometer and appropriate demonstrations, being sure to impress upon the students' minds that it is by means of the difference in expansion of the mercury and glass by which we measure temperature.

Discuss the construction and calibration of the thermometer, emphasizing the fixed points, the division of the distance between the fixed points into 100 parts, and the definition of each division as a "degree of temperature." See that students appreciate the fact that this is a satisfactory way of practically comparing temperatures but that this definition of temperature is entirely arbitrary. Show that any substance, solid, liquid or gas might be used to measure temperature and point out the practical advantages of the mercury in glass method. At the same time it is well to point out the shortcomings of this thermometer and particularly its liability to error due to different properties of the glass and structural defects in the thermometer. In this discussion the opportunity will arise to point out that water when freezing and when boiling remains at a constant temperature.

一鍋滿盛自井新汲上之冷水,加熱後必外溢。

可安置任何單筒示例,現明此爲一切物質之大半通具性質。

如此我們可以用此種性質計量物體之「熱」與「冷」。實際上我們也是如此作,所計量之性質,謂之溫度。

此處介紹玻璃溫度計中之水銀,與其他顯著示例與學生,確切銘刻於其心目中,用水銀與玻璃不同之膨脹,我們能計量溫度。

研究溫度計之構造與刻畫,注重其定點。定點中間之距分爲一百份。每一份之界說爲一「度溫」。

使學生明曉此種事實爲實用比較溫度之完滿法則;但溫度之界說,則爲完全假定者。

現明任何物質:固體,液體,或氣體皆可用以計量溫度,更指明水銀在玻璃內計量溫度之實在優點。至好同時也指出此等溫度計之缺點,特別是因玻璃性質不同,與構造上之缺陷所出之差誤。

在此研究中亦爲至好之機會提出水當結冰或當沸騰的時候,溫度持恆。

By boiling water in a flask, corking the flask and pouring water over it the water in the flask will be seen to boil, though the temperature is obviously not  $100^{\circ}\text{C}$ . This will give an introduction to the subject of the relation of pressure to the boiling point and will impress upon the student's mind the necessity of consulting the barometer rather than the thermometer when the temperature of steam is measured in an experiment.

*Volume Coefficient of Expansion.* It will be remembered that because we wished to compare the densities of bodies we found it was necessary to compare the pull of the earth upon unit volumes. Similarly if we wish to compare the rate at which gases expand with rise of temperature we must not only consider equal rises of temperature, but we must also consider the initial volumes of the gases to be compared to be the same. This will be most conveniently done if we simply agree to always compare unit volumes of gases. If we have a volume of gas  $V_1$  at a temperature  $t_1$ , and we increase the temperature to  $t_2$ , let us say the volume becomes  $V_2$ . Then the increase of volume per degree rise in temperature will be given by  $(V_2 - V_1) / (t_2 - t_1)$ . This only tells half the story however, since we decided always to refer to unit volumes of gas. This ratio will therefore need to be divided by  $V_1$ , and the final expression becomes,

$$a = \frac{V_2 - V_1}{V_1 (t_2 - t_1)}$$

煮水於瓶中至沸，用軟木塞瓶口，潑水於其上，水在瓶中仍然沸騰，雖其溫度顯非  $100^{\circ}\text{C}$ 。此將作壓力與沸點關係之題目一個介紹；且使學生心中注重當計量蒸汽溫度的時候，氣壓計較溫度計尤為緊要。

*體漲係數：*須記我們要比較物體密度的時候，我們曾尋得必須要比較地球施於單位體積的引力。類此，我們若要比較氣體因溫度升高而體漲之數的時候，我們不但也須審量升高相等的溫度；且是也必須審量要比較的氣體原初體積必是相等的。這個也必是極便利的，若是我們要一致的去拿單位體來比較。若是有  $V_1$  體積氣體，在  $t_1$  溫度，我們加溫度到  $t_2$  他的體積如說成爲  $V_2$  如此每加溫一度所增的體積必爲  $\frac{V_2 - V_1}{t_2 - t_1}$  此僅及事之半功，因爲原規定是單位體積氣體，所以這個必須再用  $V_1$  (原體積) 去除他，結果，

$$a = \frac{V_2 - V_1}{V_1 (t_2 - t_1)}$$

By analogy have the students set up the definition of the *Linear Coefficient of Expansion*, for solids.

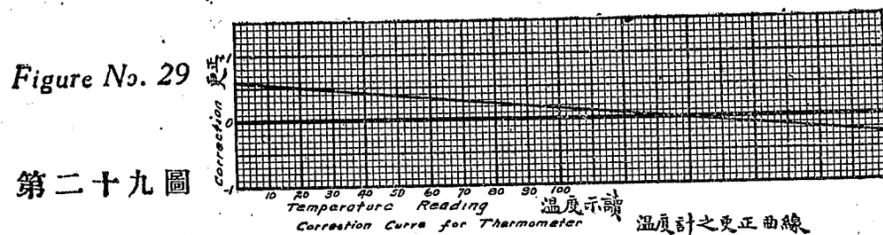
### Experiment 1.

*Object:* To Calibrate a Mercury in Glass Thermometer.

*Materials:* Thermometer, glass funnel and catch basin, ice, boiler, barometer.

*Method:* Let the student first examine the thermometer until he realizes that it is actually a means of measuring temperature by the difference of expansion produced between the glass container and the mercury. He should be told something about the construction of the thermometer so that he can report this to the class in a later period.

Place the thermometer into finely ground ice and distilled water until the mercury column remains stationary. Later put it into the steam dome of the boiler (Fig. 30) and let it remain there until the column becomes stationary. Record both these readings as well as the barometer. From these find the error at the freezing and the boiling point. Now plot the relation between temperature scale as marked upon the thermometer stem and the error. This will be done by making the ordinate represent error and the abscissa the scale reading. Mark the error at freezing and boiling point and join by a straight line which will give the error at any point on the thermometer. (Fig 29.)



類此，令學員自擬固體線漲係數之界說。

### 實驗一。

*目的：*校準水銀溫度計。

*儀器：*溫度計，玻璃漏斗，面盆，冰，汽罐，氣壓計。

*手續：*先使學生詳細觀察溫度計，直至確實了解他計溫度是藉着水銀在玻璃管內膨脹以後，與未膨脹時的差數。也必須使學生略曉溫度計的造法，以後回報於班衆。(見三十圖)

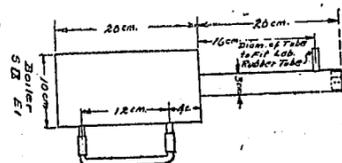


Figure No. 30 第三十圖

### Experiment 2.

**Object:** To Find the Coefficient of Linear Expansion of a Sample of Glass Tubing.

**Apparatus:** Glass rod, (6 to 8 mm.) about 0.8 to 1 meter long. thermometer, rubber tubing, boiler and lever for reading expansion.

**Method:** Place the rod so that one end A (Fig. 31) will rest upon another glass rod B, which in turn rests on a glass plate C. The other end D of the glass rod is fixed by filing a notch in it and placing the notch upon the edge of a piece of zinc or tin E. This end of the tube is

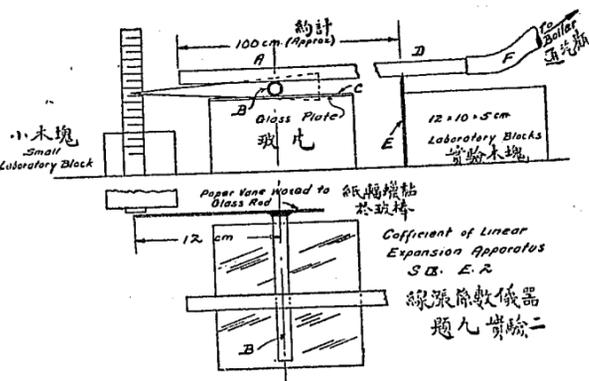


Figure No. 31 第三十一圖

also attached to a rubber tube F, which connects with the boiler. Place the thermometer inside the open end of the tube. When the thermometer becomes steady, read the temperature and at the same time record the length of the rod from the open end to the notch. Now get steam up in the boiler and let it pass through the glass tube until the thermometer shows a steady temperature. When this occurs read the barometer.

置溫度計於細冰球(摩擦而成)與汽水混合物中,直到水銀柱安定。再置於汽罐上蒸汽洞中直到安定。記錄二次之示度與氣壓計示度,從此找出冰點與沸點的錯誤來。畫曲線表示溫度計管上之刻度,與錯誤之關係,以縱坐標代表錯誤,橫坐標代表刻度,察出冰點與沸點之錯誤,以直線連之即得溫度計任一點之錯誤。(見二十九圖)

### 實驗二.

**目的:** 求一標模玻璃管之線漲係數。

**儀器:** 玻璃棍(6到8毫米之徑)約0.8到一呎長,溫度計,橡皮管,汽罐,膨脹示度之槓桿。(見示圖) (見三十一圖)

**方法:** 放玻璃棍之彼端A於轉於玻璃片C上之別一玻璃棍FB上,玻璃棍D端刻一痕口,將痕口切於鋅片或鉛片E上,連橡皮管於此端,橡皮管連於汽罐,放溫度計於彼端管之開口內,當溫度計溫度穩定後,看其溫度,同時計玻璃管自開端至痕口之長,使汽罐蒸汽通過玻璃管,以至

Don't record the thermometer reading. Note also the divisions of the scale over which the pointer has passed. (See illustration).

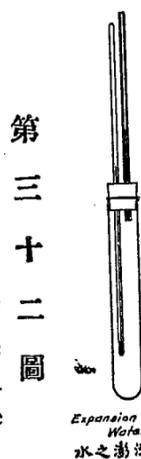
From this data calculate the coefficient of linear expansion of the glass in the tube.

### Experiment 3.

**Object:** To Study the Expansion of Water with Rise in Temperature.

**Apparatus:** Test tube with stopper to take capillary tube and thermometer, thermometer, piece of capillary tube.

**Method:** Fill the test tube with distilled water and then place the cork into the mouth until the water rises about half way up the capillary. (See Fig. 32) Place the test tube in a freezing mixture of salt, ice and water, and stir until the temperature falls nearly to zero. Add a little water to the freezing mixture and then let this gradually warm up—this must take place very slowly—and while this is going on keep note of the temperature of the water in the test tube and the height of the water in the capillary. This latter will be an indication of the increase or decrease in volume of the water.



第三十二圖

**Caution.** There must be no air entrapped between the water in the capillary and that in the test tube. Figure No. 32

溫度計溫度穩定,此時看氣壓表,計溫度計示度,注意看針尖所過度分。(見示圖)

從所得諸數計算玻璃管之線漲係數。

### 實驗三.

**目的:** 研究溫度升高水之膨脹。

**儀器:** 帶塞試筒,塞上有孔可插微管及溫度計於內,溫度計,微管一截。

**方法:** 試筒內裝滿汽水,口塞軟木塞,直至水在微管內升至半滿(見三十二圖)放試筒於鹽,冰,水混合寒劑內,攪動之直至溫度降為0°少加水於寒劑內使溫度漸漸升高(使極慢)此時注意試筒內水之溫度,與微管內水之高度,高度即表示水體積之增減。

**預防:** 作此實驗必須微管與試筒內,無空氣關鎖在內。

It will not be possible for the student to obtain the result, that the density is a maximum at four degrees, because of obvious errors, but this may be pointed out to him and the experiment will show clearly the anomalous expansion of water. The student should at the same time note the flotation of ice.

#### Experiment 4.

*Object:* To Determine the Relation between Volume and Temperature of a Given Quantity of Gas.

*Materials:* Capillary tube about 30 cm. long, having one end sealed and a column of dried air enclosed by a small mercury piston about two cm. long, ice, boiler, thermometer, meter stick.

*Method:* Record the room temperature and the length of the air column at this temperature. Place the air column in melting ice, until the mercury piston ceases to fall. Tie a thread at the bottom of the mercury piston and remove it from the ice bath. When it has remained in the air for a short while, put it into a steam bath and mark the bottom of the piston with a thread, when the mercury piston ceases to rise. Measure the lengths of the columns of air thus obtained and record. Read the barometer and thus find the temperature of the steam from tables.

From this data calculate the coefficient of expansion of air at constant pressure. From the result thus found and the length of the column of air at room temperature calculate room temperature, and compare it with the thermometer reading. Record your error.

因為顯然的錯誤學生或不能恰得水之頂大密度在四度。可以向他們指明。但此實驗是顯示水之膨脹特徵，學生同時也必注意冰之浮水。

#### 實驗四：

**目的：**定某定量氣體體積與溫度間的關係。

**儀器：**30厘米長之微管一端嚴封，乾空氣柱被約二厘米長之小水銀活塞封閉於內，冰，汽罐，溫度計，尺桿。

**手續：**記室內溫度與在此溫度時空氣柱之長，將空氣柱放在融冰裏，直到水銀活塞不降，繫線於水銀活塞之底記之，從冰櫃移出在空氣內少留，再放於蒸氣內，直至水銀活塞不再上升，繫線於活塞底記之，量二次空氣柱之長記之，看氣壓計，按表查出蒸氣之溫度。

於得數內計算定壓力之空氣之體漲係數，從你所得結果和在室溫度空氣柱之長計算室內溫度(假此為未知者)將求得者與溫度計所記者比較之。記下你的錯誤。

The coefficient of expansion of air is .0036. What is your percentage error?

### Subject X. Heat and Change of State

*Introduction.* There are two kettles, one large and one small. They are filled with water from the same well and placed at the same time over the same fire. What do we know about the temperatures of the water in the two kettles when they are first placed upon the fire? What do we know about the temperatures of the two kettles when they come to a boil? Then we know that they have been raised through the same temperatures. Will they come to a boil at the same time? Why not? Evidently it takes more heat to raise the large kettle of water through a given range of temperature than the small kettle.

Our ideas, then, of heat, and of temperature differ. We measured temperature by means of a thermometer and we agreed upon a definition of "one degree rise in temperature". How shall we measure heat, and what shall we call "one unit of heat".

Here any appropriate demonstration may be introduced to show that substances differ in the amount of heat which is required to raise their temperatures through the same range. A suggested demonstration is to put spheres, of the same weight, of different substances into boiling water until they have all reached the same temperature. Now dump them all at the same time upon a plate of paraffin wax. The amount of wax melted under each sphere will give an indication of the

空氣的體漲係數是0.00366,你的百分差幾何?

## 熱與狀態變化

### 題 十

**概論：**有二鍋於此，一大一小，盛一同井新汲上之水，同時置於同一火上煮之。

當二鍋甫置火上時，我們知道他們裏面水的溫度是什麼？

如二鍋都沸騰我們也知道他們的溫度是什麼？

所以我們知道他們從初至沸升高同一之溫度。

但他們一定同時沸騰麼？

為何不然？

顯然的大鍋必須較多之熱始能與小鍋達同一之溫度。

因此我們對於熱與溫度兩個東西的意義是不相同的。

我們計量溫度用溫度計，我們也都同意於「升溫一度」之界說。

amount of heat which each sphere gives out while it is cooling from boiling point to room temperature.

*The unit of heat.* Since the heat absorbed by a substance seems to depend upon three factors, viz. (1) the rise of temperature, (2) the kind of substance, and (3) the mass of the substance, it will be necessary when setting up a definition of the unit of heat to consider the heat needed to raise a gram of a definite substance through one degree. Water has been chosen as the substance to be used for this purpose.

*The unit of heat* is then, the heat necessary to raise the temperature of one gram of water one degree. It will be easily seen that this might be stated, the heat given up by one gram of water when cooling through one degree.

Since the heat required to raise a gram of different substances through one degree differs, it will be useful to know how substances compare with water in this respect. Hence, arises the idea of *Specific heat*, which is the heat required to raise one gram of a given substance through one degree, compared with the heat required to raise a gram of water through one degree. Or since the latter value is one unit of heat, we may say that Specific Heat of a substance is the heat required to raise one gram of the substance through one degree. The student, however must not lose sight of the fact that this latter statement arises because of the way in which we defined a unit of heat.

此處可介紹顯著示例，表明不同物體需用不同量之熱，始能使其皆升達某溫度。

設想之示例：投不同質而同重之球於沸水，以至升同一之溫度。於是同時加之於巴拉芬上，各球下巴拉芬融化之量數，即表示各球所散出之熱量自沸點至室溫度。

**熱之單位** 既然物質吸熱似依三因素：(一)升高之溫度，(二)物質之種類，(三)物質之質量。所以要給一個熱之單位的時候，可以想度某物質每一克升熱一度所須之熱。水已經被選為此等物質標準；所以熱之單位，為使一克水升熱一度所須之熱量，或說一克水降熱一度所放之熱量也是一樣。

既然一克不同之物質升熱一度所需之熱量不同，所以曉得不同之物質與水比較便有用。

從此興起比熱之意義，即物質每升熱一度所需熱量，與水每升熱一度所須熱量之比數，既然次者是一單位熱量，所以也可說比熱即某物質升熱一度所需之熱量，但學員不可輕忽此末後之說明係源出熱之單位之界說。

Using water to illustrate, draw attention to changes of state, (ice-water-steam) when heat is applied to a body. Note also, (see Temperature and Expansion) that when a substance is changing its state, its temperature remains constant, though heat may be added or removed. The teacher will be prepared to give a very elementary explanation of this upon the molecular theory.

This gives rise to the ideas of *heat of fusion and heat of vaporization*. The *heat of fusion* of a substance is the heat required to change one gram of the substance from the solid state to the liquid state. The *heat of vaporization* is the heat required to change one gram of a substance from the liquid to the gaseous state. Note the reverse processes.

The fact that the temperature of a substance remains constant while its state is changing gives us a means of finding the melting and freezing points of substances. If we let a substance cool down from the liquid state until it freezes, and while doing so, record the temperature every minute or half minute, then plot temperature against time, the curve will be horizontal while the state of the substance is changing because then the temperature is constant.

### Experiment 1.

*Object:* To Study the Law of Mixtures.

*Apparatus:* Calorimeter (Fig. 33) constructed from a 250 cc. and a 500 cc. beaker, one 250 cc. beaker, one 500 cc. beaker, two thermometers, alcohol lamp, ice.

用水表示狀態變化，(冰—水—汽)在物體加熱之後，也注意(見溫度與膨脹)當物質變化狀態時，溫度仍然持恆，雖然熱可以加上或是移去。

教員須預備給學生一個淺白之講解，論及物質之分子理論。

此將發生熔解熱與蒸發熱之意義。

物質之熔解熱即使一克物從固體狀態變成液體狀態所需之熱量。

蒸發熱 即使一克物質從液體狀態變成氣體狀態所需之熱。

注意：反而言之亦然。

物質溫度不變而狀態變，給我們一個求物質融點與冰點的法子，如吾使一物質自液體狀態變冷至固體狀態，畫一曲線以溫度對時間，此曲線將為水平式，以溫度未變，但物質之狀態則已變矣。

### 實驗一。

目的：研究混合之定律。

**Method:** Place a thermometer into the calorimeter and let it remain there until a steady state is reached. Call this room temperature. Pour 100 grs. of water into each of the two beakers. The water must be well below room temperature. Adjust the temperatures of the two vessels of water until one is 5 or 6 deg. below room temperature and the other 5 or 6 deg. above room temperature. (If ice is available and a difference above and below room temperature of  $10^\circ$  can be obtained so much the better). Each beaker must have a thermometer in it, in order that the readings of temperature may be as instantaneous as possible. Immediately after taking the two temperatures pour the water from the two beakers into the calorimeter which is at room temperature. Stir for about a minute with *both* thermometers and then take the reading on each thermometer. Calculate how many calories of heat the warmer water has lost and how many the colder water has gained.

Repeat the experiment by mixing 200 grams of water at a temperature  $5^\circ$  below room temperature with 100 grams of water at a temperature  $10^\circ$  above room temperature.

### Experiment 2.

**Object:** To Find the Water Equivalent of a Glass Beaker.

**儀器:** 用 250cc. 與 500cc. 比格杯作成之卡計, (量熱器) (見三十三圖) 250cc. 比格杯一, 500cc. 比格杯一, 溫度計二, 酒燈, 冰。

**方法:** 放溫度計於卡計內多時以至溫度穩定, 以此為室溫度, 每杯內傾入 100 克水, 水必須較室溫度低校正二杯內水之溫度, 以至一較室溫度低 5 度一較室溫度高 5, 6 度 (如用冰可得較室溫低高各 10 度之差數更好) 每比格杯內必有一溫度計, 以便同時查其溫度, 看明二溫度後立刻將二杯之水傾入室溫度之卡計內, 用二溫度計攪動約一分鐘, 看各計示度, 計量熱水共失熱之卡數, 冷水共得熱之卡數。

重作此試混合 200 克較室溫度低之水與 100 克較室溫度高之水, 計算之。

### 實驗二.

**目的:** 求玻璃杯之水當量。

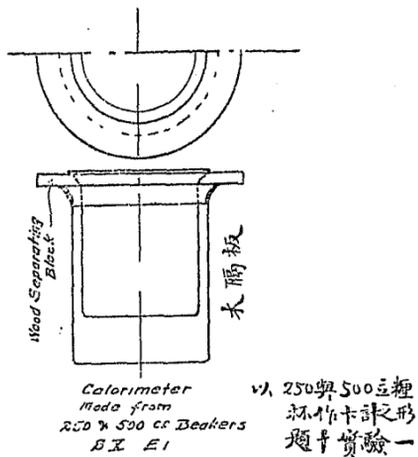


Figure No. 33 第三十三圖

**Apparatus:** Calorimeter constructed of a 250 cc. and a 500 cc. beaker, one 250 cc. beaker, two thermometers, alcohol lamp, ice.

**Method:** Pour 125 grams of cold water into the calorimeter and adjust its temperature until it is  $10^\circ$  below that of the room. Then pour 75 grams of water into the 250 cc. beaker and make its temperature about one and one-half times as many degrees above room temperature as the water in the calorimeter is below room temperature. With different thermometers stir the water in each vessel thoroughly, at the same time tipping the calorimeter so that the water in it will come into contact with all parts of the surface. This is to give the vessel the temperature of the water. Read the temperature in each vessel very accurately and then pour the warmer water into the colder. Stir for half a minute with *both* thermometers and then read the temperature on each thermometer. Calculate the number of calories lost by the hot water and the number gained by the cold. Why are these quantities not equal? Consult with students who are doing experiment No. 1. From the difference between this result and that given by the law of mixtures calculate the number of calories required to raise the temperature of the vessel through  $1^\circ$ . This is called the *water equivalent of the vessel*.

### Experiment 3.

**Object:** To Find the Specific Heat of a Metal.

**Apparatus:** Calorimeter made from a 250 cc. and a 500 cc. beaker, metal dipper, metal "shot," thermometer, barometer.

**儀器:** 用 250cc. 與 500cc. 比格杯所造之卡計, 250cc. 比格杯一, 溫度計二, 酒燈一, 冰。

**方法:** 傾 125 克冰水於卡計內, 較準其溫度以至  $10^\circ$  低於室溫度。於是傾 75 克水於 250cc. 比格杯內, 使其溫度約高於室溫度一倍半, 於卡計內水低於室溫度之數。用各溫度計攪動各杯之水均勻, 同時傾斜卡計使內中之水得與內面各部相切, 如是水之溫度給予筒, 看準二器水之溫度, 傾熱水於冷水內, 用溫度計攪動約半分鐘, 看溫度計之溫度, 計算熱水失熱卡數與冷水得熱卡數, 二數量何故不同? 與作過實驗一之學生討論之, 從結果之差數, 與混合定律之差數, 計算每使筒升熱一度所須熱之卡數, 此數即筒之水當量。

### 實驗三.

**目的:** 求某金屬之比熱。

**儀器:** 用 250cc. 與 500cc. 所製之卡計, 金類屏, 金類彈, 溫度計, 氣壓計,

*Method:* Weigh the inner beaker of the calorimeter and then, pour into the calorimeter about 200 grams of water which is as far below room temperature as possible ( $10^{\circ}$  below room temperature will be very satisfactory) Into a metal dipper put about 120 grams of the metallic "shot" whose specific heat is to be determined, weigh the dipper and the shot, and then place this dipper into the steam of a boiler until you are sure that the shot has all taken up a steady temperature. Read this with a thermometer. Remove the thermometer and cool it to practically the temperature of the water in the calorimeter and then put it into the calorimeter and immediately after reading the temperature of the water in the calorimeter, pour the hot "shot" into the calorimeter. Be careful not to splash the water about. Stir vigorously for about two minutes and then read the final temperature.

Now weigh the empty dipper in which the shot was heated, and weigh the inner calorimeter vessel with its contained water and "shot." Calculate the specific heat of the metal.

#### Experiment 4.

*Object:* To Find the Heat of Fusion of Ice.

*Apparatus:* Calorimeter as in above experiments, thermometer, ice.

*Method:* Weigh the inner vessel of the calorimeter when it is empty, and then after it has been filled about two-thirds full of water.

**方法:** 稱卡計內比格杯之重, 倒入約200克之水, 水愈低於室溫度愈好 (如低十度即足) 放一欲求比熱之120克金類彈丸於金類厚' 稱厚與彈丸之重, 於是置此厚入汽罐之蒸氣內以至確知彈丸已得到穩定溫度, 用溫度計試其溫度, 移去溫度計冷之以至其溫度約同於卡計內水之溫度, 乃放之於卡計內, 看其示度後, 速放熱彈丸於卡計水內, 小心不要撥出其水, 力攪約二分鐘時看其終結溫度, 再稱空厚之重, 卡計內筒與容水及彈丸之重。

以所得諸數計算某金類(彈丸)之比熱。

#### 實驗四.

**目的:** 求冰之熔解熱。

**儀器:** 卡計如上試, 溫度計, 冰。

**方法:** 稱卡計內空筒之重, 盛水三分之二滿再稱之。

Heat the water to a temperature of about  $25^{\circ}$  above that of the room, then replace the inner vessel in its jacket. Prepare a lump of clear ice of about the size of a hen's egg, and perform the following operations in quick succession.

While one student is drying the ice upon a towel let another stir the water in the calorimeter thoroughly. If its temperature is less than  $15^{\circ}\text{C.}$  above that of the room, heat it up again until it is between  $15^{\circ}\text{C.}$  and  $25^{\circ}\text{C.}$  above. Again check the weight, for the loss by evaporation may not have been inappreciable. Stir vigorously: then quickly take a careful reading of the temperature, keeping the thermometer bulb all the time immersed, and not more than a second or two after the reading let the first student drop the ice into the water, being very careful not to spill a drop.

Stir continuously while the ice is melting and read the temperature of the water just after the ice has all disappeared. This temperature should be from  $2^{\circ}\text{C.}$  to  $10^{\circ}\text{C.}$  below the temperature of the room. If it should happen to be above the room temperature try again with a larger piece of ice.

Again weigh the inner vessel of the calorimeter with its contained water, and take the difference between the second weighing and the last as the weight of the ice.

#### Experiment 5.

*Object:* To Determine the Heat of Vaporization of Water.

致熱此水使較室溫度約高 $25^{\circ}$ , 將盛此水之筒置卡計內, 預備大如雞卵之淨冰一塊, 作速施行以下手續:

一學生用手巾擦淨此冰, 一學生攪勻卡計之水, 若此水較室溫度之度高少於 $15^{\circ}$ , 可再熱之, 使高至 $15^{\circ}$ 與 $25^{\circ}$ 間之數再計其重, 因汽蒸發失重不可忽略。力攪之, 細察溫度後不過一二秒鐘, 令擦冰學生慎投其冰於水內, 小心連一滴水也不可撥出來。

繼續攪動, 當冰正融化時以至化完看其溫度。此溫度將 $2^{\circ}\text{c.}$ 或 $10^{\circ}\text{c.}$ 低於室溫度。如遇較室溫度尚高時, 可用較大之冰塊另作實驗。

再稱卡計內筒與其容水之重, 以前後二重之差數為冰之重。

計算冰之熔解熱若干?

#### 實驗五.

**目的:** 定水之蒸發熱。(見三十四)

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*Apparatus:* Steam Generator, water trap, (Fig. 34) calorimeter as in above experiments, thermometer, glass and rubber tubing.

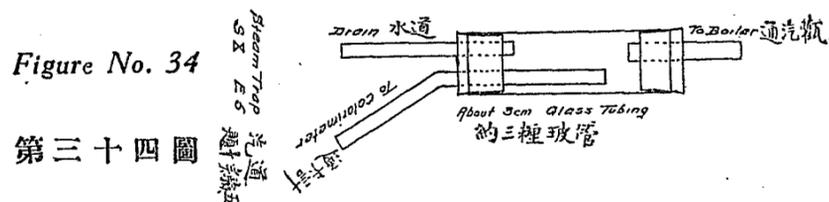
*Method:* Set up the apparatus as shown in the illustration. Weigh the calorimeter and compute the water equivalent. Fill it two-thirds full of water at a temperature of about  $10^{\circ}$  below that of the room and find the mass. After weighing the water take its exact temperature and then immediately introduce steam from the generator. Stir the water constantly with the thermometer while admitting steam. When the temperature of the water has risen nearly  $10^{\circ}$  C. above that of the room, stop admitting steam. Then stir the water thoroughly for a moment before taking its temperature. Weigh the calorimeter and its contents. The increase in weight will be the amount of steam introduced. Read the barometer in order to get the temperature of the steam.

*Caution:* Let the steam run through the trap for a considerable time before admitting it to the calorimeter in order that the trap may be brought to a steady temperature. Keep the trap free from water by means of the drain pipe.

From the data obtained calculate the heat of vaporization of the steam.

### Experiment 6.

*Object:* To Plot the Cooling and Melting Curves of Naphthaline and from these to Determine its Melting Point.



**儀器:** 汽罐, 排水管, 卡計如上試, 溫度計, 玻璃管, 橡皮管。

**方法:** 安置儀器如示圖, 稱卡計, 算其水當量, 盛水三分之二滿, 較室溫約低 $10^{\circ}$ 稱其重。後細察其溫度於是從生汽器用排水管導汽入內。當汽入時用溫度計恆攪其水, 以至溫度計較室溫高約 $10^{\circ}$ 停止放汽。攪動一回, 察其溫度, 稱卡計與內容之物重, 所增之重即入汽之重, 看氣壓計以知此時汽之溫度。

**預防:** 先使汽通過排水管若干時, 然後導入卡計內, 使排水管溫度鎮定, 用洩水管保守排水管無水。

從所得諸數計算水之蒸發熱。

*Method:* Put enough naphthaline into the test tube so that, when it is melted, the test tube will be somewhat over half full. Insert a thermometer and place the test tube into a vessel of hot water. Heat the water until the thermometer indicates a temperature between  $95^{\circ}$  and  $100^{\circ}$  C. Then remove the test tube, clamp it in a vertical position, and support the thermometer so that the bulb is about at the center of the naphthaline. Read and record the temperature (to 0.1 degree) at half minute intervals as the naphthaline cools. If the rate of cooling becomes less than half a degree in 30 seconds readings may be taken at intervals of one minute. Continue the readings for several minutes after the naphthaline has solidified.

Heat the test tube in a water bath so that the temperature increases at about the same rate as it decreased when cooling, and read and record the temperature at half-minute intervals as before. When the temperature has reached about  $90^{\circ}$  C. remove the thermometer, and wipe it carefully.

Plot both curves obtained and study them in order to learn what they tell you about the temperature of a body when it is changing its state. From the curve what is the melting or freezing point of naphthaline?

(Concluded in the March issue)

### 實驗六.

**目的:** 作石腦油之變冷與融化曲線,從此曲線定石腦油之融點。

**方法:** 裝滿石腦油於試筒,當融化後能使試筒半滿。插入一溫度計,將試筒放於盛熱水之杯內,熱其水以至溫度計所示溫度在  $95^{\circ}$  與  $100^{\circ}$  間,移去試筒,以夾子夾之,支持溫度計使其表球約在石腦油中心石腦油變冷每半分鐘間看其溫度記之(記到0.1度)如變冷之度半分鐘時少於半度;可每分鐘間記一次。繼續觀察以至石腦油固結後數分鐘。

熱此試筒於一水罐內,使其溫度上升之率與變冷時下降之率同。讀記他的溫度每半分鐘間一次,當溫度到  $90^{\circ}$  C. 時移出溫度計,小心擦淨之。

作二者之曲線研究之,看他們狀態變化的時候,物體的溫度如何。從此曲線知石腦油之融點與冰點(固結點)在何處?

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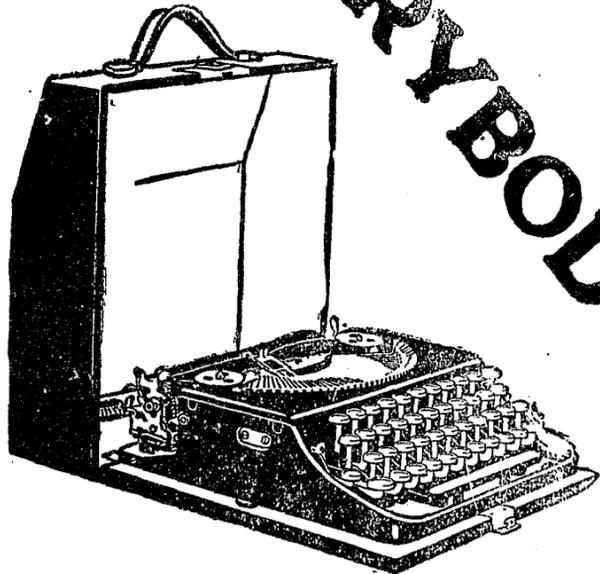
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