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MEDICAL EDUCATION IN HONG KONG.

by

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I have chosen this subject to-day for a number of reasons. Firstly because it is important that students, especially new students, should have a general idea of the courses of studies which lie before them for the next six years; secondly, because it is desirable that you should all have some knowledge of the history and aims of the institution that you have joined and thirdly because I welcome the opportunity of giving publicity to a subject which I consider should be of definite interest to the general public of Hong Kong.

I should like to introduce my subject with the second of these points, namely, a brief consideration of the history of medical education in this colony and before I have finished I feel sure you will agree that it is a history of which any country of this size might well be proud.

The Hong Kong College of Medicine.

As far back as the eighties of the last century, public-spirited men in Hong Kong were moved to give expression of their realization of the importance of medical education to the welfare of this colony, and on the 30th of August, 1887, a meeting was held in the then recently opened Alice Memorial Hospital and at this meeting it was decided to establish a "College of Medicine for Chinese in Hong Kong." Those present were, the Rev., Dr. Chalmers (in the chair), Dr. Wm. Young, Dr. (later Sir Patrick) Manson, Dr. (later Sir James) Cantlie, Dr. (later Sir Kai) Ho Kai, Dr. Jordan, Dr. Gerlach and Mr. W. E. Crow. Just let us consider those names for a moment. One is that of a versatile scholar who served his generation as the acclaimed leader of the Chinese in this city; another is that of a member of a prominent firm of European doctors in this colony whose great help and interest

* Read before the Medical Society on the 24th September, 1936.

in medical education here we still commemorate by the Jordan Scholarship given every six months in the University. Two further names are of those who were members of a British firm of doctors, which firm has continued to this very day to render the same type of self-sacrificing service both to the public and to the cause of medical education in Hong Kong. I refer to the names of Cantile and Manson. Manson became a pillar not only of British but also of world medicine. His work is known and revered in all countries and climates and commemorated in not a few, excepting the one place that gave him his opportunity. In Hong Kong we have no Manson Memorial Chair of Public Health, no Manson Lectureship in Tropical Medicine, no Manson Research Institute or even scholarship in Tropical Diseases, not even a bust or a plaque or a photograph to remind us that he who helped so largely to found the modern science of tropical medicine, also laid the foundation of medical education in this colony. Next year we celebrate the 50th anniversary of this foundation and we in the Medical Faculty are already considering how this may be done most appropriately. I need only add "He that hath ears to hear, let him hear."

Dr. Manson was appointed the first Dean of the Medical College and on the 1st of October of the same year he delivered an inaugural address in the City Hall at a largely attended public meeting presided over by His Excellency Major-General Cameron, C.B., the Officer Administrating the Government.

Sun Yat Sen.

In the proceedings of the Senate of the College held on the 16th July, 1892, there occurs the following, a minute which time has surely invested with interest and importance undreamt of when it was penned by its writer. It reads:—

> "It was resolved to recommend Sun Yat Sen and Kong Ying Wa, who have passed all the Professional Examinations, to the Court for the Licence of the College, Sun Yat Sen to qualify 'with high distinction.'"

These were the first diplomas to be given by the College and thus to the accompaniment of those prophetic words "with high distinction" became the future leader of the vast Chinese Republic, the first fruits of organized medical education in Hong Kong. These diplomas, a copy of which you may all see hanging on the wall of the vestibule of the present Anatomy and Physiology building, were presented at a public meeting in the City Hall on the 23rd of July, 1892. Already I hope you are beginning to realize what a heritage you have made yours by coming to Hong Kong for your medical education.

The College then entered on a period of quiet and unobstrusive work and the next important event in its history was that in 1907 it was decided to alter the name to "The Hong Kong College of Medicine" since it was found that students of nationalities other than Chinese desired to avail themselves of the opportunities of medical education in Hong Kong.

The teaching was carried out in the Alice Memorial Hospital, the Nethersole Hospital, the Ho Miu Ling and Tung Wah Hospitals, and accommodation for special lectures was provided in various places such as the Government Civil Hospital, Queen's College, the Sanitary Department, the Public Mortuary and the Bacteriological Institute with the headquarters of the College at the Alice Memorial Hospital. For many years the teachers in this College gave their services entirely gratuitously; but as the College grew both in size and in value it is readily understood why, sooner or later, it became necessary to consider the requisition not only of permanent buildings but also of permanent staff. In 1905 the Government reserved on the Tai Ping Shan area a site suitable for the purpose of a medical building and it was offered to the College. Two years later Ng Li Hing—a generous benefactor whose memory is perpetuated by scholarships in Anatomy, given annually in this University—donated $50,000/- and Tang Chuk Kai donated $10,000/-. With this sum of money at their disposal the Senate of the College proposed to make an appeal for funds sufficient to erect buildings and engage a small permanent staff.

The University of Hong Kong.

In 1905, the "China Mail" and others advocated the establishment of a University in Hong Kong, and in December 1907 at the prize-giving at St. Stephen's College, the then Governor, Sir Frederick (later Lord) Lugard expressed the hope that this ambitious project might before long take shape. Later Sir Frederick wrote, "Shortly afterward Mr. H. N. Mody intimated to me privately that he had read my remarks with great interest, and was prepared to erect the necessary buildings at a cost of $150,000/- and to give $30,000/- towards an Endowment Fund."

You will note that the offer of Mr. Mody was made about the same time as the benefactions of Mr. Ng Li Hing and Mr. Tang Chuk Kai were made to the College of Medicine, and Sir Frederick, realizing that these two projects might be advantageously combined, consulted the College authorities who welcomed the larger scheme of a University in Hong Kong and offered to amalgamate their College therewith. Although realizing that if a University were established, one of its most important faculties would be that of Medicine, Sir Frederick with characteristic prescience considered that the Tai Ping Shan site would be all too small for a university as he envisaged it, and it was then decided to obtain the views of the benefactors and the past and present students of the College on the suitability for the larger University scheme, of another proposed site in Bonham Road. These views proving favourable, the Court of the College decided to abandon their building scheme and devote their appeal to the endowment of the University.

On the 18th of March, 1908, His Excellency convened another public meeting at which he stated that the revenues of the colony could not undertake any responsibility for carrying this project through, but he would readily recommend to the Secretary of State the gift of an adequate site for the purpose, and, if successful, the Government would necessarily be closely connected with its control. The University must in fact be "financially independent though the Legislative Council might not improbably approve of a grant in aid of its revenue."

At this meeting it was decided to appoint a sub-committee to report on what would be, in their opinion, a minimum staff and its cost for two faculties, one of medicine and another of engineering; how far local assistance, to aid the professorial staff could be counted on; if a school of law were added later what buildings it would be advisable to erect at once; and what sum would be required for maintenance and endowment. Amongst the names of those sitting on this sub-committee it is interesting to find that of the Hon. Mr. (now Sir Henry) Pollock, and though unnecessary, surely it is fitting here to draw attention to one of the many valuable services Sir Henry has rendered the public life of this colony.

A period of tremendous committee activity followed during which scheme after scheme was submitted, discussed, rejected or modified, until in January, 1909, through the generosity of the Chinese of Hong Kong and various other places, of the Viceroy of Canton, of Messrs. Butterfield & Swire and allied firms, a scheme for the forming of the University in a manner acceptable to all the donors concerned was approved. A document was drawn up between the University of Hong Kong on the one hand and the Hong Kong College of Medicine on the other, whereby amongst other things it was agreed "When the University is opened the Faculty of Medicine shall be simultaneously inaugurated and no other Faculty shall be before it."

I must ask you to bear with me in this long historic preamble but I want you to understand that the history of medical education in Hong Kong began long before the University was brought into being and that we in the University are in duty bound to preserve our inheritance and uphold the prestige of medical education so ably begun by our parent foundation, "The Hong Kong College of Medicine."

At the opening of the University in 1912, the teaching staff of the College of Medicine became lecturers in the Faculty of Medicine and the students were transferred to the University. The next event of vital importance to the Medical Faculty was the record in the minutes of that body of the receipt in September, 1913, of a letter from the

Registrar of the General Medical Council in Great Britain announcing "that the Council had decided to recognise the degrees in Medicine and Surgery of this University, granted after examination, for the registration in the Medical Register."

Medical Education.

It is important that you should realize exactly what the General Medical Council is. This Council was established by the Medical Act in 1858 in order "that persons requiring medical aid should be enabled to distinguish qualified from unqualified practioners." It is thus seen that this,

> "Council exists for the protection of the public and not for the medical profession. Its principal functions are three. First to keep the Medical Register; second, to see that the name of no person is entered thereon as qualified unless he has had an adequate professional education, and to remove therefrom the names of qualified persons who are no longer entitled to public confidence; and third, to provide for the publication of the British Pharmacopoeia. It is the appearance of a name upon the Medical Register, and not the possession of a degree or diploma, that constitutes a person a "duly qualified" or "legally qualified" practitioner of medicine. The Council has no power to make rules in regard to the medical curriculum or examinations, but it can pass resolutions and make recommendations relating thereto, and, if any of these were ignored by the licensing bodies, it would be open to the Council to make representations to the Privy Council, which, if it thought fit, might order that the qualifications obtained from such bodies should not be registrable. The name of any medical practitioner who has been convicted of felony or misdemeanour, or who is judged, after due inquiry before the Council itself to have been guilty of "infamous conduct in any professional respect," may be erased from the Medical Register." The medical acts prohibit attempts being made to impose restrictions as to any theory of medicine or surgery, and, once a practitioner has been trained and tested in the knowledge essential for public safety, he may adopt any "theory" of medicine or surgery in which he honestly believes. The Medical Acts do not prohibit the practice of medicine by unregistered persons, but if they "wilfully and falsely" assume any title implying registration they are liable to prosecution. In this respect the Medical Acts differ from the Midwives and the Dentists Acts, which entirely preclude the practice of midwifery or dentistry by unregistered persons. Unregistered medical practitioners, however, are under certain disabilities,

> for they cannot recover charges for medical or surgical attendance, etc., in a court of law; they cannot hold an appointment as medical officer of health, in public (including mental) hospitals, or as a medical officer in the Military or Naval Services, or in ships; they cannot give any valid certificate which is required by any Act from a medical practitioner—for example, a certificate of death; and they cannot engage in insurance practice, obtain dangerous drugs, or attend cases of venereal disease."

You will notice that the Council has no power to make rules, but it makes recommendations and is in a very strong position to see that they are carried out, and this it does not in order to inconvenience Universities or other teaching bodies, but for the benefit of members of the public, so that they may have a means of recognising a person who has had a reasonably efficient medical training and one who has proved himself reasonably proficient in his profession. We, therefore, in Hong Kong follow the scheme of medical education in England which briefly is this. The student first of all before entering his university or medical school, must receive a good general education; this is ensured by demanding that he or she should pass an examination, such as a university matriculation which, under certain conditions is recognised as suitable for a general education test. The student then starts his course by studying the sciences of Physics, Chemistry and Biology (including Botany), the first two because, however much the practice of medicine may be considered an art, the principles of medicine are basically scientific; the last because medicine is really only one aspect of the human branch of the general subject of biology. Here the study of these subjects occupy one year and the examinations in them form the 1st Degree Examination. In the second year the medical subjects proper are begun with the study of Anatomy and Physiology along with Organic and Physical Chemistry. At the end of the second year the 2nd Degree Examination in this branch of chemistry is taken and the successful student then enters in his third year where he completes his Anatomy and Physiology courses. In the former he learns the structure—both macroscopic and microscopic—of the body and in the latter he becomes acquainted with the functions of the different parts of the body, and how these functions are correlated in the harmoniously working unit we call the normal individual. At the same time the student becomes acquainted with the action of drugs on the normal functions of the body—pharmacology—and after having been tested and found proficient in these subjects of Anatomy and Physiology including Pharmacology, which forms the 3rd Degree Examination he enters on the clinical period of his studies. So far he has found the student life a joyful succession of new and pleasing experiences interspersed with a few weeks of nightmares in the form of examinations, but always (we hope) followed by the dawn of brighter days in the form of enjoyable vacations. He has sampled the struggles of athletic contests with his fellows and tasted the joys of social intercourse in the various societies university life has to offer. But now he comes face to face with devastating disease, with crippling accidents and yes, even with death itself; he hurries off to operations early in the morning, stays late in the evening dressing patients, goes about with measured tread, a pensive mien and a conspicuous stethoscope, and eventually climbs back to his hostel at night more tired than he ever felt after returning from the sports field. For three long years he must continue to serve his tiring apprenticeship in the wards, taking an ever increasingly active part in the actual treatment and healing of fellow human beings; he forms an intergral though small part of the hospital mechanism; his absence from duty means either more work for one of his fellow students or more suffering for one of his fellow men. Each of these three clinical years is divided up into three-monthly appointments called clerkships; first come two medical and two surgical clerkships during which time actual cases in the wards are assigned to the students, who themselves are responsible for certain parts of the treatment, case reports and clinical laboratory investigations. During the next year the clerkships are in pathology, where practical experience is obtained in the study of diseased organs and of disease causing organisms (of so much more importance in tropical countries) in anaesthetics and practical pharmacy, in radiology and venereal disease, and in obstetrics; during this latter period the student receives practical experience in the conduct of labours both normal and abnormal. Concurrently with this, lecture courses in pathology, bacteriology, public health and medical jurisprudence are taken, and at the end of the fifth year comes the Fourth Degree Examination in these subjects. Then follows the final or sixth year with further clerkships in medicine, surgery, obstetrics and gynaecology, along with instruction in those special subjects ever increasing in both numbers and importance:—vaccination, fevers, children's diseases, venereal disease, public health, ophthalmology, therapeutics and antenatal work.

Then comes the last great hurdle, the finals, those days of torturing written papers in Medicine, Surgery, Obstetrics and Gynaecology, followed by clinical tests on actual cases and orals conducted by people who seem to the candidate to have forgotten what an examination feels like on the other side of the table; then the period of enforced inactivity and almost insuppressible excitement awaiting the result, and at last the successful candidate hears the words he had begun to think would never be directed to him "congratulations Doctor!" I don't know what the usually accepted procedure is here in Hong Kong after the posting of results; whatever it is, it fortunately falls outside the realm of the Dean, but it will surely have this in common with all such celebrations in other places that it will be associated with the feeling that all life's struggles are over. But it takes more than success in a final examination to accomplish that.

Just let us see how far our student now has really progressed. He has learned the normal mechanism and function of the body; he has learned how to apply that knowledge to the detection of disease, its diagnosis, its prevention and its treatment. But all the patients he has dealt with were selected ones; he starts off with the premise that the patient is ill, otherwise he would not be in hospital. It is one task to find out what is wrong when you know something is wrong, but how much more difficult it may be to have to decide whether anything is amiss or not, especially if you have to take the whole responsibility of your decision on your own shoulders. Therein lies the immense value of house officerships and I would like to-day to try and impress on you (because my experience as your Dean now for a number of years makes me feel it necessary) how valuable the tenure of such a post is. The house officer is not only completing his medical education, but coming in contact with the families of his patients as he is for the first time, he is learning to deal with his patient as the loved or all important unit of some human home however humble; he shoulders responsibility while still under the eye of his teachers, with whom he now comes in contact in a manner not possible in his student days; he plays a very important role in the efficient working of his ward and his hospital, and he gets his first real introduction to what should be the motto of his future life, "service before self." This is not a time for holidays; holidays during these appointments defeat the whole aim both from the point of view of the house officer and that of his clinic and hospital.

And now this period being completed, what next? For the majority it is the wide world, for a chosen few, demonstratorships or assistantships in the University departments. These posts we were able to create with our share of the Boxer Indemnity money, given to the University a few years ago, and they provide our best men with opportunities for teaching experience and further study fitting them for specialization in clinical subjects, or for academic and research posts. Without this further training and teaching experience we cannot possibly expect our graduates to reach the standard required from those who wish to take charge of teaching departments in Universities in China.

The Future.

A student who has been through this training and obtained his M.B., B.S., degree is entitled to practise anywhere in the Empire subject only to local regulations and requirements—that is a fact of which we are rightly proud, and the recent achievements of our graduates confirm our opinion that we do provide facilities for a reasonably good medical education. For the last three years Boxer

Indemnity Scholarships in Medical Sciences have been allotted by open competitive examination throughout China, and each year we have been successful in gaining one of these scholarships; the frequency with which we receive word concerning our graduates who gain special post-graduate diplomas in England is gratifying in the extreme; but we are nevertheless conscious of two great shortcomings in our educational scheme, the first is in our curriculum and the second in the absence of provision for research work. From the foregoing it can be seen that our curriculum must of necessity be that of a home institution modified to suit local requirements, and in Hong Kong that demands more emphasis to be laid on public health, preventive medicine, tropical medicine, parasitic diseases, bacteriology, ante-natal work and nutritional problems. Our late Chancellor, Sir Wm. Peel, made an eloquent appeal but a short time ago, an appeal which many of you here no doubt remember. This was for money to enable us to give instruction in public health and preventive medicine so necessary for doctors in this part of the world. As far as original work is concerned, no medical school can be considered as playing its part fully unless it contributes to medical science as a whole the experience to be gained from its own peculiar environment. Opportunity carries in its train responsibility, and any medical man in this colony for ever such a short period cannot fail to be impressed by the magnitude of our opportunities. It is often said that our duty in the University is to teach and not to indulge in research. Let us hear for a moment what Sir Thomas Lewis said last year in the Huxley Lecture on Clinical Science.

> "To make clear what I have in mind, I will attempt broadly to sketch professorial duties. The first duty of a University professor is the advancement of knowledge of his subject by research; his second duty is to encourage and disseminate learning. These are the accepted duties of professors in scientific departments in all universities worthy of the name;"

It seems therefore that if this colony wishes to have a university which others consider worthy of the name, more funds must be provided, for one thing is certain and that is that at the moment our endowment will not allow of money being spent for such a purpose. There is no need to emphasise the fact that one does not use the term research in a university in the narrow sense of original work conducted in a laboratory but in the real sense of honest thinking applied to accurate observations. There is yet another important reason why we should make provision here for medical research. We endeavour to so train our demonstrators and assistants that they will ultimately become fitted to occupy university chairs and senior teaching posts. Since all other universities expect their professors to engage in original work, how can we expect our graduates to attain that standard if we do not provide facilities for such training in methods of original work? Our duty towards the higher education of our best graduates demands attention to this neglected side of our activities. (In discussing our shortcomings I have omitted all mention of those very important branches of medical training, viz., dentistry and nursing. They open a much larger field than we can be prepared to discuss now).

The moment one begins to consider possible and desirable developments, one must first of all answer this important question. "Is there a real need for medical education of this standard and along these lines in Hong Kong? Should we aim at supplying local demands only, or should we attempt to provide education of such a type that it would attract students from all over the far east, raising of the prestige of the British educational system in general and British medical training in particular?" These to my mind are our only two possible alternatives; if the former be our true function, we must not only shape our course accordingly, but must limit our numbers so as to prevent growth past the size calculated to fulfil local requirements, and we could reasonably expect the necessary monetary support for such a medical school from local sources. But if the latter be our accredited policy, developments such as I have indicated are essential to its achievement and the financial responsibilities for such a scheme should not begin and end with this colony. A far-sighted policy such as this should demand and receive support both moral and financial from medical funds in England.

In order to arrive at conclusions concerning the two alternatives cited above, let us now see what we are at present accomplishing in the Medical Faculty. This is a point which I was very pleased to see discussed in the leading article in the "China Mail" on August 15th, last. On the subject of "Unwanted Graduates," the writer said concerning our University "It would be interesting to know what percentage of graduates each year is in fact absorbed into the professions and business houses locally." Not only for our own

Locality	*General Practice*	*Teaching*	*Govt.*	*Dispensaries and Hospitals*	*Post-Grad. Study*	*Ship Surgeons*	*Totals.*
Hong Kong	19	10	6	21	—	—	56
China	7	2	—	—	—	—	9
Malaya	12	—	—	—	—	—	12
Borneo	2	—	—	—	—	—	2
P. I.	—	1	—	—	—	—	1
India	5	—	—	—	—	—	5
United Kingdom	—	—	—	—	13	—	13
						4	4
Totals	45	13	6	21	13	4	102

information but for that of the public who should be interested—for they by endowments and government subsidy, finance our departments —I have gone through the data we have in the Dean's office concerning our medical graduates for the five years 1930-34 inclusive, and I give it here in tabulated form with the reservation that owing to the absence of recent information concerning some graduates it must not be taken as absolutely accurate, but nevertheless it is accurate enough to provide food for thought, and grounds for reasonable deductions.

These figures show that roughly 56% of our medical graduates stay in Hong Kong, and when one considers that of those studying in England at the moment, some at least will return here and some of the ship surgeons will probably settle here as opportunities present themselves, we may say 60% stay in Hong Kong, 10% go into China, 15% to Malaya and other far eastern countries.

Since for the last 11 years we have on an average granted 16 medical degrees per year, we might expect 10 new doctors to be added to the local register per year, 1 or 2 to go into China, and 2 or 3 to other far eastern countries. Through the kindness of Dr. Uttley I am able to quote the following figures. The 1931 census revealed that in Hong Kong we had one registered medical practitioner to every 2,600 persons whereas in England there was one to every 800. The difference is made greater because here we have a large percentage of the population attended by practitioners of Chinese medicine. The number of western trained practitioners in Hong Kong has increased four fold between 1921 and 1931. It seems to me therefore that we must either educate the local Chinese to patronise western trained practitioners or else limit the numbers of our graduates. Indiscriminate overloading of the medical market especially amongst a population such as ours in Hong Kong is fraught with serious problems both economical and ethical.

If our function is merely to supply Hong Kong with medical practitioners then we are overstepping the mark in two directions *(i)* we are in danger of supersaturating the local market and *(ii)* we are sending 25% of our graduates elsewhere, educating them in fact, to serve other masters. Is that what the colony wishes us to do with its money? But if we desire to provide a medical centre of value to China as well, surely again we are falling very far short of our aim for only 10% of our graduates find their life's work there. Immediately I am met with this argument, "Yes, true, but that is probably because very few of your students come from China in the first place," to which I in turn say, "Yes, true, but if we gave a course designed to pay special attention to those aspects of medicine of most value to medical pioneers in China, we would attract more students from China." The need is there, we have but to provide the means for meeting that need, and by so doing we would be fulfilling what in my humble opinion is our highest function.

Which then is our policy? Neither; we have no policy; but in spite of the length of this talk, that is too depressing a finale. In fairness to the Medical Faculty it must be stated it does more than train a few graduates to win scholarships, and turn out unwanted or misplaced doctors. Remember how in the days of the College, the teaching was done all over the colony. When through the munificence of the Rockefeller Foundation money was provided to establish the three clinical chairs, the arrangement was made with government whereby all the clinical teaching should be done at the Government Civil Hospital. Through the co-operation of the medical department we have now taken over and are responsible for the treatment of patients in a number of wards as well as certain out-patient clinics. The whole of the Tsan Yuk Hospital with its in-patients of over 1,800 (as shown in the last annual report) is run by our Department of Obstetrics and Gynaecology, together with its out-patients and ante-natal clinics. By means of the University assistants in these departments, large numbers of patients can be dealt with and thus treatment as up to date and efficient as Hong Kong can supply is made available for even the poorest of Hong Kong's poor. Apparatus and drugs otherwise unavailable are provided in a small but definite degree from the University funds allotted to these departments, and the appointment of three clinical professors as government consultants in their own branches makes it possible for any one in the colony, rich or poor, to obtain the benefit of their expert advice. Our graduates enable the colony to fill certain medical posts at a cost much smaller than that which would be necessitated by recruitment from England, and also provide such organisations as the St. John Ambulance Association with medical officers for their dispensaries, officers who have an intimate knowledge of the language and of the lives of the poor people whom they succour. Our University Departments of Pathology and Physiology carry out hundreds of tests per year for patients in the university wards of the hospitals and the expenses are met from departmental funds. This of course is no new disclosure, for it was one of the arguments which persuaded the government to increase, a few years ago, its annual grant to the University, but the fact remains that without the Medical Faculty of this University it would cost the colony a great deal more to carry out all this essential work through other departments, for the simple reason that at present University money is also being used for this purpose.

Will you permit me to summarise my thoughts in a few sentences? We have inherited from worthy forerunners the management of medical education in this colony. For many years the institution has flourished, but flourished, I am afraid more after the manner of Topsy, for as far as she knew she just "growed"; now we are of age we are faced with the problems of manhood. What is to be the life's work of the Medical Faculty? What is our policy? The decision is for the colony to make, our task is to carry out that decision. I can only hope that this address may help to put the case more clearly before you and the public at large, and to stimulate them to give us a mandate, and what more fitting occasion than 1937 for them to say "Go ahead and produce a memorial worthy of Manson your founder, so that from your walls you may continue to send forth men and women imbued with such spirit and endowed with such learning that they may be a source of help to fellow countrymen as was your first graduate, "Sun Yat Sen."

BLOOD GROUPS OF HONG KONG CHINESE.

by

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In this note we propose to record the frequencies of the four blood groups O, A, B and AB (groups I, II, III and IV of Jansky or IV, II, III and I of Moss respectively), found in a random sample of the Chinese population of Hong Kong. Individuals tested included students, hospital patients, both in-patients and out-patients; in addition all blood samples sent to this laboratory for investigation are grouped and recorded and we were also given access to many hundreds of samples sent to the Bacteriological Institute for various tests.

The test sera used were from the stocks of this laboratory, which stocks are constantly tested for activity and titre. The method used was the open slide method, a drop of corpuscle suspension (roughly about 1 in 200), a drop of saline and a drop of test serum being mixed together on a slide by means of a wire loop. In dry weather the corpuscle suspension was protected from drying by placing the slide in a moist chamber, and all slides were subjected to a rolling movement found to produce conditions most favourable to agglutination. All slides were examined under the microscope, the low power objective being used.

As far as possible the figures given here include only full blooded Chinese; those of other nationalities will be given later. The Chinese were drawn from both the city of Victoria on the island and from Kowloon on the mainland and they are listed here independently of their ancestral provinces. Some natives from neighbouring islands or country villages may be included, as also may some Hakka and some boat people, and hence these results must not be taken by anthropologists as representative of those of the southern Chinese or even of the Kwangtung Chinese; they are merely a representative cross section of the Chinese found frequenting a busy seaport on the South East coast of China, comprising unknown proportions of city, boat and rural peoples.

TABLE I.

Groups	O	A	B	AB	Totals
Frequencies...	1041	642	666	155	2504
Percentages ...	41.57 ±.98	25.64 ±.87	26.60 ±.88	6.19 ±.49	100

Table I.—Setting out the blood group frequencies and group percentages of 2,504 Hong Kong Chinese.

The results obtained are set out in Table I. If we consider these figures from the point of view of the triple allelomorph theory of blood group inheritance where

p = the frequency of gene A
q = ,, ,, ,, ,, B
and r = ,, ,, ,, ,, O
$(p+q+r)$ should equal 1.

The deviation D of this value from unity can be calculated from the equation

$$D = 1 - (p+q+r)$$

and its standard error S.E.$_D$ can be calculated according to the method of Bernstein. These values are set out in Table II.

TABLE II.

p	q	r	$p+q+r$	D	S.E.$_D$
.1743	.1802	.6448	.9993	+.0007	±.0030

Table II.—In which the various gene frequencies p, q and r are set out together with the deviation of their sum from unity (D) for 2,504 Hong Kong Chinese.

From these values can be calculated the frequencies of the various genotypes and also of the ten different blood group matings, all of which data are of use in statistical consideration of the blood groups in the community. These are set out in Tables III and IV.

TABLE III.

	Haemotype frequencies		*Genotype frequencies*		
	Actual	*Calculated*	*Calculated*		
O	0.4157	0.4157	0.4157	(r^2)	OO
A	0.2564	0.2551	0.0304 0.2247	(p^2) $(2pr)$	AA AO
B	0.2660	0.2648	0.0325 0.2323	(q^2) $(2qr)$	BB BO
AB	0.0619	0.0628	0.0628	$(2pq)$	AB
Totals	1.0000	0.9984	0.9984		

Table III.—Showing the frequencies of the six genotypes in the Hong Kong Chinese population.

TABLE IV.

Parental mating frequencies		Haemotype frequencies of children			
		O	A	B	AB
O x O (r^4)	.1728	.1728	—	—	—
O x A $2pr^2 (p+2r)$	.2121	.0034	.1187	—	—
O x B $2qr^2 (q+2r)$	2201	.0966	—	.1236	—
O x AB $4pqr^2$	.0522	—	.0261	.0261	—
A x A $(p^2+2pr)^2$	.0651	.0126	.0525	—	—
A x B $2(p^2+2pr)(q^2+2qr)$	.1351	.0261	.0332	.0334	.0424
A x AB $4pq(p^2+2pr)$	.0320	—	.0160	.0071	.0090
B x B $(q^2+2qr)^2$	.0701	.0135	—	.0567	—
B x AB $4pq(q^2+2qr)$	.0333	—	.0073	.0166	.0093
AB x AB $4p^2q^2$	.0039	—	.0010	.0010	.0020
Totals	.9968	.4150	.2547	.2644	.0627

Table IV.—Showing the frequencies of each of the ten different parental matings, as well as the blood group frequencies of children in each of these matings as found amongst Hong Kong Chinese.

The uses of these studies may be classified as three-fold, (*a*) anthropological, (*b*) genetical and (*c*) medico-legal. The anthropological aspect will be discussed later when the haemagglutination studies throughout this colony are completed. The genetical value is discussed in another paper in this issue. With the third we shall now deal.

There can be no doubt that the agglutinogens and agglutinins which are responsible for the differentiation of the four human blood groups are inherited, and that the inheritance of the agglutinogens a any rate depends on three allelomorphic genes known as A, B and R, A. and B being dominant and R recessive. On the constancy of the blood group of an individual throughout life depends its value as a character for personal identification and on our knowledge of the method of its inheritance depends the value of the blood groups in child and parental identification. Where the haemotypes of the mother and father are known, we can definitely predict to which blood groups the children of such a union must belong, and this knowledge may be applied in two ways. First, it may be used in attempts to identify which of two infants in a maternity hospital belongs to a certain mother or to certain parents, and second, it may be used to prove non-paternity in some cases of alleged parentage. In the latter case it is sometimes of value for the putative father or his counsel to know what are the chances that blood examination will prove his non-paternity and from the above figures we now propose to derive the chances of a falsely accused Chinese male in Hong Kong proving his non-paternity (*a*) when his group is known, and (*b*) when it is unknown, and in so doing we shall employ the method of Wiener, Lederer and Polayes (1930). Hooker and Boyd (1934) have also published a method of estimating these chances, but as they themselves point out, the method of Wiener gives the same results and at the same time avoids a lot of arduous arithmetic.

Let P_O, P_A, P_B, P_{AB}, and $P_{(?)}$ represent the probability of proving non-paternity when the putative father is of O, A, B, AB or of unknown haemotype respectively. Then according to Wiener et. al.,

$$P_O = r^2(p+q) + 2pq(1+r)$$
$$P_A = q(p+r)^2$$
$$P_B = p(q+r)^2$$
$$P_{AB} = r^2$$
$$P_{(?)} = p(q+r)^4 + q(p+r)^4 + pqr^2(p+q) + 2pqr^2$$

i.e., $P_O = .2507$ or 1 in 3.99
$P_A = .1209$ or 1 in 8.27
$P_B = .1186$ or 1 in 8.43
$P_{AB} = .4157$ or 1 in 2.41
$P_{(?)} = .1926$ or 1 in 5.19

In his paper quoted above Wiener points out that if haemotype O children of haemotype AB fathers are not classed as illegitimate then the chances of proving non-paternity are slightly reduced and the above formulae become

$$P_O = r^2(p+q) + pq(1+3r)$$
$$P_A = q(p+r)^2$$
$$P_B = q(p+r)^2$$

$$P_{AB} = O$$
$$P_{(?)} = p(q+r)^4 + q(p+r)^4$$

i.e., $P_O = .2400$ or 1 in 4.17
$P_A = .1209$ or 1 in 8.27
$P_B = .1186$ or 1 in 8.43
$P_{AB} = O$
$P_{(?)} = .1619$ or 1 in 6.18

The values obtained by Wiener and by Hooker are tabulated along with these in Table V.

TABLE V.

Investigators	Country	P_O	P_A	P_B	P_{AB}	$P_{(?)}$
Wiener et. al.	U.S.A.	0.2407	0.0974	0.1890	0.3636	0.1805
Hooker et. al.	U.S.A.	0.1998	0.0611	0.1426	0.45	0.1434
Ride et. al.	Hong Kong	0.2507	0.1209	0.1186	0.4157	0.1926
Maximum possible chances		0.2901	0.1342	0.1342	0.3107	0.1999

SUMMARY.

1. The frequencies of the four blood groups amongst Hong Kong Chinese are given, based on examination of 2,504 individuals tested.

2. The values of p, q and r are estimated and from these are calculated

(*a*) the frequencies of the six genotypes,

(*b*) the frequencies of the ten different blood-group matings possible,

(*c*) the frequencies of four groups in each of these matings,

(*d*) the chances of a wrongfully accused Chinese man in Hong Kong establishing his non-paternity of a child.

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ON THE INHERITANCE OF BLOOD GROUPS.

by

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In this paper it is intended to examine the blood grouping results of the writer in the light of the theories of their inheritance; this will be done under two headings (*a*) gene frequencies and (*b*) family data.

Gene Frequencies.

If the blood groups be inherited according to the theory of von Dungern and Hirszfeld which is based upon the supposition of the existence of two independent pairs of factors, it can be easily shown that the product of the frequencies of haemotypes O and AB should equal that of the frequencies of haemotypes A & B. In Table I the products of these frequencies for the different groups of people examined by the writer are set out and it is readily seen that in no case is there anything approaching equality between the products thus obtained.

TABLE I.

Country	BRITISH NORTH BORNEO						British Columbia	Hong Kong
People	Putatan Dusuns	Tambunan Dusuns	Keningau Muruts	Uluns	Kwijaus	Totals	Indians	Chinese
Number	738	331	720	431	189	2570	203	2617
O × AB	0.0103	0.0090	0.0208	0.0215	0.0038	0.0153	0.0000	0.0259
A × B	0.0370	0.0125	0.0475	0.0431	0.0170	0.0380	0.0035	0.0689

Figure I.—Setting out the products of frequencies of groups O & AB and of A & B amongst the various peoples indicated.

If on the other hand the theory of triple allelomorphs put forward by Bernstein be true, it can be shown that the equation $(p+q+r)=1$ must hold for any homogeneous population in equilibrium, where p is the frequency of the gene A, q that of gene B, and r that of gene O in the population under consideration. If the deviation of $(p+q+r)$ from unity be represented by D, i.e., if $D=1-(p+q+r)$, we can ascertain the chances of the value of D being greater than would be expected by random sampling alone, by estimating the standard error of D. Following Bernstein this standard error $S.E._D$ is equal to $\pm\sqrt{\frac{pq}{2N(1-p)(1-q)}}$ where the frequencies p an q are as described above and N equals the total number of individuals from which the values p and q are estimated.

TABLE II.

Country	BRITISH NORTH BORNEO						British Columbia	Hong Kong
People	Putatan Dusuns	Tambunan Dusuns	Keningau Muruts	Uluns	Kwijaus	Totals	Indians	Chinese
Number	738	331	720	431	189	2570	203	2617
$(p+q+r)$	0.996	1.002	1.002	1.003	0.997	1.000	0.999	1.000
D	+ 0.004	− 0.002	− 0.002	− 0.003	+ 0.003	0.000	+ 0.001	0.000
SE_D	± .0033	± .0027	± .0045	± .0052	± .0039	± .0010	± .0017	± .0030

Table II.—Setting out the values of $(p+q+r)$, its deviation from unity (D) and the standard error (SE_D) of this deviation.

In every case the standard error of the deviation is many times the size of the deviation itself, hence the deviation of $(p+q+r)$ from unity is in no case significant. These data from the point of view of gene frequency may therefore be considered as being quite consistent with the theory of triple allelomorphs, while they cannot be taken as supporting the earlier theory of two independent pairs of factors.

Strandskov (1931) investigated the question as to which theory available data supported and in so doing he used Pearson's well-known Chi-square method. In Table III are the figures resulting from the application of this method to the above data; in the triple allelomorph theory, the statistical error introduced because $(p+q+r)$ never actually equals 1 is reduced to a minimum by adopting the values suggested by Bernstein, namely,

$$p=(1-\sqrt{O+B})\ (1+\frac{D}{2})$$

$$p=(1-\sqrt{O+A})\ (1+\frac{D}{2})$$

$$r=(\sqrt{O}+\frac{D}{2})\ (1+\frac{D}{2})$$

These figures show that in every case the frequency distributions are consistent with the triple allelomorph theory, but where we have large numbers, the discrepancies between actual and expected frequencies —calculated according to the two factor theory—are hardly due to random sampling and hence due to the fact that the data do not substantiate this theory.

Family Data.

If Bernstein's theory be true, the following two laws relating to the blood groups of parents and children must hold,

TABLE III.

People	Number	Two-factor theory		Triple allelomorph theory	
		X^2	P	X^2	P lies between
Putatan Dusuns	738	18.8351	$< .01$	1.9815	.10 and .20
Tambunan Dusuns	331	24.6926	$< .01$	0.6292	.30 and .50
Keningau Muruts	720	14.4180	$< .01$	0.1260	.70 and .80
Uluns	431	5.7625	$< .05 > .02$	0.3375	.50 and .70
Kwijaus	189	2.5003	$< .20 > .10$	0.4982	.30 and .50
Borneo Totals	2570	44.8594	$< .01$	0.2390	.50 and .70
British Columbia Indians...	203	1.0014	$< .50 > .30$	0.4233	.50 and .70
Hong Kong Chinese	2617	99.9014	$< .01$	0.5836	.30 and .50

Table III.—Showing the probability (P) that differences, just as great as those existing between the actual frequencies and those estimated according to the inheritance theories, will arise from random sampling.

(*a*) in order that an agglutinogen A or B may appear in the blood of a child, it must be present in the blood of one, at least, of the parents, and

(*b*) no child of group O can be born of a group AB parent, nor can a group AB child be born of a group O parent.

For the earlier theory of two independent pairs of factors, law (*a*) above must also hold, but not law (*b*). In Table IV are found all the family data collected to date by the writer and the blood groups of the children are set out according to the groups of their parents.

TABLE IV.

Haemotype Mating	No. of Families	No. of Children	Haemotype			
			O	A	B	AB
O × O	80	182	178	(1)	(3)	—
O × A	48	96	52	43	(1)	—
O × B	69	176	89	(2)	85	—
O × AB	13	29	—	13	16	—
O × ?	95	269	212	29	28	—
A × A	4	6	2	4	—	—
A × B	33	70	25	13	19	13
A × AB	3	6	—	3	1	2
A × ?	41	79	43	30	4	2
B × B	27	48	15	—	33	—
B × AB	11	28	—	2	15	11
B × ?	66	124	42	4	68	10
AB × AB	—	—	—	—	—	—
AB × ?	5	10	—	4	6	—
Totals	495	1123	658	148	279	38

Table IV.—Setting out the family data collected by the writer, showing the haemotypes of all the children in the various parental blood-group matings. Those cases which contravene the triple allelomorph theory are shown in brackets.

Out of 495 families involving 1,123 children only 7 cases contravene the first law stated above, and they are indicated in Table IV by being enclosed in brackets. These cases all occurred in the British North Borneo data and we shall now consider them individually. Of the O × O matings the first case was in a family of two children, the elder No. 2247 being haemotype B and the younger haemotype O. From the history of this case there was very strong evidence to suspect that the husband was not the real father of the elder child. The second family also consisted of two children, No. 2323 being haemotype A, whereas the brother belonged to group O. No information throwing light on this case could be obtained, and the mother had not been previously married. In the third case, No. 2489 was the only child and belonged to group B, the mother having been married before. The fourth case involved No. 2790, a group B child as the only child of the union, and the mother had not been married before. In considering these cases it must be remembered that these data were taken amongst native tribes where what we term illegitimacy is certainly not unknown; furthermore it was often very difficult to get the natives to differentiate between true and adopted children, and full, half and step-brothers and sisters; and considering all these facts, the cases cited above can hardly be of great significance, in fact the wonder is that more were not recorded.

In all the other cases, the child's group was not incompatible with the mother's, and hence illegitimacy cannot be definitely ruled out in any of them. It should be noted that the first law set out above holds equally for both theories, so that these cases do not differentiate at all between them.

With regard to evidence relevant to the second law, in the 32 matings involving haemotype AB as one of the parents there were *no children at all* out of the 73 belonging to Group O. In the 305 matings involving haemotype O as one of the parents there were *no children at all* out of the 752 belonging to Group AB. Of the 13 matings of haemotype O with AB there were 29 children examined, and *none* of *these* was found to belong to either of the groups O or AB. In fact these results are typical of family studies made all over the world since attention was drawn in 1926 to the importance of marriages involving haemotypes O and AB in deciding between these theories.

Lattes (1932) has published figures showing the change in frequencies of groups O and AB amongst children of matings involving an AB parent since attention was drawn to the importance of these investigations in 1926, and in Table V the writer's figures have been added to those of Lattes. A consideration of these figures shows how the frequencies of groups O and AB in O × AB matings, and of group O in AB × A, AB × B, and AB × AB matings have fallen in the post-1926 period; these groups will be recognised as those precluded in the offspring of the matings concerned according to the triple allelomorph theory, but possible according to the older theory.

The argument is that since the triple allelomorph theory was proposed, the importance of all the above types of matings has resulted in the use of more care and more accurate technique, and hence the post-1926 data are accepted as the more accurate.

TABLE V.

Parental Combinations	Families	Children	Children's Groups			
			O	A	B	AB
O × AB Before 1926	110	312	27 8.6%	148 47.4%	109 35%	28 8.9%.
O × AB After 1926	264	631	6 1.0%	314 49.8%	306 48.5%	5 0.8%
AB × {A, B, AB} Before 1926	171	422	17 4.0%	138 32.7%	137 32.4%	130 30.9%
AB × {A, B, AB} After 1926	377	918	7 0.8%	356 38.8%	300 32.7%	255 27.8%

Table V.—In which the writer's data are added to those published by Lattes comparing the figures obtained before with those obtained after 1926.

Of those there are some cases which still contravene Bernstein's theory, but of these only those where a haemotype O child is born of an AB mother or a haemotype AB child born of an O mother can not be explained by the more likely theory of illegitimacy. It will therefore be necessary to classify the data according to the mother-child haemotypes in other to eliminate such a cause.

In Table VI it is seen that out of a total of 19,730 children, the haemotypes of 174 of them do not fit in with the triple allelomorph theory. The possible reasons are errors in technique and observation and compilation of data, undetected illegitimacy, and lastly, faulty

TABLE VI.

Haemotype Mating	No. of families	No. of children	Haemotype O	Haemotype A	Haemotype B	Haemotype AB
O × O	1272	2829	2808	(*16*)	(5)	—
O × A	2583	5400	2308	3064	(*19*)	(9)
O × B	1066	2376	1047	(*13*)	1315	(*1*)
O × AB	478	1197	(*38*)	584	541	(*34*)
A × A	1260	2848	478	2368	(*1*)	(*1*)
A × B	1137	2483	426	804	660	593
A × AB	484	1112	(*21*)	528	254	309
B × B	320	707	141	—	565	(*1*)
B × AB	338	627	(*13*)	123	321	170
AB × AB	67	151	—	39	42	70
Grand Totals	9,005	19,730	7,280	7,539	3,723	1,188

Table VI.—Setting out the grand totals of family data available at present, being the writer's data added to those given by Lattes. Those cases which contravene the triple allelomorph theory are shown in brackets.

hypothesis. Concerning errors in technique and observation, loose methods and mistakes due to pseudoagglutination and rouleaux formation must, in the hands of experienced investigators, be reduced to a minimum and hence they cannot be very great sources of error. The greatest source under this heading is indicated by the fact that 72 out of 174 discrepancies are recorded as belonging to group O, and one therefore is led to suspect that these cases were classed as type O on account of weak agglutinations passing unnoticed. Had these cases all been tested more carefully or with stronger sera, or had the corresponding sera been tested for agglutinin content, this number of group O discrepancies would certainly have been greatly reduced. As the importance of good and accurate technique has become more and more realised by investigators, so have the numbers of incompatible groups reported become less and less until nowadays, it is the exception for workers to record such cases even in many thousands of children tested.

The only way to get rid of the error due to undetected illegitimacy is to collect data concerning only those cases where the haemotype of the child does not fit in with that of the mother. When this is done there remain out of the many thousands of children examined only a few authentic cases in which the blood types of the child and mother do not agree with the expectation according to the theory of triple allelomorphs.

Wiener (1935) has quoted a method of Schiff whereby the application of p, q and r values for a population, to family data collected from that same population may be used as a test of the validity of the theory on which the p, q and r values are estimated.

Table VII shows the way in which Schiff set out the frequencies, in terms of p, q and r, of the differing haemotypes in the children of the various possible parental matings.

TABLE VII.

Parental Matings	Haemotype frequencies of children			
	O	A	B	AB
O × O	r^4	——	——	——
O × A	$2pr^3$	$2pr^2(p+r)$	——	——
O × B	$2qr^3$	——	$2qr^2(q+r)$	——
O × AB	——	$2pqr^2$	$2pqr^2$	——
A × A	p^2r^2	$p^2(p+r)(p+3r)$	——	——
A × B	$2pqr^2$	$2pqr(p+r)$	$2pqr(q+r)$	$2pq(p+r)(q+r)$
A × AB	——	$2p^2q(p+2r)$	$2p^2qr$	$2p^2q(p+r)$
B × B	q^2r^2	——	$q^2(q+r)(q+3r)$	——
B × AB	——	$2pq^2r$	$2pq^2(q+2r)$	$2pq^2(q+r)$
AB × AB	——	p^2q^2	p^2q^2	$2p^2q^2$

Table VII.—Shows for each of the possible parental matings the child group frequencies in terms of p, q and r (after Schiff).

In the author's Borneo data, the values of *p*, *q* and *r* are 0.0995, 0.1400 and 0.7597 respectively and applying Bernstein's correction quoted above, these become 0.0995, 0.1401 and 0.7604 respectively, and substituting these values for *p*, *q* and *r* in Table VII we derive Table VIII.

TABLE VIII.

Parental Matings	Haemotype frequencies of children				Totals
	O	A	B	AB	
O × O	·3343	——	——	——	·3343
O × A	.0875	.0989	——	——	.1864
O × B	.1232	——	·1459	——	.2691
O × AB	——	.0161	.0161	——	.0322
A × A	.0057	.0203	——	——	.0260
A × B	.0161	.0182	.0191	.0216	.0750
A × AB	——	.0045	.0021	.0023	.0090
B × B	.0113	——	.0410	——	.0523
B × AB	——	.0030	.0061	.0035	.0126
AB × AB	——	.0002	.0002	.0004	.0008
Totals	.5781	.1612	.2305	.0279	.9977

Table VIII.—Showing for each of the possible parental matings the child group frequencies calculated from the author's Borneo data.

The test of the theory lies in comparing these calculated figures with those actually found. In all we have records of 280 families including 612 children. We can, as shown in Table IX calculate the relative frequencies of the various possible matings in a population, and, as this table shows, the families are not thus distributed according to expectation. Since we are not testing distribution of family matings, but the frequencies of children in a random sample of the matings of the population, these frequencies are corrected for the abnormal sampling as shown in Table IX.

Using these corrected values for the sample of matings, the distributions of the groups among the children can readily be calculated from the observed data given in Table IX and these along with those expected from Table VIII are set out in Table X for comparison, which shows the close agreement of the observed and expected frequencies.

TABLE IX.

Parental Matings	Actual Number	Actual group frequencies of children				Totals	Parental matings (corrected)	
		O	A	B	AB		Frequencies	Number
O × O	76	161	1	3	—	165	$r^4 = .3343$	94
O × A	46	48	38	1	—	87	$2pr^2(p+2r) = .1864$	52
O × B	68	88	2	84	—	174	$2qr^2(q+2r) = .2691$	75
O × AB	13	—	13	16	—	29	$4pqr^2 = .0322$	9
A × A	3	2	3	—	—	5	$(p^2+2pr)^2 = .0260$	7
A × B	33	25	13	19	13	70	$2(p^2+2pr)\ (q^2+2qr) = .0750$	21
A × AB	3	—	3	1	2	6	$4pq(p^2+2pr) = .0090$	3
B × B	27	15	—	33	—	48	$(q^2+2qr)^2 = .0523$	15
B × AB	11	—	2	15	11	28	$4pq(q^2+2qr) = .0126$	4
AB × AB	0	—	—	—	—	0	$4p^2q^2 = .0008$	0
TOTALS	280	339	75	172	26	612	0.9977	280

Table IX.—Showing the method of obtaining the corrected sample of parental matings.

TABLE X.

Parental Matings.	Frequencies of groups among children							
	O		A		B		AB	
	Observed (corrected)	Expected	Observed (corrected)	Expected	Observed (corrected	Expected	Observed (corrected)	Expected
O × O	199	205	1	0	4	0	0	0
O × A	54	54	43	61	1	0	0	0
O × B	97	75	2	0	93	89	0	0
O × AB	0	0	9	10	11	10	0	0
A × A	4	3	7	12	0	0	0	0
A × B	16	10	8	11	12	12	8	13
A × AB	0	0	3	3	1	1	2	1
B × B	8	7	0	0	18	25	0	0
B × AB	0	0	1	2	5	4	4	2
AB × AB	0	0	0	0	0	0	0	0
TOTALS	378	354	74	99	145	141	14	16

CONCLUSIONS.

(*a*) These new figures here given, strongly support the law that an agglutinogen cannot appear in the blood of a child unless it is also present in the blood of at least one of the parents and hence on this aspect they are compatible with both of the theories of blood group inheritance considered namely :—the two independent pairs of factors theory and the triple allelomorph theory.

(*b*) Statistical treatment of the data shows the actual frequencies found to be compatible with the triple allelomorph theory, but not with the two factors hypothesis.

(*c*) The data given concerning families involving haemotypes O or AB or both, among the parents are overwhelmingly in favour of the triple allelomorph theory.

SUMMARY.

1. Data concerning the blood groups of 2,570 British North Borneo Natives, 203 British Columbia Indians, and 2,617 Hong Kong Chinese are given.

2. These data are examined according to the two theories of blood group inheritance.

3. The family data are also examined from the point of view of inheritance of the blood groups and the totals added to those already collected from all sources and published by Lattes.

4. The conclusions drawn from these figures are given.

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PHYSIOLOGICAL BLOOD CONSTANTS IN HONG KONG CHINESE. (I).

by

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In the first article of this series we propose to describe the technique used in this department in experiments designed to establish physiological blood constants amongst Hong Kong Chinese. The The students in this University willingly volunteered to act as subjects and to them we tender our thanks for their ready co-operation. Observations concerning the following were made:—

Red Cell Count	Sedimentation Rate
White Cell Count	Fragility Tests
Differential Cell Count	Average Size of Red Cells
Polynuclear Count	Mean Corpuscular Volume
Haemoglobin Content	Mean Corpuscular Haemoglobin

Mean Corpuscular Haemoglobin Concentration

All these investigations were carried out on one blood sample and since a number of samples had to be done simultaneously, a rather elaborate technique had to be devised along with a working time table which had to be rigidly adhered to.

All observations were carried out on venous blood, about 5 ccs being withdrawn from one of the veins in the arm according to the usual clinical procedure. The blood was immediately sub-divided into small samples by transferring approximately a cubic centimetre to each of a series of five small test tubes, each containing enough oxalate for 1 cc of blood, care being taken that the blood in each tube was well mixed with the oxalate so as to prevent clotting. The actual anti-coaggulant used was that suggested by Heller & Paul (1934) and quoted by Britton (1936), namely, for each cubic centimetre of blood .1 cc of a solution containing 4 grams of potassium oxalate and 6 grams of ammonium oxalate per 500 ccs was placed in the test tube and allowed to evaporate. At the same time as this transfer of blood was being made, a drop was placed on each of three clean slides, and three thin films prepared using the usual technique. Blood from six individuals was examined per day, and all blood samples were withdrawn and treated in the above manner first. Each test tube, as well as each series of test tubes, was labelled and corked and put in racks and left untouched until required for the sedimentation test. Half an hour after the blood from the first subject (subject A) was withdrawn, test tube A1 was taken and thoroughly shaken and a sedimentation test set up using the method of Wintrobe (1933). The first sample from subject B was set up so that the blood began to sediment six minutes after the sample from subject A and this procedure was followed with all the other first samples, so that each sedimentation sample was set up about half an hour after the blood was withdrawn from the vein. Hence when the sixth sample was set up A1 had been sedimenting for 30 minutes, B1 for 24, C1 for 18, D1 for 12, E1 for 6 and F1 for O minutes. An hour after A1 was set up, the second sample of subject A was set up, followed at six minute intervals by B2, C2, D2, E2 and and F2. Those second samples were taken from the second test tubes of each subject and hence the only difference between the blood used in the first and second tests was that the latter had remained standing for one hour longer after it had been withdrawn from the vein before the commencement of the sedimentation test.

The details of the test will be described in a later paragraph, here we shall just state that readings in each case were taken photographically every six minutes for two hours, at the end of which time the tube was removed and its place taken by sample three of the same subject's blood taken from test tube 3 and set up with the same procedure as before. Thus at six minute intervals were samples A1 to F1 replaced by those of A3 to F3. When samples A2 to F2 had sedimented for two hours, they were replaced by samples A4 to F4, and similarly A3 to F3 were in due course replaced by A5 to F5.

The result of this was that we measured the sedimentation rate of the blood of each subject five times, the first on a sample of blood which had been withdrawn from a vein ½ hour previously, the second 1½ hours the third 2½ hours, the fourth 3½ hours the fifth 4½ hours previously. The idea was that we would thus be able to ascertain whether the length of time elapsing between the withdrawal of the blood and the commencement of the sedimentation examination had any effect on the rate of sedimentation, and if it did whether a correction could be devised which would make allowance for the effect of this time factor.

It was essential therefore that as far as possible each sample should differ from the other samples from the same subject in one respect only, that is in length of time after withdrawal from the vein. It can now be understood why all the blood from one subject was not placed in one test tube, for in that case the blood would be shaken up once to set up sample 1, twice for sample 2, thrice for sample 3 and so on, and thus each sample of blood would differ from every other in that respect as well. This we regard to be a point of great importance, for as shown in a previous article (Ride 1936) we consider that the distance fallen by the corpuscule meniscus in one hour depends amongst other things on the rate of formation of the maximum aggregates of the corpuscles. This aggregation of red cells takes place while the blood is standing awaiting the test, and we are ignorant of the effect of repeated shaking on these aggregates and until it is proved that such

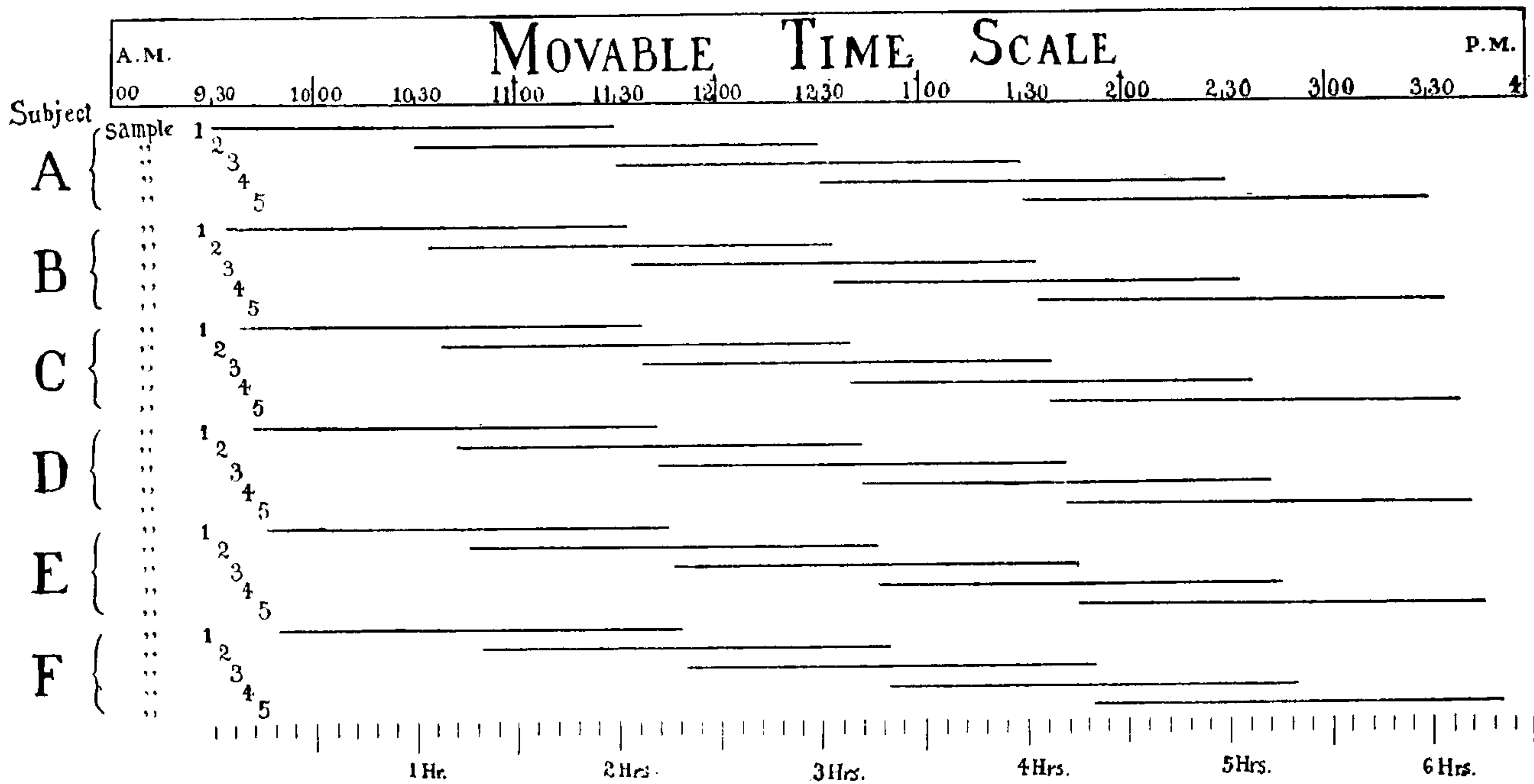


Figure 1.—The time schedule described in the text. From this it can be seen how readily the time for setting up or removing any blood sample can be read off, and also how easily the stage of the investigation can be ascertained at any given time during the experiment.

an effect is negligible it is important that each sample should be shaken up the same number of times.

The whole experiment for measuring the sedimentation rates for six subjects as thus outlined took 6 hours 20 minutes and as all of us could not be present all the time, two methods were devised to minimise mistakes; they were (*a*) a schedule graph and (*b*) an automatic photographic device for recording the sedimentation. The graph was so drawn as to show each sample of blood covering a period of two hours and placed in correct time relation to all the other samples; a movable time scale was attached and the time of commencement of the experiment set opposite the zero of the graph and then at any time of the day an observer could see at a glance what samples were then being tested and also at what stage of the test each sample had arrived. Thus the mistake of allowing a sample to sediment for too long or too short a period was obviated and also one observer was able to take over from another without fear of mistakes being made. When one visualises the work entailed in hours of continuous observation per day for a number of consecutive days without a mistake, one realises the value of such a graphic aid. (See Figure 1.)

The second device was just as valuable. The Wintrobe tubes were placed in a row and held vertically in a rack in front of a frosted glass which was illuminated from behind, and the height of the blood column in each tube was photographed every six minutes using a Leica camera. The camera was rigidly fixed in position with the tubes in focus and it was operated electrically so that an exposure was made every six minutes; at first a buzzer was used which warned the operator one minute before the exposure time so that the film could be turned on and camera set, but later a device was included whereby preparing the film for exposure was done automatically and hence the only attention the camera needed was every 3 hours and 36 minutes when a new film had to be inserted, and thus the observer was free to do other work while the sedimentation results were permanently recorded with accuracy and precision. Placed alongside the Wintrobe tubes were a wrist watch and a thermometer; by this means the actual time of each reading was automatically recorded and hence if by any chance an exposure was not made at the appointed six-minute interval, the accurate plotting of the fall of the meniscus on the time graph was still possible. The thermometer served not only to give the temperature of the experiment, but also to record any change in temperature during the sedimentation. Such changes were minimised by two means, first, by turning on the light only when an exposure was being made and second by having two pieces of frosted glass between the light and the tubes, the cushion of air separating them acting as a efficient insulator. In order that the corpuscle meniscus could be read accurately, it had to be as near to the level of the optical axis of the camera as possible, and hence throughout the experiment the rack had to be raised repeatedly to compensate for the meniscus fall. This had two disadvantages, firstly the shaking of the tubes that such movements entailed and secondly each meniscus fell at a rate different from the others, and hence movement of the rack as a whole could not compensate for these different rates of fall. These difficulties were overcome by attaching each tube to the plunger of a glass syringe which was placed nozzle downwards in the rack. Each nozzle was then connected by a separate rubber tube to a reservoir of water common to the whole set of syringes and each tube was provided with a clip. The reservoir could be raised or lowered below the level of the rack. If while above the rack, the clip on tube 1 was opened, plunger 1 would rise steadily and evenly, carrying with it its Wintrobe tube. Thus at regular intervals all the observer had to do was to bring all the corpuscle menisci to a level previously marked on the frosted glass, by manipulating the clips on the rubber tubes, and by this means undue movement of the corpuscle column was obviated, and one tube could be adjusted without interfering with any of the others. (See Figure 2.)

At the end of the experiment the cell volume was ascertained by means of the method of Millar (1925); the tubes were centrifuged at 1,000 revolutions per minute for 10 minutes and then replaced in the rack and their cell volumes recorded; the cell volumes were also recorded after centrifuging for 10 minutes at each of 1,500, 2,000, 2,500, 3,000 and 3,500 revolutions per minute, and the ultimate cell volume deduced from a graph made by plotting the centrifuging rate against the cell volume.

After exposure, the films were developed and the fall in each meniscus was read off from the negative using a dissecting microscope; for each sample a sedimentation graph was drawn by plotting the fall in the meniscus in mms. against the time in minutes each graph thus covering a period of two hours. From these graphs there could be ascertained for each sample not only the ordinary sedimentation rate, but also the aggregation time, sedimentation time, and aggregate sedimentation rate as described in a previous paper (Ride 1936).

The advantages of the technique here described are (1) the apparatus is very cheap and, with the exception of the Wintrobe tubes and the camera can be made in any laboratory. In our case it was all made in our department. (2) A large number of blood samples can be examined at one time without loss of accuracy. (3) A permanent record of the whole process of sedimentation is made and photographing the time of each exposure along with the tubes makes the accuracy of the investigation unaffected if one exposure is missed out or taken at the wrong time. (4) A mistake in reading can be

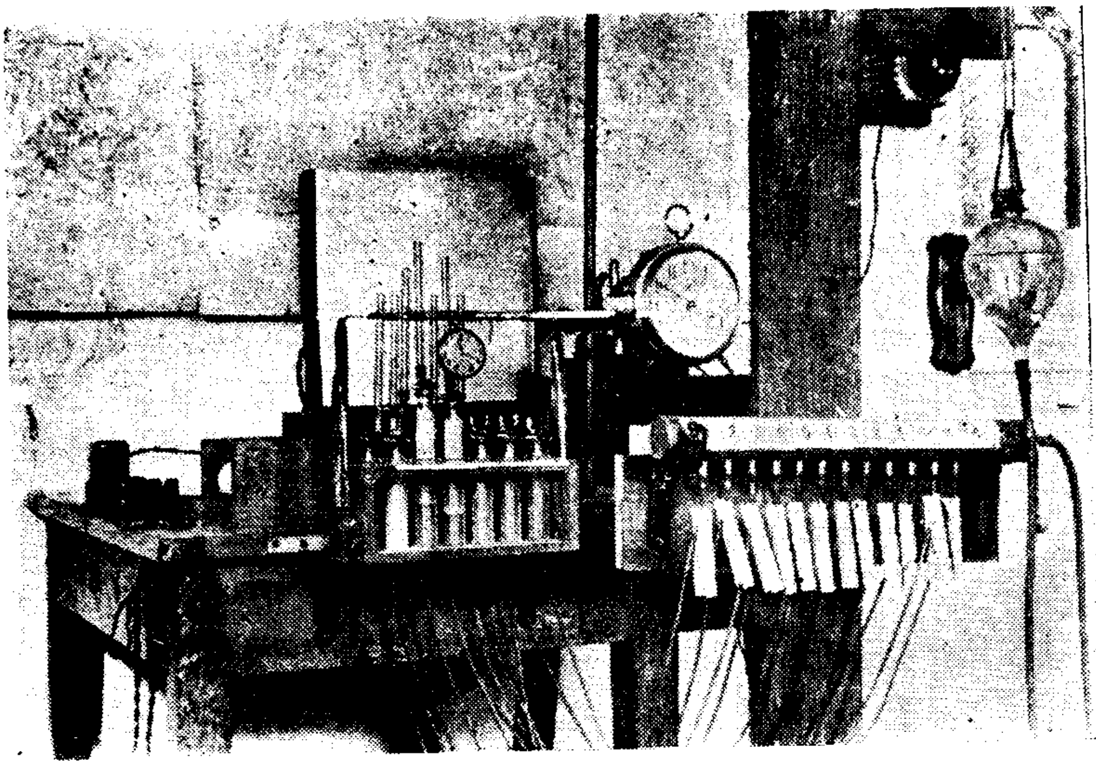
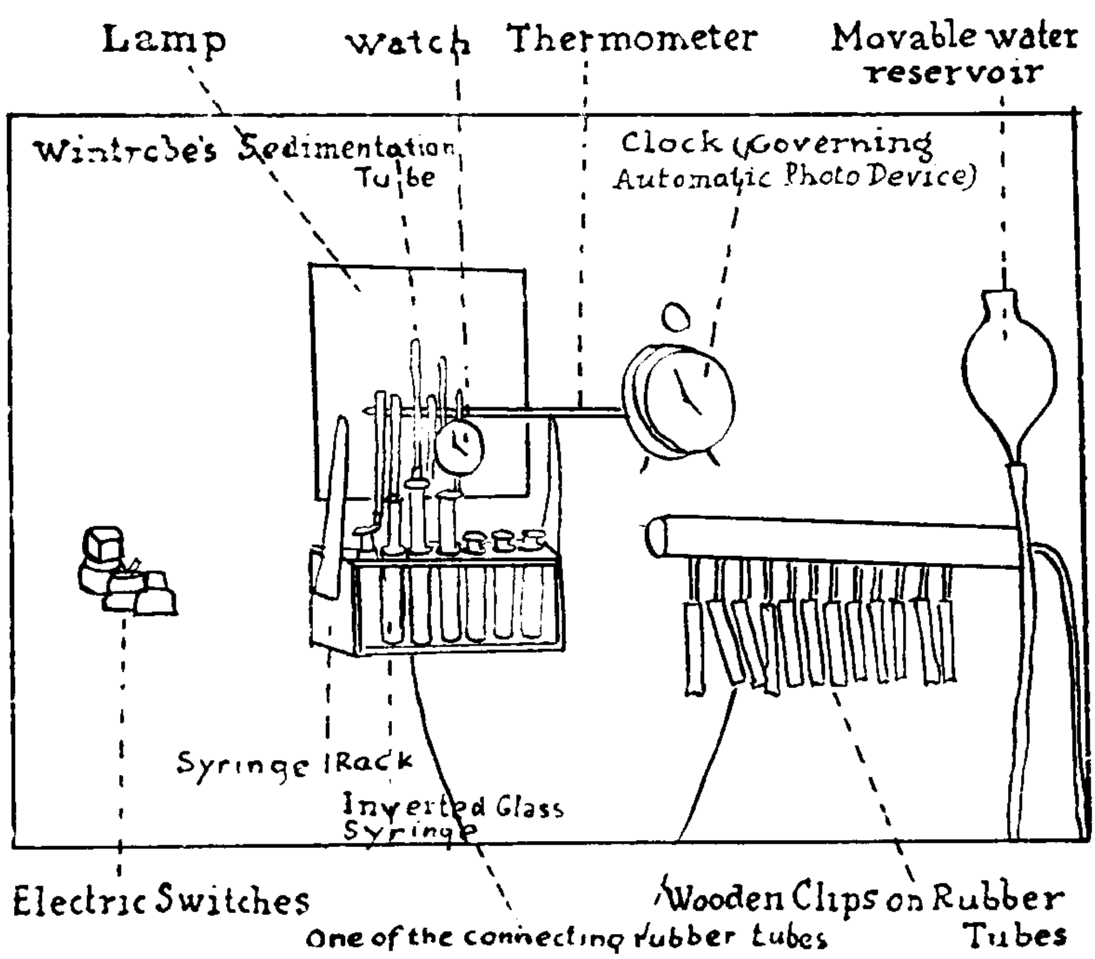


Figure 2.- Above, a photograph, and below, a sketch in outline of the equipment used in the photographic method of recording sedimentation rates of 12 blood samples at a time. For details, see text.



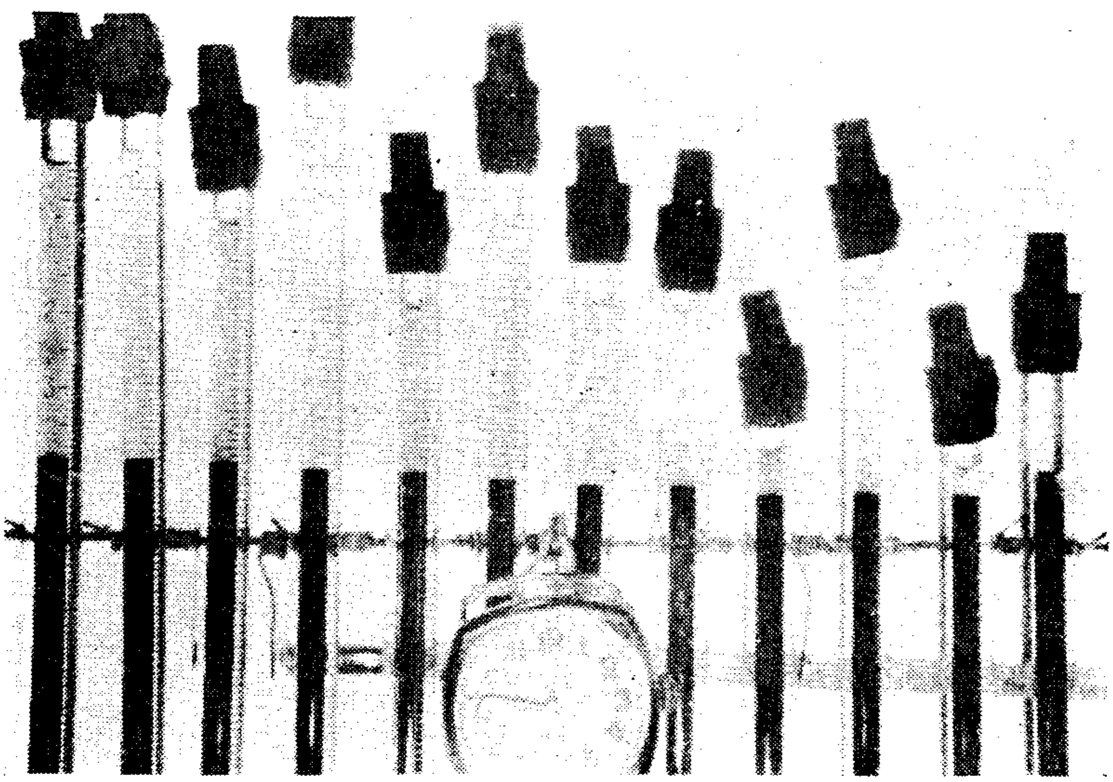
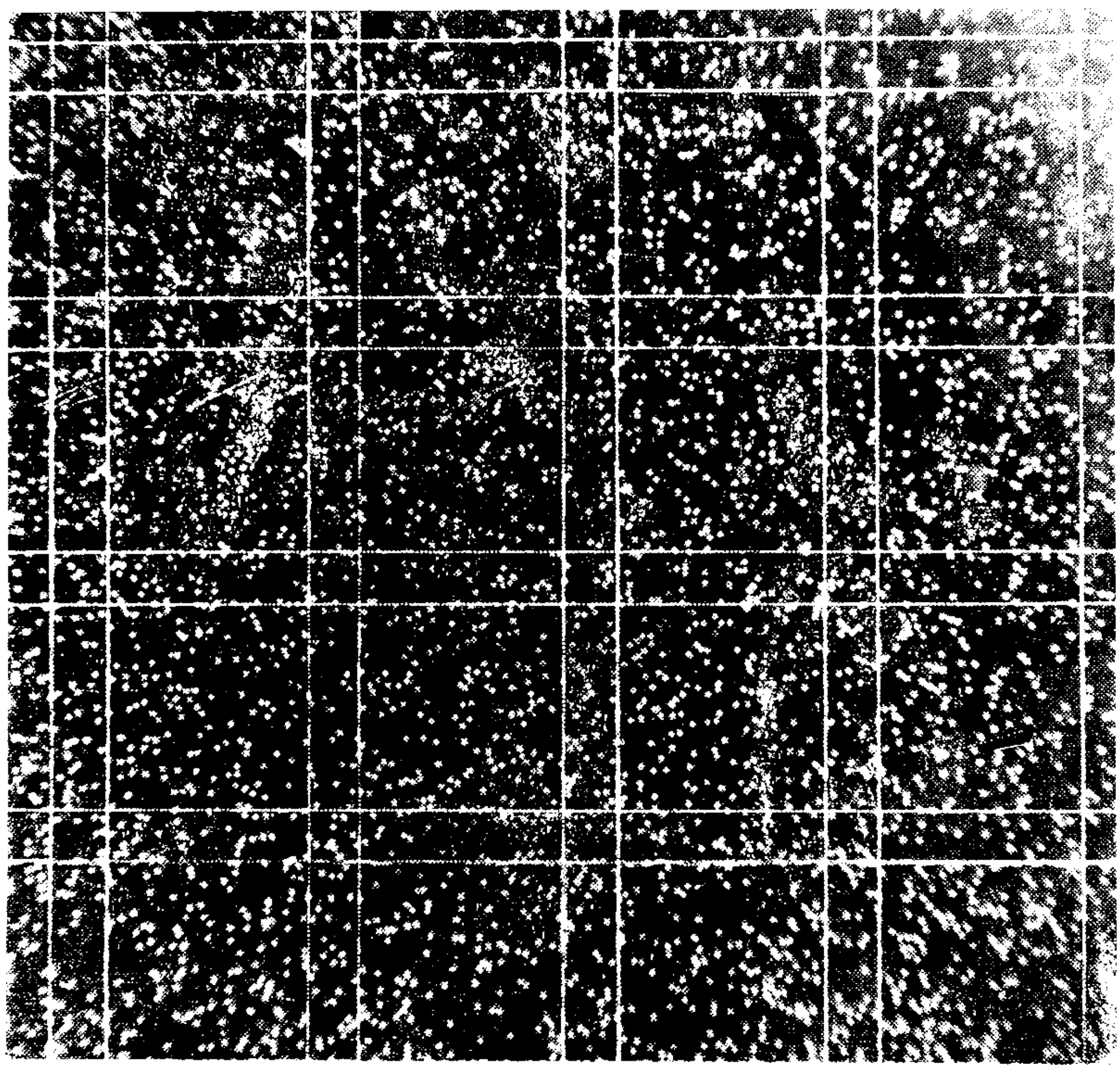


Figure 5.—A print from one of the actual negatives used, showing twelve samples of blood in Wintrobe's tubes at different stages of sedimentation and the watch recording the time of the observation. The tubes, with rubber caps fitted to prevent evaporation, are all at different heights, but the corpuscle menisci have all been brought to the same level by the mechanism described in the text.



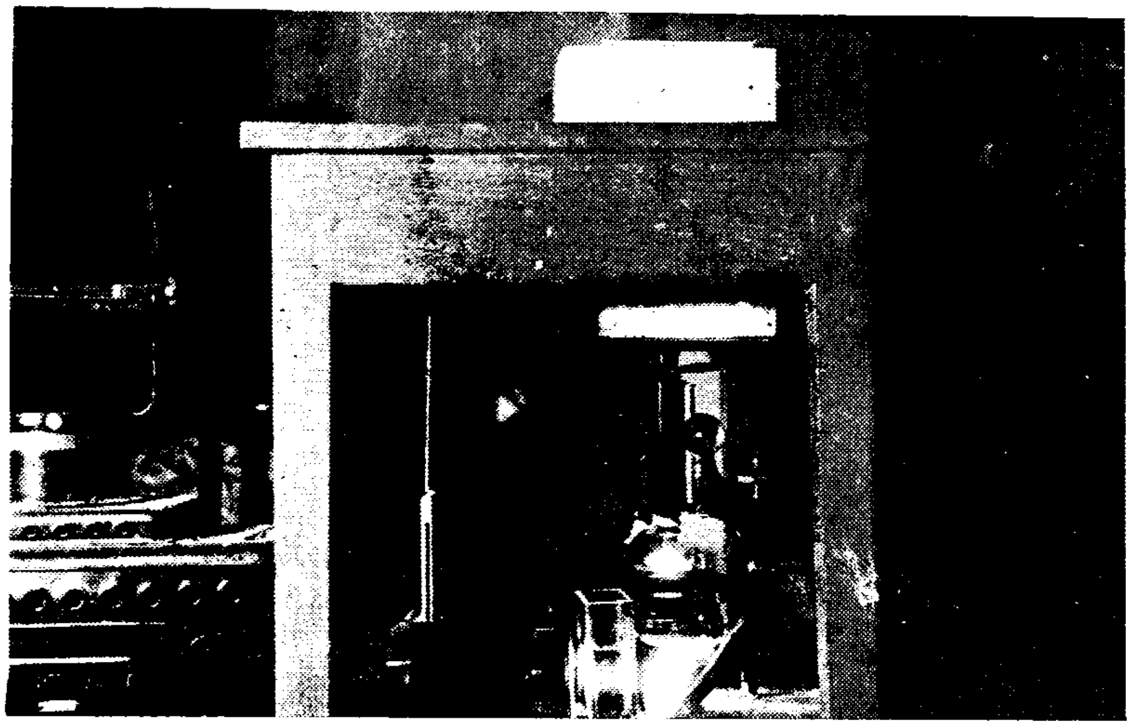
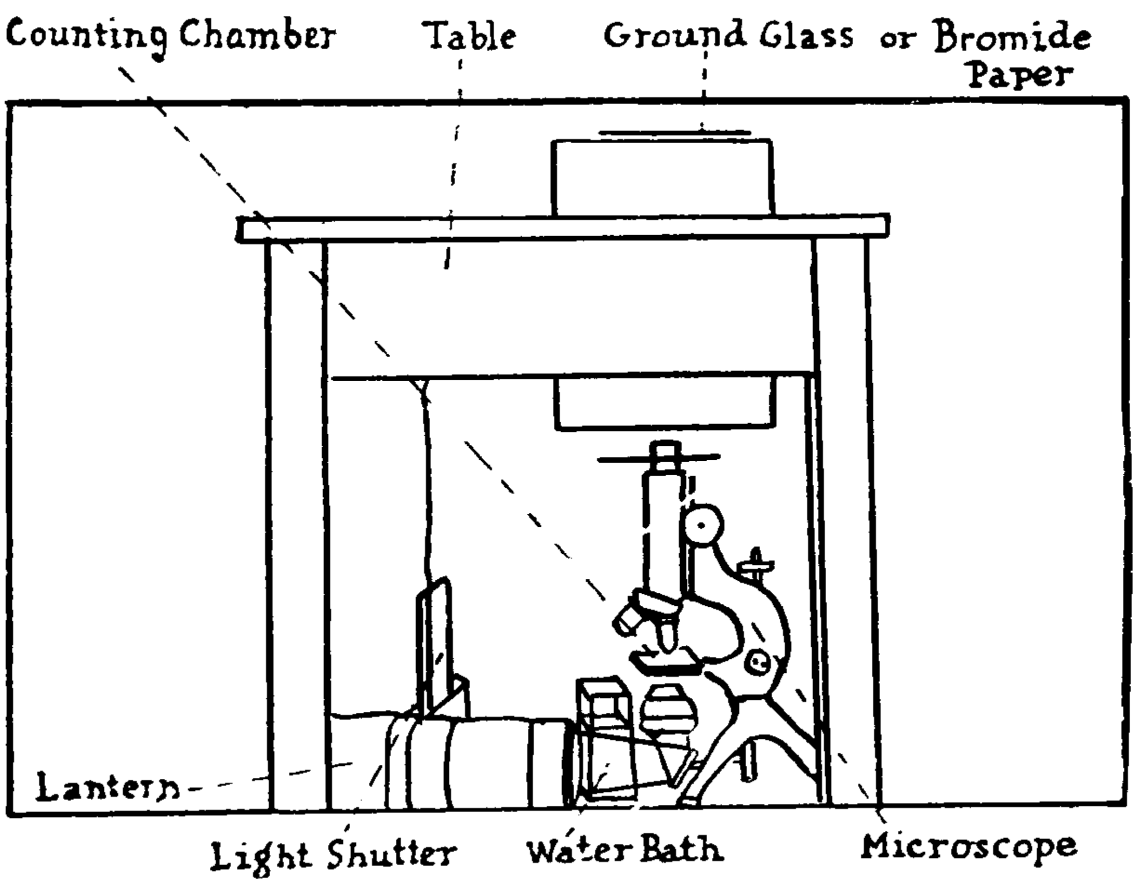


Figure 4. Above, a photograph, and below, a sketch in outline of the equipment used in the photographic method of blood counts described in the text.



readily rectified by reference to the negative at any time, whereas when measuring the sedimentation rate by taking a reading at the end of one hour, everything depends on taking the reading at exactly the hour, and a mistake in the reading or in entering it up nullifies the whole investigation. (5) From the sedimentation graph much more information can be obtained than the mere sedimentation rate, and more valuable and important comparisons between blood samples can be made as we hope to prove by our data.

For these reasons we can strongly recommend a method such as ours to any laboratory worker responsible for making a number of such investigations at a time. (See Figure 3.)

As soon as the blood from the first sample tube of each subject was set up for sedimentation, the blood left in the test tube was used for red and white cell counts; the usual technique was employed in carrying out dilution, except that a Schaffler's new pipette-filling device was used and found to be very satisfactory. The dilution used for the red cells was 1 in 200 and for the white cells 1 in 10. Owing to the large number of counts to be made per day, it was a physical impossibility to do them all with efficiency and accuracy by the usual method, so here again resort was made to photography. The microscope was set under a table framework with a glass plate so arranged in the table top that the image of the counting chamber falling on the glass plate was about 4″ × 4″. When the counting chamber with its diluted blood cells was placed in position and accurately focussed on the glass plate, a piece of bromide paper was placed sensitive side downwards on the glass plate, and the counting chamber, the grid and its cells were photographed. The paper was marked with the sample number and developed and thus a permanent record of the blood count was made and the count could be estimated later at leisure and with great accuracy since each cell could be ticked off as it was counted. This photographic method demands of course a dark room, but in the absence of such facilities a scheme could easily be devised for making the exposure in an ordinary room. Where funds allow, a micro-photographic apparatus would save a great deal of labour, but the inexpensive method here outlined can be highly recommended, for we found it to work admirably. (See Figures 4 and 5.)

We did at first experience some difficulty in getting both the grid and the corpuscles to show up clearly on the sensitive paper. This was overcome by projecting the grid on to the glass plate and then drawing it thereon, and care had then to be taken as each count was photographed, that the size of the projected grid and that on the glass plate were equal. This photographic method of doing the blood counts was employed for both red and white cells and it has all the advantages described for the sedimentation rate method concerning accuracy and permanancy of records. Furthermore two or three records can be made from one blood dilution in a few minutes, minimising inaccuracy due to evaporation, haemolysis and sedimentation in the pipette. But the greatest advantage is the complete absence of counting errors due to fatigue and eye strain, which are inevitable in counting many thousands of cells. By this method, the print is so large that no more ocular fatigue is experienced than when engaged on any other clerical work, and the prints can be set aside and counted at leisure and a recount made at will.

Tests carried out by us showed that the variations in the counts of the same diluted blood samples were much less by this photographic method than by the ordinary method.

At the same time as the dilutions for the cell counts were being made up, a sample for the haemoglobin estimation was also taken. The method of Sahli was the method chosen, and the results expressed in grams per 100 ccs, but later the densitometer as used by Obermer (1935) and described in his book was adopted in an attempt to reduce the personal factor to a minimum.

Of the three blood slides made, one was stained by Leishman and used for making a differential cell count, the second was stained by the iron-alum method of Heidenhain and used for the polynuclear count, whereas the third was used in a Direct Halometer (Allan & Hanbury) for estimating the average diameter of red cells.

From the red cell volume, haemoglobin estimation, and red cell count, the mean corpuscular volume, mean corpuscular haemoglobin and mean corpuscular haemoglobin concentration were estimated as described by Wintrobe.

With the blood left over in the test tubes, supplemented usually by blood from the first sedimentation sample, fragility tests were carried out on the red blood corpuscles of each subject, the strength of the saline solution used ranging from .24% to .48% the difference between adjacent solutions being .02%.

In the rest of this series of articles we intend to give the results obtained from the experiments outlined above.

SUMMARY.

Experiments designed to establish certain physiological blood constants amongst Hong Kong Chinese are outlined. The methods used are mostly the established ones except for sedimentation rates and blood counts where photographic methods were employed. These are described and their advantages examined.

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Review of Books.

"*A Pocket Medical Dictionary.*" By E. & S. Livingstone, Edinburgh. 3/- net.

This is a book of 366 + xx pages but it gives much more information than its title would suggest. The first twenty pages are given over to abbreviations of degrees, medical terms, etc., thermometric scales and weights and measures. The dictionary itself comprises 324 pages, the print is clear and easily read, the pronunciation of each word being given as well as its definition. In many cases much more than a definition is given e.g., Esbach's method is described in half a page, and Gastro-photography has a page of description plus an illustration of a gastrophotor. There are numerous illustrations interspersed throughout the book, some useful, e.g., bougies and forceps, but some might be left out without much loss of value to the book, e.g. "The Amoeba," "The Atlas," "The Axis."

Nearly 50 pages are devoted to appendices where information concerning the Kata thermometer, wet and dry bulb thermometers, dosage, dietary tables physiological standards, poisons, examinations of urine, faeces and blood, history of medicine and diseases designated by proper names is given in a useful and readable form.

It is a very handy and valuable book not only for the student and his pocket, but also for the doctor and his surgery; in fact we might even suggest that the first principle of treatment of poisons on page 354 of this book for doctors be changed from "Send for a Doctor" to "Refer to the Pocket Medical Dictionary."

"*Salts and Their Reactions.*" A Class Book of Practical Chemistry. Leonard Debbin, PH.D. and John E. Mackenzie, D.SC. Sixth Edition. By E. and S. Livingstone. 6/-.

This textbook of elementary practical chemistry has a history of almost fifty years. It originated in 1889 in the notes given by Professor A. Crum Brown to his students and was first issued in book form under the title "Notes on Reactions of Salts" between 1889 and 1901. These notes were subsequently extended by Dr. Dobbin and Dr. Marshall and were published under their present title in 1904.

The demand for a sixth edition which has now been produced by Dr. Dobbin in collaboration with Dr. Mackenzie is a guarantee of the excellence of this text book.

The first section on "The Nature and Properties of Salt" is a theoretical introduction of great value to beginners and is followed by a short chapter on "General methods of preparing Salts."

The third chapter gives practical hints on methods of working and anyone who reads this section carefully will avoid most of the bad habits which beginners are apt to acquire.

The next chapter is a series of forty experiments, including some simple gravimetrical determinations which can be carried out with the simplest apparatus.

The reactions of the metallic and acid radicals are dealt with in the following sixty pages.

The reactions are stated very clearly and concisely, the names of the reagents being printed in heavy type. There are also schemes for the detection of single salts and of mixtures in solution.

Sixteen pages are devoted to dry tests and to the examination of solid substances.

A chapter on volumetric analysis includes exercises in acidimetry, alkalimetry and also the use of standard solutions of potassium permanganate, sodium thiosulphate and silver nitrate.

The book concludes with an appendix containing useful and interesting reactions on organic substances such as starch, dextrin, malt, wheaten flour, bread, bone, etc.

A second appendix deals with the usual reagents.

The book is clearly printed and strongly bound in a blue linen cover. It is admirably fitted for the rough usage to which such books are generally subjected.

The reviewer can cordially recommend this book to the consideration of teachers of chemistry.

"*Gray's Anatomy 26th Edition.*" By Longmans Green & Co., Ltd. 42/- Net.

We welcome the 26th edition of Gray's Anatomy and appreciate the improvements both in text and illustrations, also the method of treating the Skull as a whole, the tedious description of the individual bones being relegated to small type. The revised terminology we are sure will be gratefully received. The illustrations are excellent and explicit and to those of us who have a sentimental attachment to the book it is comforting to see that some of the original and familiar illustrations have been retained.

In the description of the Ligamentum Denticulatum it might be mentioned that the triangular tooth-like processes pierce the Arachnoid Mater to become attached to the Dura Mater. Also in the description of the Medial Longitudinal Bundle on p. 935, its connection with the lateral Intersegmental Tract of the Cord as mentioned on p. 888 might be added to make the description more complete. It is difficult to reconcile the statements concerning the Calcarine Sulcus and the Post Calcarine Sulcus on p. 966 with those on p. 123 in relation to the formation of the Calcar Avis. Again on p. 245 we read—the Optic Foramen establishes communication between the orbit and the Anterior Cranial Fossa, but on p. 265 we are told the Optic Foramen is in the Middle Cranial Fossa which is the usually accepted statement.

There is no doubt but that this work is one of the best for the purpose for which it is intended; it is clearly written, easy to read and excellently cross indexed; there are very few errors. On p. 933 'figure 918' should read 'figure 942.' We commend it to students as their text book and congratulate the Editor for maintaining the same high standard of accuracy and detail throughout each section it contains.

"*Student's Pocket Prescriber*": by D. M. Macdonald, M.D., D.P.H. Tenth edition, 262 pages. 3s. nett. pst 2d. 1934. E. & S. Livingstone, 16 and 17 Teviot Place, Edinburgh.

We should welcome this little volume better had the author arranged his well selected prescriptions according to the principal drugs instead of diseases. Under the present arrangement the young student is apt to look upon it as an encyclopedia of treatment. While we have no objection to a common prescription for the treatment of flatulence or neuralgia we certainly cannot accept one for Appendicitis or Haemophilia! Nevertheless the great number of prescriptions (600 in all) it contains, covering most of the common diseases, certainly will be of great help to students during their study of the art of prescribing, which art is much neglected in the modern schools. It shows how a good variety of mixtures can be prepared from a few time-tested drugs instead of experimenting with the new patent preparations. The book is therefore handy for new practitioners. Judging from the many new editions and reprints within a few years its usefullness has been well appreciated by the medical profession.

"*A Student's Handbook of Clinical Electrocardiography*": by William Evans, M.D., M.R.C.P. (Lond.), 60 pages, 64 illust. 5s. nett. H. K. Lewis and Company, 136 Gower Street, London, W.C. 1.

In a clear and concise manner, interposed profusely with excellent illustrations, the author presents the current concept of the electrical changes of the heart muscle in their proper relationship to clinical medicine. The book will not only be useful for students when preparing for their examinations but also valuable for the busy practitioner who wishes to know the significance of the reports on his patients by a cardiologist and finds no time to consult standard text books.

"*Catechism Series*": 1s. 6d. net. each part. E. & S. Livingstone, 16 & 17 Teviot Place, Edinburgh. Bacteriology and Protozoology in Medicine and Public Health by W. R. Logan, M.D., F.R.C.P.E., D.P.H. 4th edition part II. Anatomy (the thorax), by C. R. Wittaker, F.R.C.S.E., F.R.S.E. 4th edition part I. Physiology part I. Medicine part V.

These volumes will be welcomed by the students as they give a rough idea of the kind of questions he is likely to be asked in the examinations. There are a few points which the reviewer cannot refrain from critisizing, otherwise the students might be misled by the answers. Among some of them I shall mention the following examples:—

In Physiology, on page 4 his answer to the question "What takes place when a Nerve Trunk is stimulated by Galvanic current Electricity?" is "When a current of galvanic electricity is applied to a nerve trunk it only stimulates when it enters and when it leaves, but not during the flow unless it undergoes changes in intensity. This is true whether the nerve trunk be motor or sensory." Any junior student in the physiology class will learn that a lot of things take place besides what has been mentioned.

On page 5 of the same book the sentence "The instantaneous currents of the induced type stimulate nerve tissue better than the slow galvanic," is even more misleading. The author has perhaps overlooked the fact that the instantaneous current of the high frequency type does not stimulate the nerve tissue at all.

The reviewer cannot agree with the author's preference of Haldane's haemoglobinometer by saying that the standard is definite and permanent. He finds that the standard is much less definite than that of Sahli's and it fades very quickly.

In Medicine on page 383, "Those of touch, pain, temperature and the Muscular Sense! . . . . . ." are the first few words in his answer to the question "What are the principal varieties of cutaneous sensation!" Pupil reflex was not mentioned in the answer to the question on page 385 which reads, "In nervous disease what reflexes are commonly tested?"

It will be safer for the student to check the answers with text-books or by consulting their teachers.

Acknowledgements

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