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A PRELIMINARY REPORT ON INVESTIGATIONS INTO CERTAIN RACIAL CHARACTERISTICS OF THE NATIVES OF BRITISH NORTH BORNEO

(Continued)

by

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The data collected on our 1931 expedition concerning blood groups and hair whorls has already been published in this Journal and in this paper it is intended to place on record the data obtained concerning the papillary ridges on the palms of the hands. In view of the fact that much more data was collected in a further expedition last year, full discussion of the entire results is postponed until the rest has been tabulated.

Since the beginning of this century, a large amount of scientific attention has been turned to the distribution of the papillary ridges on the palms of the hands and the soles of the feet. These ridges must not be confused with the lines on the hands which are of such vital importance to fortune tellers. These latter lines are merely skin hinges, and their existance is thus to a certain extent dependent on the action of the underlying intrinsic muscles of the palm.

The papillary ridges however are completely independent of muscular action, being formed about the third or fourth month of foetal life. When considered as a whole, these ridges are seen to form themselves into patterns or open fields in a more or less constant manner, the general plan of which will be discussed later. These patterns, once they are laid down in the embryo, never alter. The actual sizes of the different parts of the pattern may vary during the process of growth, but the underlying pattern as a whole remains unchanged, just as stretching a fabric may distort but cannot alter its intrinsic pattern. It is due to this coupled with the fact that it is impossible to have two ridge systems alike in every respect, that the study of finger prints owes its use not only in the detection of criminals but in the establishment of identity.

in the Auditory Nerve." Through the experimental method introduced by them it was made possible for the first time to determine in experimental animals the part played by the Tympanic membrane, the Ossicle, Round Window membrance, Eustachian Tube, Tensor Tympanic muscle and the Stapedius muscle in the transmission of voice and sound waves. It also enable us to study the transmission of high tones in relation to middle ear structures, and this is important because the majority of these cases of deafness were impairment of transmission of high tones. Let us take a typical book case:—Low tones are heard normally: the greatest impairment is for tones above middle C air conduction is better than bone conduction. Bone conduction in some patients seems shortened, in others it is normal for 256 and 512 double vibration. This condition is described as a "lesion of the inner ear due to Toxic Neuritis of the acoustic nerve or to nutritional disturbances in the basal coil of the cochlea."

Clinically there are two distinct groups of high tone defects. In one the higher pitched forks and even the intense penetrating tones of the monochord are not heard; in the other there is marked impairment, but if the sound is of sufficient intensity it can be recognised. Degeneration changes are always found in the microscopic section of the cochlea, when there is complete loss for the high tones. Lesions in the middle ear are hard to interpret as they are rarely confined to one place.

Now let us turn to what evidence we get from experimentation on animals through the Wever Bray effect. Cats are mainly used because of the easy exposure of the middle ear structure. The Wever Bray experimental "set up" is as follows:—The animal is anæsthetised by ether, a tracheal tube is introduced into the trachea and connected by a tube with a Woulfe bottle containing ether and through which is passed a current of compressed warm air. A small trephine opening is made over the cerebellum and a silver electrode placed on the auditory nerve. (7th nerve facial twitch is evidence of correct placing). Another electrode is grounded in the muscles of the neck. Wires from the two are carried to a six tube amplifier in another room of the building. Connected with the output of the amplifier is a microphone. Now if spoken words or tuning fork tones are conveyed to the cat's ear, they are reproduced with great clarity in the microphone. The sound waves are transmitted by the cat's ear to the nerve causing a change in potential or modifying in some way circuit leading to the amplifier. If cats are used the middle ear may be exposed, without injury, by opening the mastoid bulla through an incision in the neck. An inspection of the middle ear through a binocular microscope and a preliminary test with voice, tuning forks, Galton whistle are made to asertain that the middle ear is normal and conducts sounds normally. The different experimental proname and called a *palmar main-line,* and it is the writer's belief that the position of these main lines on the palm has a definite developmental, and in view of that perhaps a racial, significance.

It will be noticed that the above description of the tri-radii was confined to that portion of the palm at the base of the digits II, III, IV and V. This was done purposely, for at the base of the thumb there is no tri-radius, but the transverse ridge system over the proximal phalanx of this digit spreads right down over the thenar skin until it meets the ridge system of the palm proper along a line running roughly from the vicinity of tri-radius 'a' to the region near the middle of the proximal border of the palm, just distal to the carpal skin folds. Here at this position is generally found another tri-radius known as the *carpal tri-radius.*

It is both interesting and constructive to consider the relation of each of the tri-radii to the underlying bones. Each tri-radius is found on the skin in the vicinity of the growing end of its corresponding meta-carpal; or if we consider the first meta-carpal to be in reality the modified proximal phalanx of the first digit, we may put it that each of the five tri-radii is found near the proximal end of its corresponding digit. Viewed in this light it is hoped to be able to show that the distribution of the papillary ridges on the palm has an important significance. According to this plan, the carpal tri-radius would be far better termed the *1st digital tri-radius.* Just as we saw that the two lateral radiants of the four digital tri-radii 'a,' 'b,' 'c' and 'd' separated the ridge systems of the digits from that of the hand, so the corresponding radiants of the first digital tri-radius separate the ridge system of the thumb from that of the hand. The radiant running to the radial side of the thumb is not of much moment in this connection, but the one running distally towards the tri-radius 'a' is very important and interesting, for its position in the hands studied in British North Borneo natives varies tremendously.

The significance of this finding will be better appreciated when we consider briefly the comparative anatomy of the papillary ridges. If the palm of lower animals be examined, it will be seen that in some of them the ridges are restricted to the palmar pads, on which they occur in patterns of more or less concentric rings. In the monkeys the ridges have spread off the pads all over the palm, but the resulting distribution is interesting for we can still see concentric circular patterns—or whorls—on the original sites of the pads, but the intervening skin is covered by the outer ridges of the whorls which no longer make a complete circuit, but have been drawn out into linear ridges coursing between two whorl systems, and generally ending freely somewhere along the palmar edge. In the apes the whorl system has expanded still further, many more of the ridges

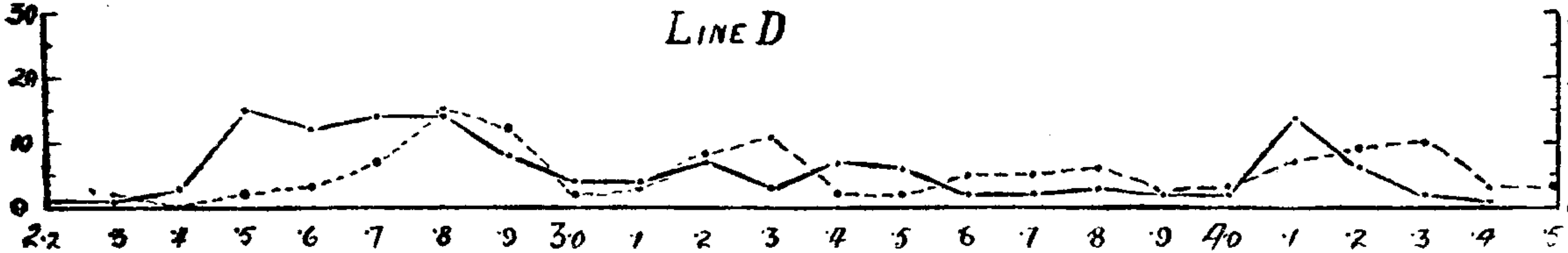

Figure 4. Graphs showing the frequency of termination of palmar main-line D in positions with values ranging from 2.2 to 4.5, as found in the hands of North Borneo Natives. Note how the whole graph is shifted to the right in the right hands, and also how each peak in the polyphasic curves also individually show this shift to the right. For the purposes of this and succeeding graphs, the line values are plotted to the nearest tenth, thus any line falling between 2.65 and 2.74 is plotted as 2.7. The continuous line represents the left hand values and the dotted line those of the right.

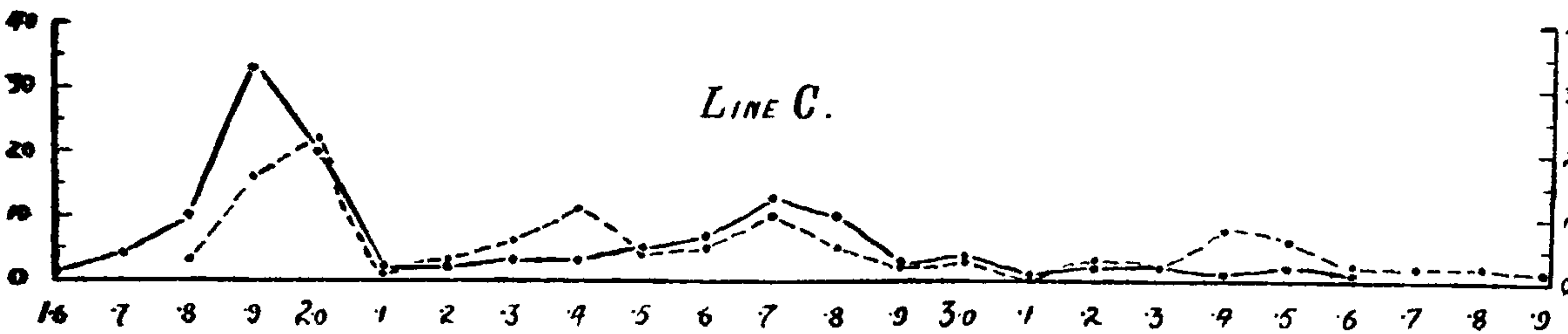

Figure 5. Graphs showing the frequency of termination of palmar main-line C in positions with values ranging from 1.6 to 3.9. The continuous line represents the left hand values and the dotted line those of the right. Again note the shift to the right in the right hand values of this line.

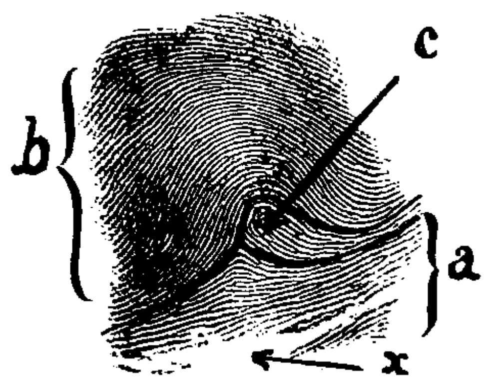

Figure 1. *(i)* A slightly rolled finger print showing the three types of ridges mentioned in the text. 'a' — the proximal ridges running parallel to the inter-phalangeal skin fold (showing as a white gap in the print and marked x) being part of the transverse ridge system covering the proximal phalanges. 'b'—The distal or terminal ridges sweeping across from one side to the other more or less parallel to the finger edge. 'c'—The ridge system enclosed between a and b, in this case forming a loop pattern.

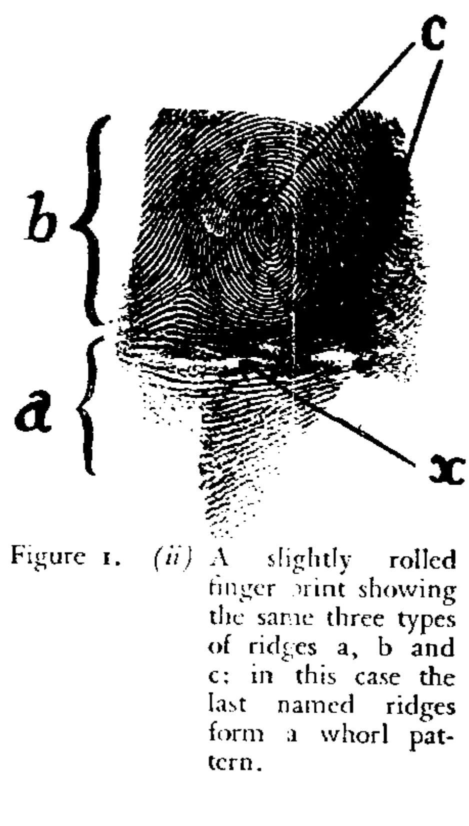

Figure 1. *(ii)* A slightly rolled finger print showing the same three types of ridges a, b and c: in this case the last named ridges form a whorl pattern.

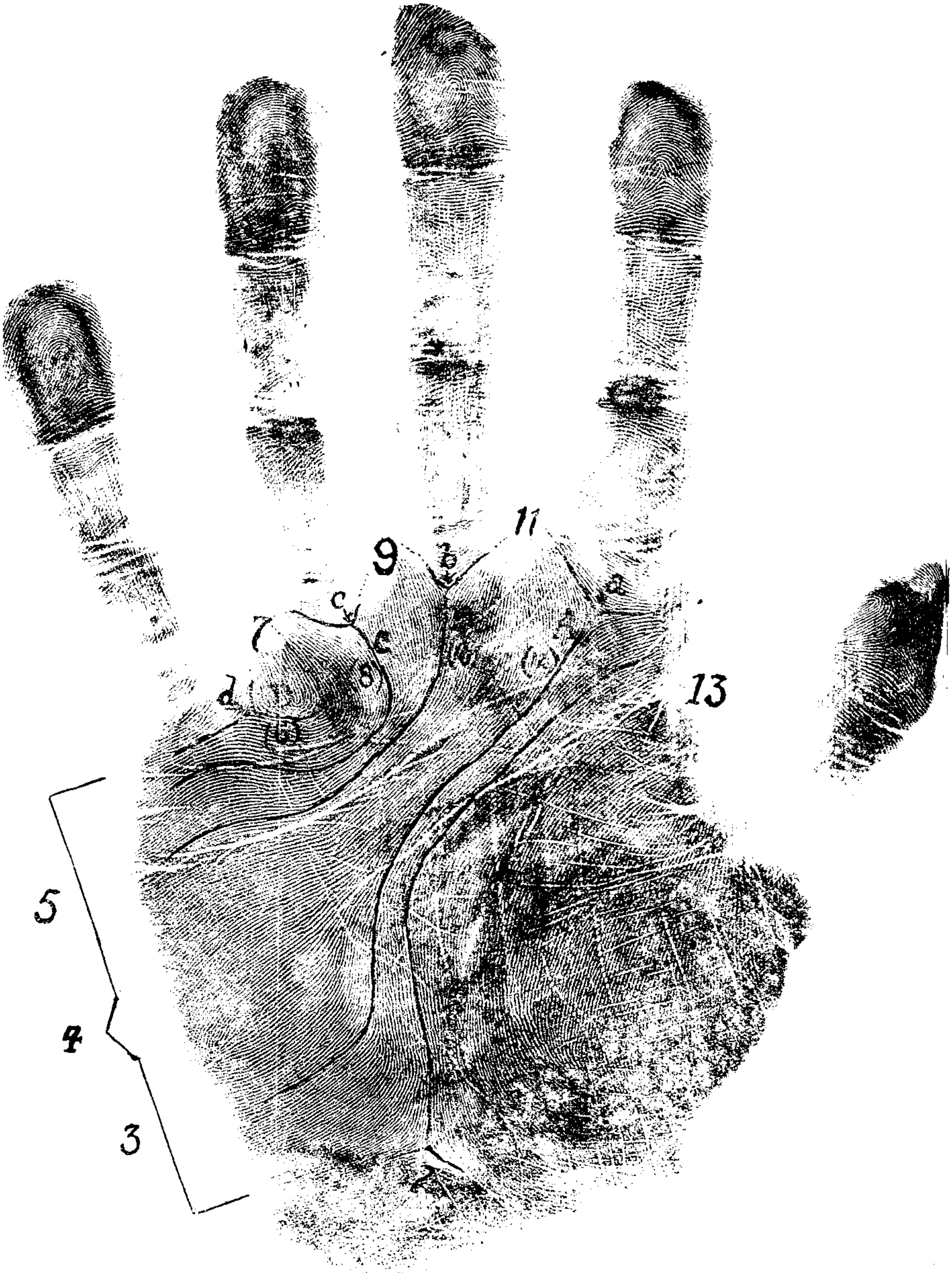

Figure 2. A print of a left hand, showing Wilder's method of designating the various points and areas on the palms. The four digital tri-radii are marked 'a', 'b', 'c' and 'd' respectively, and the corresponding palmar main-lines 'A', 'B', 'C' and 'D' while the values of these lines are shown in brackets (12), (10), (8) and (6) respectively. The palmar tri-radius has the value 2 and the areas between the tri-radii have their respective values shown just outside the palmar margin.

losing their circular character and becoming linear. In the human, actual whorls sometimes still exist, but they are not common, constant or characteristic features of the palm; the typical distribution of the ridges in the human, is in lines running across the palm, in general slightly transversely, but that these lines are the representatives of the old whorl systems is indicated by the presence of the tri-radii which mark the meeting-places of the ridge systems derived from the different embryological palmar pads. The radiants therefore constitute the lines of demarcation between adjacent pad-ridge-systems, and the palmar main-line from the carpal tri-radius is important because it divides the ridges derived from the thenar pad on the radial side, from the ridges derived from the hand proper on its ulnar side. The more ulnarwards the distal end of this line is placed, the more the skin over the distal part of the palm is covered by ridges derived from the thenar pad; the more radially it is placed, the more is the thumb and its skin being divorced from the distal end of the palm.

The writer's view is therefore this, that in the precursor of the human hand, the palmar ridge systems were more or less longitudinal, running distally to end against the transverse running ridges of the five digits, thus forming the digital tri-radii. The tri-radii 'a', 'b', 'c' and 'd' were in the same positions as they are now found, but the first was then in line with the rest. As the first meta-carpal dwindled, so the first phalanx of that digit was drawn towards the wrist, bringing with it its digital tri-radius. The transverse ridge system of the first digit therefore encroached on the palm, forcing the true palmar ridges towards the ulnar side, and changing their direction from longitudinal to diagonal. The more the thumb is divorced from the other digits and approaches the wrist, the more transverse become the true palmar ridges, and in the following results it is hoped to show how this change has not yet been completed, for in the Borneo natives there is a distinct difference in this respect between the two hands, left and right.

In the light of the forgoing descriptions, it will be seen that the positions of termination of each palmar main-line is important. In the case of those arising from the four tri-radii 'a', 'b', 'c' and 'd', this has been recognised for some years, and Wilder and Cummins and their co-workers in America have derived a method whereby different areas along the palmar border where the main-lines end, may be given various arbitrary values. Each main-line is then given the value of the area in which it ends and the values written in the order 'd', 'c', 'b', 'a', thus translating into a numerical formula the main-line distribution of any hand. (Figure 2).

Palmar Main-line Formulæ.

If one examines the hand in Figure 2, one sees its formula is 7, 5, 5, 3. But this formula is not peculiar to that hand alone. There are many hands which have exactly that same formula, some of them perhaps with ridge systems very like the one depicted in the figure, and others perhaps very different. The inability of Wilder's formula to express such differences whether they be large or small, led the writer to suggest a modification which was described in detail in a paper submitted to the 5th Pacific Science Congress. The following were the criticism of Wilder's method, and the reasons for suggesting the modification:—

(1) It took no notice of another palmar main-line which is the distally running radiant from the carpal tri-radius. It might be argued that having been given the site of the termination of the other four main-lines, that of the fifth must be fixed and it is superfluous to give it. To a certain extent this is true, but in the next paragraph it is hoped to show that this line is important enough to be included in the formula; also in Wilder's formula its exact position is not capable of being located.

(2) It takes note only of the *area* within which a main-line falls, and gives no indication whatsoever of its relative position within that area. Thus when line A ends just at the ulnar side of the carpal tri-radius, it is represented by the same formula as a hand in which that line ends at the distal border of that same area. Furthermore, in every case of the native hands examined, it was found without exception that the carpal main-line on the right hand ended further towards the radial side of the hand than the corresponding line on the left hand. Unless this radial shift takes this main-line to a different side of the tri-radius 'a', this difference between the two hands remains unrecorded in Wilder's formula. This radial shift is such a constant feature of all these native palms that it becomes advisable to devise a formula which will record the finding.

(3) The numbers 2, 6, 8, 10 or 12 can only occur in a formula when the main-line concerned ends by fusing with another main-line, whereas the occurrence of the numbers 1, 3, 4, 5, 7, 11 or 13 represent the fact that a main-line has ended anywhere within the *area* thus designated. With this territorial inequality in the meaning attached to the numbers, it is impossible to take the formulæ of a large number of hands and calculate mathematically an average formula for those hands. This point may perhaps be better seen when one tries to obtain a graphical representation of the frequency of the termination of any one of the main-lines; e.g. if one takes prints of one hundred hands and plots along a horizontal axis the numbers given by Wilder to the hand areas, and along the vertical axis the actual number of cases in which line A is found to end in the various areas, one obtains a graph showing the relative frequency of termination of line A in the various hand areas. Since 2 represents the fact that the line has ended at the carpal tri-radius, and 3 that it has ended anywhere over a large part of the hypothenar eminence, 2 is found re-

latively infrequently in any 100 cases taken, and therefore all graphs are alike in this respect. All graphs thus drawn for any of the lines will drop almost to zero opposite the even numbers, 4 excepted, because in Wilder's method the value 4 is given to an area.

(4) The demarcation of area 3 from area 4, and that of 4 from 5 is very indefinite and inexact. In fact there exist more than one method of interpreting the extent of these fields.

(5) Errors in ridge tracing, however slight, may alter the formula considerably if made in the vicinity of a main-line or a tri-radius, but a considerable error made in an area such as 3 makes no difference whatever. For example, where line A ends correctly at position 2, an error which places the line one ridge to the radial side makes the formula read 1, or if it be incorrectly traced one ridge to the ulnar side, the formula reads 3; whereas, in the case where the line ends in the middle of the area 3, a very large margin of error is possible before the formula is falsified.

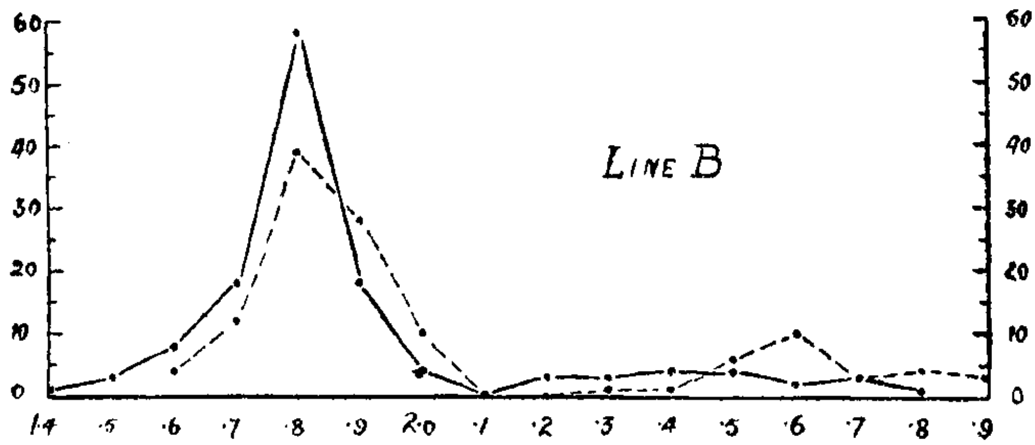

Figure 6. Graphs showing the frequency of termination of palmar main-line 'B' in positions with values ranging from 1.4 to 2.9.

The continuous line represents the left hand values and the dotted line those of the right. The shift to the right is again definitely shown both in the whole graph and each of the peaks of the biphasic curves.

(6) Having been given the Wilder formula for a hand, it is impossible to reconstruct the ridge distribution with any degree of accuracy.

The Suggested Formula.

The writer's suggested modification of Wilder's method is depicted in Figure 3. It will be seen that the whole numbers 1 to 5 are reserved for the five tri-radii, that at the carpus being given the value 1, and 'd'' 'c', 'b' and 'a' being given the values 2, 3, 4 and 5 respectively. The distance between any two adjacent tri-radii is therefore assumed to be one unit, and the exact position of termination of any main-line between two tri-radii can be expressed by the fraction of that unit which separates such point of termination from the previous tri-radius. In making such measurements, the direction followed is always from the carpal tri-radius along the ulnar border of the palm to 'd' and then radially across to 'a', and if necessary, proximally along the radial border. These fractions are expressed as decimals to two places, and thus any line ending half-way between 'd' and 'c' would have the value 2.50. We must now discuss the method of calculating this fraction. One obvious method is by direct measurement along a line joining the two tri-radii. Although in general this was found quite satisfactory, it was often a matter of extreme difficulty in the region between 1 and 2 because there in part of its extent, this line runs *along* and not across the general direction of the ridges, making its exact evaluation often an impossibility.

The method found most useful was that of ridge counting. The total number of ridges separting two adjacent tri-radii are counted, and the number separating the ridge in question from the previous tri-radius, expressed as a percentage of the total number, is the decimal value of the line under consideration. The counting of the ridges is greatly facilitated by joining the tri-radii with straight lines, except in the case of the carpal and the 5th digital tri-radii. These two are joined by a curved line running roughly parallel with the ulnar border of the palm. Such a curved line has the advantage that it runs approximately transverse to the ridges throughout its whole extent, thus minimising the error of counting, while it also avoids that area of the junction of the hypothenar and the centre of the palm where there is a tremendous amount of division or fusion of lines with a consequent difficulty in accurate counting. In a large number of cases both lines were used (i.e. both straight and curved) on each hand and it was found that the results corresponded very accurately, so that the ease of counting and the smaller liability to error made the adoption of the curved line preferable.

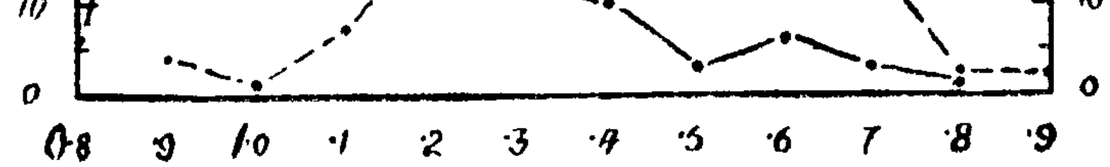

Figure 7. Graphs showing the frequency of termination of palmar main-line 'A' in positions with values ranging from 0.8 to 1.9.
The continuous line represents the left hand values and the dotted line those of the right. Again the shift to the right in the right hand is demonstrated and also the fact that the main-lines arising from the more radially placed tri-radii have a more constant termination value. The previous graphs have all been becoming gradually less polyphasic, the graphs in this figure being definitely monophasic.

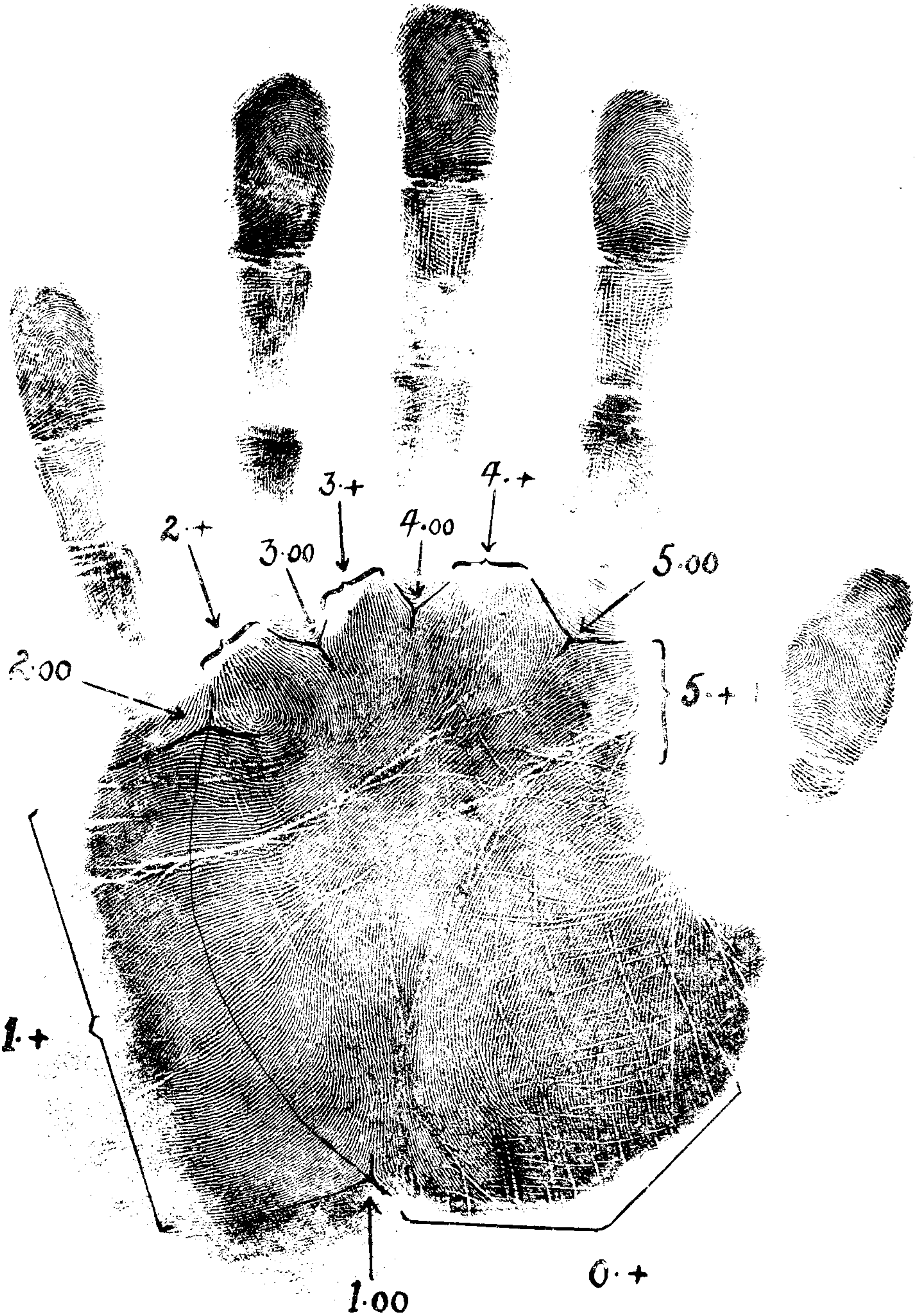

Figure 3. The author's modification of Wilder's method, to be compared with the latter as shown in figure 2. From this figure it is readily seen how each point along the edge of the palm has a value peculiar to itself, and quite distinct from that of any other point.

Note also the curved line drawn in, joining the carpal, with the 5th digital, tri-radius, along which line the ridge counts in this area are made.

As there is no point valued 6, one cannot apply the above method in estimating the decimal value of a ridge lying to the radial side of the index tri-radius. In this case the actual number of the ridge is used as the decimal, counting along the normal dropped from the tri-radius to the ridge as it sweeps past towards the border of the hand. Similarly since there is no place valued 0, lines falling to the radial side of the carpal tri-radius are estimated by counting the ridges along the normal dropped from the tri-radius to the ridge, and this number subtracted from 100 gives the decimal value of the ridge, the whole number in this case being 0. It will be seen that these results are the same as if it were assumed that the number of ridges between 5 and 6, and between 0 and 1 were in each case 100.

This method has the following advantages:—

(1) Every ridge along the border of the palm can be denoted by a number peculiar to its own position; this number not only indicates the two tri-radii between which the ridge can be found, but the decimal fraction indicates its exact position between these two fixed points in relation to the other ridges.

(2) The territorial inequality of the numbers comprising the formula is removed, for each of the hundred decimals between two integers represents a separate hundredth of the distance between the two tri-radii.

(3) The ridge distribution of the palm can be fairly accurately reproduced, at any rate with regard to the main-lines, from the formula obtained by this means.

(4) Error in ridge counting or tracing makes an error in the formula of only a few decimal places and not as in the other method, a difference of a whole unit if the error be made in the vicinity of a main-line.

The following tables give the results of our 1931 expedition drawn up according to this new formula.

TABLE IX.

Serial Number	Tribe	Sex	Left Hand Main-lines. D	C	B	A	Carpal	Right Hand Main-lines. D	C	B	A	Carpal
B.1	Simunol	M	3.09	2.18	1.73	0.93	4.72	3.33	2.41	1.91	1.35	5.08
B.2	„	F	2.81	1.94	1.82	0.87	4.64	2.80	1.96	1.82	1.54	5.08
B.4	„	F	2.60	1.91	1.78	0.93	4.59	2.95	1.98	1.76	1.22	5.14
B.5	„	M	—	—	—	—	5.11	—	—	—	—	—
B.6	„	M	4.06	3.00	2.25	0.88	4.42	4.18	3.73	2.56	1.49	5.15
B.7	„	M	3.35	2.45	1.93	1.30	5.18	3.33	2.45	1.92	1.69	5.28
B.8	„	M	3.50	2.43	1.84	1.24	5.17	4.10	3.40	2.50	1.70	5.28
B.9	„	M	2.88	1.98	1.73	1.65	5.05	2.84	1.99	1.76	1.40	5.17
B.31	„	M	2.76	18.1	1.59	1.10	5.04	2.93	1.97	1.70	1.22	5.17
B.33	„	M	4.13	2.83	2.30	1.41	5.10	—	—	—	1.63	5.20
B.34	„	M	4.05	3.20	2.50	1.52	5.15	4.30	3.53	2.76	1.70	5.30
B.35	„	M	3.80	2.72	1.94	1.08	5.18	3.29	2.37	1.85	1.51	5.24
B.36	„	M	3.36	2.75	1.85	0.92	4.23	3.20	2.36	1.93	1.19	5.14
B.37	„	M	2.84	1.84	1.54	1.13	5.11	2.93	1.85	1.67	1.15	5.17
B.39	„	M	2.84	1.87	1.77	1.16	5.16	2.68	1.96	1.74	1.45	5.25

TABLE X.

Serial Number	Tribe	Sex	Left Hand Main-lines. D	C	B	A	Carpal	Right Hand Main-lines. D	C	B	A	Carpal
B.29	Dusun	M	3.15	2.56	1.71	0.83	4.43	4.19	3.35	2.53	1.22	5.08
B.77	„	M	3.06	2.29	1.76	1.30	5.11	2.75	1.97	1.81	1.44	5.22
B.78	„	F	3.30	2.11	1.74	0.88	4.50	2.88	1.98	1.60	0.90	4.74
B.79	„	F	2.59	1.93	1.72	1.13	5.10	3.17	2.75	1.87	1.64	5.20
B.80	„	M	2.83	1.87	1.57	0.89	4.43	2.91	1.98	1.78	1.54	5.06
B.81	„	F	2.45	1.72	1.62	1.06	5.02	2.73	1.97	1.78	1.52	5.22

TABLE X.—*Continued* 1.

Serial Number	Tribe	Sex	Left Hand Main-lines. D	C	B	A	Carpal	Right Hand Main-lines. D	C	B	A	Carpal
B.85	Dusun	F	—	—	—	—	5.25	—	—	—	—	5.30
B.86	,,	M	4.13	3.62	2.16	0.98	4.85	3.75	2.59	1.98	1.47	5.21
B.87	,,	F	2.59	1.70	1.78	0.91	4.57	2.80	1.92	1.79	0.92	4.75
B.88	,,	M	3.36	2.69	1.81	0.96	4.60	3.15	2.13	1.88	1.29	5.17
B.89	,,	F	3.00	2.00	1.75	0.93	4.91	2.93	1.97	1.79	1.48	5.15
B.91	,,	F	2.68	1.86	1.71	0.95	4.67	2.87	1.98	1.84	1.24	5.10
B.97	,,	F	4.09	2.73	2.37	1.25	5.05	4.25	2.33	2.62	1.26	5.14
B.98	,,	M	2.88	1.93	1.82	1.14	5.14	3.23	2.35	1.84	1.31	5.30
B.99	,,	F	4.11	2.75	2.63	1.63	5.18	4.36	3.93	2.94	1.67	5.24
B.102	,,	F	2.89	1.97	1.77	0.91	4.65	3.25	2.27	1.79	1.38	5.05
B.105	,,	M	2.32	1.95	1.79	0.91	4.59	3.90	—	1.96	1.53	5.20
B.106	,,	M	2.50	2.85	1.93	1.39	5.15	2.75	1.97	1.94	1.57	5.20
B.108	,,	M	4.06	—	—	1.59	5.05	4.25	—	—	1.61	5.20
B.110	,,	M	—	—	—	—	5.10	—	—	—	—	5.25
B.111	,,	M	4.08	2.10	2.75	1.18	5.10	4.00	3.48	2.00	1.28	5.22
B.115	,,	M	2.67	1.95	1.85	1.13	5.06	3.22	2.39	1.93	1.37	5.18
B.116	,,	F	2.55	2.83	1.83	1.21	5.12	2.27	3.66	1.97	1.44	5.16
B.117	,,	M	2.66	1.94	1.80	1.22	5.05	4.18	3.75	2.59	1.56	5.17
B.119	,,	F	2.84	1.94	1.83	1.21	5.06	3.33	2.84	1.90	1.50	5.15
B.120	,,	F	2.84	1.97	1.78	1.06	5.10	3.—	—	1.98	1.46	5.16
B.242	,,	M	2.—	1.—	1.—	0.85	4.—	—	—	—	1.—	5.05
B.243	,,	F	4.22	3.35	2.70	1.27	5.14	4.31	2.73	2.50	1.69	5.22
B.244	,,	M	4.—	—	1.—	0.88	4.—	4.—	—	2.—	1.—	5.20
B.245	,,	M	—	—	—	1.11	5.04	—	—	—	1.49	5.18
B.246	,,	F	2.40	1.94	1.79	1.13	5.05	2.67	1.96	1.78	1.46	5.14
B.247	,,	M	2.50	1.83	1.78	0.90	4.61	—	—	1.80	1.40	5.18
B.248	,,	F	4.07	2.85	2.43	1.26	5.07	4.47	3.56	2.90	1.44	5.25

TABLE X.—*Continued 2.*

Serial Number	Tribe	Sex	Left Hand Main-lines.					Right Hand Main-lines.				
			D	C	B	A	Carpal	D	C	B	A	Carpal
B.249	Dusun	M	4.34	2.83	2.63	1.33	5.10	—	—	—	1.72	5.22
B.250	,,	F	3.85	2.56	1.97	0.95	4.52	3.83	2.69	1.98	1.06	5.05
B.251	,,	M	4.26	—	2.—	1.40	5.10	4.—	—	—	1.77	5.22
B.253	,,	F	2.43	1.80	1.57	0.94	4.61	2.77	1.96	1.61	1.21	5.05
B.255	,,	M	3.20	2.48	1.84	1.08	5.10	4.00	2.71	2.00	1.30	5.14
B.257	,,	F	3.36	2.36	1.84	1.10	5.05	3.50	2.48	1.90	1.25	5.15
B.260	,,	M	2.66	1.93	1.77	0.93	4.64	3.46	2.75	1.79	1.14	5.08
B.261	,,	M	4.14	2.63	2.38	1.37	5.13	4.20	3.50	2.70	1.71	5.30
B.324	,,	M	2.69	1.95	1.80	1.08	5.20	3.24	2.38	1.80	1.40	5.25
B.349	,,	M	2.79	1.99	1.83	1.24	5.10	3.71	2.43	1.97	1.63	5.22
B.350	,,	F	2.90	1.94	1.78	0.82	4.44	3.59	2.38	1.82	0.94	4.80
B.351	,,	F	3.43	2.84	1.72	0.88	4.41	3.75	3.17	1.92	1.59	5.20
B.352	,,	F	2.67	1.90	1.75	0.95	4.43	3.63	2.86	1.83	1.53	5.15
B.353	,,	F	3.18	2.18	1.90	1.13	5.05	3.33	2.30	1.89	1.54	5.15
B.354	,,	F	2.71	1.98	1.84	0.93	4.50	2.84	1.91	1.77	1.10	5.15
B.358	,,	M	4.16	—	2.—	1.48	5.12	4.30	—	—	1.67	5.23
B.360	,,	F	3.41	2.50	1.76	0.90	4.63	4.26	3.43	2.61	1.10	5.15
B.362	,,	M	4.08	3.58	2.50	1.23	5.11	4.22	3.25	2.46	1.58	5.22
B.363	,,	M	3.39	2.50	1.75	0.94	4.86	3.36	2.25	1.90	1.32	5.14
B.364	,,	M	2.90	1.94	1.86	1.16	5.16	2.78	1.96	1.82	1.58	5.26
B.365	,,	M	2.80	1.97	1.78	1.25	5.04	2.48	1.94	1.74	1.49	5.23
B.368	,,	M	3.54	2.61	1.91	1.41	5.10	4.11	3.42	2.48	1.48	5.27
B.369	,,	F	2.82	1.96	1.81	1.16	5.12	2.78	1.99	1.89	1.56	5.15
B.370	,,	F	2.61	1.88	1.81	1.12	5.05	4.22	2.77	2.47	1.18	5.12
B.371	,,	M	3.10	2.42	1.72	1.28	5.25	2.84	1.98	1.78	1.43	5.32
B.372	,,	F	3.75	2.74	1.93	1.07	5.04	4.10	2.67	2.33	1.33	5.20
B.373	,,	F	3.73	3.00	1.90	0.85	4.46	—	3.—	2.—	1.—	5.15

TABLE XI.

Serial Number	Tribe	Sex	Left Hand Main-lines. D	C	B	A	Carpal	Right Hand Main-lines. D	C	B	A	Carpal
B.23	Murut	M	2.60	1.90	1.79	1.31	5.18	3.23	2.18	1.80	1.58	5.26
B.452	,,	M	4.22	3.00	2.46	1.42	5.05	4.31	3.00	2.82	1.72	5.21
B.458	,,	M	—	—	—	1.—	5.—	—	—	—	1.—	5.—
B.460	,,	F	2.71	1.97	1.73	1.08	5.02	2.80	1.98	1.84	1.51	5.14
B.461	,,	M	2.83	1.93	1.78	1.12	5.05	3.92	3.32	1.93	1.34	5.15
B.463	,,	M	2.47	1.96	1.85	0.97	4.71	2.90	1.95	1.87	1.57	5.20
B.464	,,	M	3.33	2.65	1.85	0.95	4.55	3.28	2.65	1.84	1.20	5.14
B.465	,,	F	3.67	2.71	1.77	1.35	5.12	4.—	3.—	2.—	1.41	5.20
B.466	,,	M	2.58	1.76	1.54	0.81	4.76	2.—	1.—	1.—	1.39	5.10
B.467	,,	M	4.21	3.20	2.65	0.97	4.86	4.42	3.60	2.91	1.52	5.14
B.469	,,	M	3.19	2.68	1.89	1.04	5.02	4.21	3.40	2.70	1.33	5.25
B.470	,,	F	—	—	—	1.—	5.13	—	—	—	1.—	5.20
B.471	,,	M	2.53	1.96	1.88	1.06	5.05	3.—	—	1.84	1.49	5.20
B.474	,,	F	2.67	1.86	1.76	0.88	4.45	2.76	1.90	1.71	1.23	5.12
B.475	,,	F	2.63	1.91	1.78	1.05	5.05	3.65	2.38	1.86	1.44	5.18
B.476	,,	F	2.86	1.97	1.82	0.96	4.67	4.11	3.—	2.—	1.33	5.12
B.477	,,	F	3.53	2.78	1.84	0.83	4.47	—	—	—	1.—	5.10
B.478	,,	M	2.50	1.88	1.73	0.91	4.55	3.28	2.24	1.72	1.35	5.18
B.479	,,	M	3.50	2.56	1.79	0.86	4.39	3.64	2.72	1.81	1.13	5.05
B.480	,,	M	2.61	1.87	1.47	0.89	4.60	2.60	1.87	1.56	0.94	4.87
B.481	,,	F	2.47	1.92	1.84	0.96	4.55	2.59	1.87	1.79	1.68	5.21
B.482	,,	M	2.48	1.67	1.60	0.88	4.55	2.88	1.94	1.66	1.17	5.11
B.483	,,	M	2.88	1.93	1.79	1.23	5.15	—	—	—	1.—	5.19
B.484	,,	F	2.57	1.83	1.68	1.17	5.03	2.77	1.93	1.74	1.43	5.23
B.485	,,	M	3.23	—	1.78	1.12	5.05	2.74	1.96	1.86	1.61	5.15
B.486	,,	F	2.65	1.93	1.68	0.93	4.74	3.26	2.35	1.88	1.38	5.10
B.487	,,	F	2.82	1.96	1.84	1.06	5.02	3.33	2.63	1.82	1.20	5.16

TABLE XI.—*Continued* 1.

Serial Number	Tribe	Sex	Left Hand Main-lines.					Right Hand Main-lines.				
			D	C	D	A	Carpal	D	C	B	A	Carpal
B.488	Murut	F	3.05	2.31	1.80	1.55	5.17	311	2.55	1.85	1.60	5.21
B.489	,,	M	2.23	2.53	1.61	0.94	4.75	2.47	1.83	1.67	1.35	5.16
B.491	,,	M	2.96	1.91	1.76	0.94	4.71	4.—	—	—	1.90	5.28
B.492	,,	M	2.71	1.90	1.83	1.34	5.12	2.86	1.98	1.82	1.52	5.20
B.546	,,	M	2.56	1.74	1.70	0.78	4.49	2.92	1.93	1.84	0.96	4.78
B.547	,,	M	2.52	1.91	1.81	1.29	5.08	3.63	2.63	1.92	1.52	5.16
B.548	,,	F	3.85	3.49	1.75	1.38	5.13	4.13	3.00	2.69	1.67	5.21
B.549	,,	M	2.50	1.57	1.39	0.83	4.37	3.43	2.30	1.80	1.33	5.05
B.550	,,	F	4.24	2.73	2.29	1.28	5.08	4.27	2.95	2.60	1.49	5.28
B.566	,,	M	3.50	2.67	1.85	1.40	5.14	3.75	2.76	1.92	1.38	5.29
B.569	,,	F	2.80	1.83	1.77	0.96	4.88	2.71	1.91	1.80	1.42	5.09
B.570	,,	M	3.63	2.79	1.91	0.88	4.72	3.71	2.68	1.95	1.67	5.10
B.571	,,	F	4.36	2.79	2.50	1.16	5.22	3.15	2.33	1.81	1.49	5.30
B.574	,,	F	2.49	1.89	1.64	0.91	4.67	2.77	1.97	1.80	1.35	5.14
B.575	,,	F	3.24	2.75	1.76	0.96	4.61	2.33	3.45	2.44	1.22	5.12
B.576	,,	M	2.80	1.93	1.83	1.23	5.03	4.24	3.44	1.61	1.24	5.22
B.577	,,	M	3.29	2.63	1.90	0.96	4.92	4.14	3.36	2.57	1.38	5.15
B.578	,,	F	2.58	1.83	1.73	0.92	4.81	3.24	2.39	1.85	1.11	5.09
B.579	,,	F	2.49	1.88	1.71	1.12	5.08	3.25	2.22	1.88	1.36	5.23
B.582	,,	M	2.65	1.91	1.75	0.97	4.64	3.68	2.70	1.88	1.66	5.20
B.596	,,	M	2.71	1.89	1.77	1.39	5.08	2.76	1.91	1.71	1.39	5.16
B.597	,,	M	—	—	—	—	—	3.80	—	1.93	1.45	5.21
B.598	,,	F	2.85	1.96	1.84	1.27	5.10	3.13	2.52	1.84	1.33	5.23
B.599	,,	M	2.65	1.83	1.68	0.93	4.44	2.71	1.78	1.75	1.27	5.12
B.600	,,	F	—	—	—	1.60	5.25	—	—	—	1.73	5.30
B.602	,,	M	4.17	3.48	2.65	1.60	5.07	4.28	2.74	2.56	1.33	5.15
B.603	,,	M	3.00	2.00	1.68	0.92	4.40	2.86	1.90	1.72	1.16	5.02

TABLE XI.—*Continued 2.*

Serial Number	Tribe	Sex	Left Hand Main-lines.					Right Hand Main-lines.				
			D	C	D	A	Carpal	D	C	B	A	Carpal
B.604	Murut	F	4.14	2.67	2.20	1.16	5.12	4.30	3.80	2.84	1.31	5.22
B 605	,,	M	2.54	3.00	1.62	0.93	4.65	2.59	1.82	1.66	1.17	5.07
B.607	,,	F	4.00	2.71	2.00	1.70	5.11	4.41	2.89	2.61	1.73	5.18
B 608	,,	F	3.78	2.72	1.94	1.22	5.21	3.70	2.62	1.81	1.36	5.26
B.609	,,	F	3.00	2.00	1.72	0.88	4.46	4.00	3.45	2.00	1.20	5.08
B.611	,,	M	4.09	2.86	2.17	0.92	4.67	4.24	3.22	2.75	1.27	5.15
B.612	,,	F	2.48	1.82	1.79	1.06	5.07	2.87	1.91	1.78	1.29	5.18
B.613	,,	M	4.00	3.33	2.00	0.95	4.56	3.00	2.00	1.80	1.11	5.06
B.615	,,	F	2.54	1.95	1.83	1.52	5.07	2.71	1.93	1.75	1.58	5.22

TABLE XII.

Serial Number	Tribe	Sex	Left Hand Main-lines.					Right Hand Main-lines.				
			D	C	D	A	Carpal	D	C	B	A	Carpal
B.27	Brunei	M	3.16	2.25	1.82	0.90	4.64	3.78	2.45	1.94	1.20	5.10
B.28	,,	M	3.50	3.13	1.77	0.96	4.67	3.61	2.67	1.93	1.29	5.15
B.24	(a)	M	4.14	3.29	2.41	1.73	5.25	4.45	3.40	2.63	1.83	5.29
B.25	(a)	M	3.56	2.67	1.98	1.75	5.23	4.54	3.20	2.50	1.92	5.33
B.41	(b)	F	2.44	1.85	1.75	0.97	4.92	4.13	3.52	2.60	1.59	5.20

Note.—In the above tables " — " means that the value for that main-line was incapable of evaluation either because of a poor print, injured hand, or inability of the subjert to get the hand flat enough to make the print. A result such as " 4.— " means that the line ends

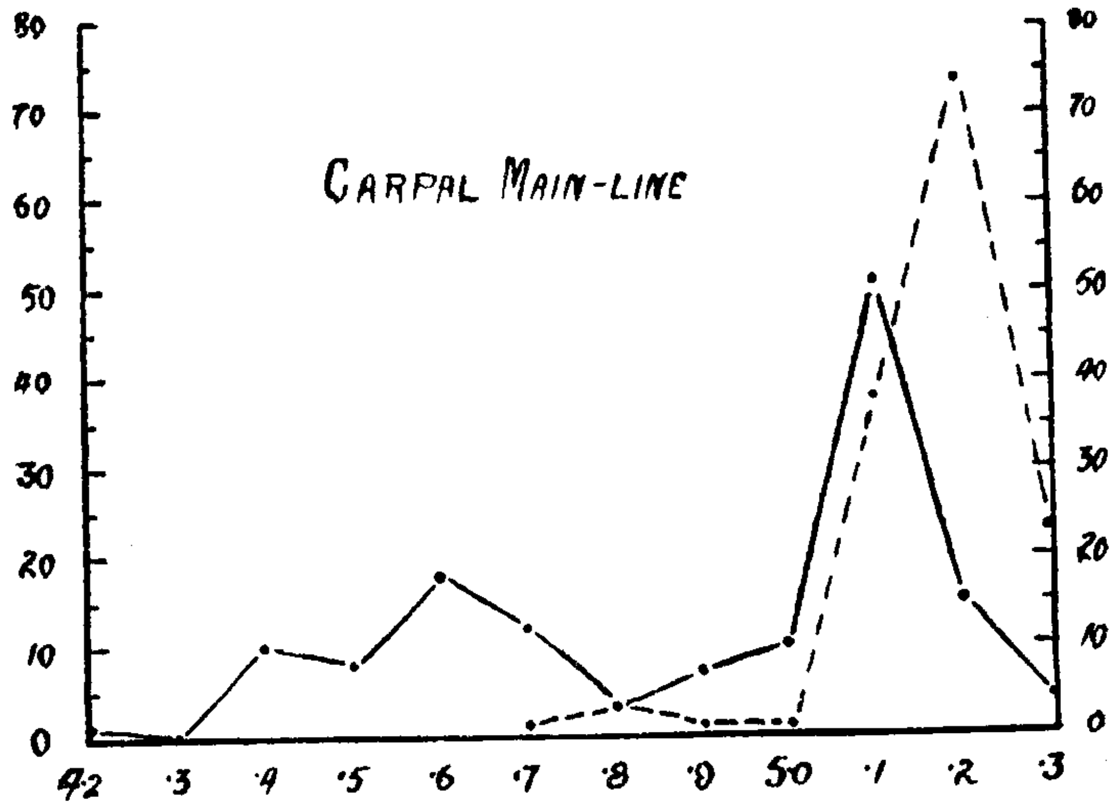

Figure 8. Graphs showing the frequency of termination of the main-line arising from the carpal tri-radius, with termination values ranging from 4.2 to 5.3.

The continuous line represents the left hand values and the dotted line those of the right. The shift to the right in the right hand values is very strikingly shown here and also the fact that in only a very few cases does this line end on the ulnar side of the tri-radius ' a ' on the right hand, whereas this state of affairs occurs in about 60 cases in the left hand. The left hand curve is therefore diphasic, and that of the right hands monophasic.

between the index and middle fingers, but for reasons similar to those stated above, the exact position can not be ascertained with accuracy. " a " in Table XII indicates that these two subjects were brothers, their father being a Malay and their mother a Kadayan. " b " in the same table indicates that this woman's father was a Bugis and her mother a Suluk.

Discussion.

As stated above, full discussion on the results will be made at a later date, but there are a few points arising from the above tables which with advantage be mentioned here.

The first point is that the difference between the right and left hands as shown by main-line values is as follows :—

Line D. Out of 71 cases in the male, this line in the right hand has a value equal to or greater than that in the corresponding left hand in 77.5%. In the female the percentage is greater, being 85.5% out of a total of 55 cases.

Line C. Out of 63 cases in the male, this line in the right hand has a value equal to or greater than that in the corresponding left hand in 73.0%. In the female the percentage is again greater, being 81.5% out of a total of 54 cases.

Line B. Out of 69 cases in the male, this line in the right hand has a value equal to or greater than that in the corresponding left hand in 84.0%. In the female the percentage is again greater, being 89.0 in a total of 55 cases.

Line A. In only two male cases out of 78 is the left hand value greater than its value in the corresponding right hand, i.e. in 97.4% the right hand value is equal to or greater than the left. In the female this percentage is again greater being 100% out of 58 cases.

Carpal Main-line. In no case in either sex is the left hand value for this line greater than in its corresponding right hand, the number of cases examined being 80 males and 60 females.

Further differences between the two hands are depicted in the following figures 4, 5, 6, 7 and 8, in which curves are drawn for each main-line, showing the frequency of their termination values. Each graph shows the 'radial shift' or 'shift to the right' in the right hand compared with the left. Whether this is a racial characteristic or whether it occurs in other races even in a modified form is at present being investigated, and also the question whether this shift has any relation to left or right handedness.

PROTECTING THE EYE IN INDUSTRY

by

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Read before the Joint Convention of the American Branch of the Science Society of China and the America Branch of the Chinese Engineering Society, New York City, August 26, 1933.

This year the Joint Convention of the Science Society of China and the Chinese Engineering Society has very wisely chosen as its theme the industrialization of China. It would not be inappropriate to call your attention to a much neglected phase of the budding industry in our homeland. I am not aware of any methods having been introduced for the conservation of vision and prevention of blindness in our ever-expanding industrial programme. It is superfluous to point out that the sense of sight dominates the activities of the industrial worker and is responsible for most of his usefulness. The impairment of the visual organ means the impairment of industry.

During the evolution of the human race, the eye has developed with outdoor illumination for pursuits requiring accurate vision. With the growth of modern civilization we are imposing an extraordinary demand on the eye for concentrated near work inside buildings. From the biologic as well as economic viewpoint, natural lighting is most desirable. The construction of plants that will admit an optimum amount of sunlight should be the object of every architect.

In order to supplement the inadequacy of solar illumination, artificial methods have been adopted. Be it natural or artificial, two general conditions should be fulfilled, namely, sufficient illumination and elimination of glare. The intensity of illumination required for different types of work varies considerably. The Illuminating Engineering Society of U.S.A. has made careful studies on this matter. It has prepared the American Standard Code of Lighting for Factories, Mills and Other Work Places. Chinese factory owners and operators, engineers and architects will find the American code a valuable source for reference.

Glare has been defined as any brightness within the field of vision, of such a character as to cause discomfort, annoyance, interference with vision or eye fatigue. It may be produced by small bright sources of light in the visual field, by a light lying within a small angle from the object looked at, by a large source of light close to the eye, by a light standing out against a dark background, by exposure of the eye to a source of light during a long period of time, or by light reflected into the eye from polished surfaces or glossy paper. It is one of the most common faults found in all lighting installations. Ways to avoid glare are also specified in the American Code of Lighting.

Statistics on the visual acuity of Chinese industrial workers are sadly lacking. Uncorrected errors of refraction must be quite prevalent. To suffer from hyperopia, myopia, or astigmatism, is absolutely unnecessary. Moreover, poor eyesight constitutes an economic risk on account of ruined work materials, low production, high accident frequency and high absentee rates. All prospective employees should have their eyes properly tested. Glasses should be prescribed to all those who need them.

Studies conducted by H. Y. Yao[1] and also by T. A. Li[2] on the industrial health of employees in a rug factory in Peiping revealed an appalling number of cases of trachoma. In a previous communication to the Science Society, the author[3] stressed the imperative need of eradicating trachoma in China. It would be quite fitting to start a campaign against this disease in each industrial centre. At the same time there would be an excellent opportunity for the investigation of all other ocular disabilities.

The National Safety Council has estimated that there are annually in the United States about 200,000 industrial accidents resulting in trauma to the eye. The great majority of these accidents fortunately do not result in permanent injury. Goggles and head masks are the best means for the protection of the eye, but these protective contrivances must be specially designed for the particular hazard. For instance, a certain type of goggles which affords complete protection from splashing chemicals is worthless as a shield against flying particles of metal or stone. The U. S. Bureau of Standards has compiled the National Code for the Protection of the Heads and Eyes of Industrial Workers. This little handbook should prove useful to all those who are interested in the industrial hazards in China.

REFERENCES.

(1) Yao, Hsun-Yuan: Industrial Health Work in the Peiping Special Health Area, China Med. Jour. 1929, v. 43, p. 379.

(2) Li, Ting-An: Occupational Diseases in the Rug Indistry, Chinese Med. Jour. 1933, v. 47, p. 44.

(3) Chan, Eugene: Trachoma Our Great Scourge, Caduceus 1931, v. 10, p. 178.

Notes and Comments

On the occasion of the 21st Anniversary of the opening of the University of Hong Kong, all the departments were thrown open to the public in order that friends and those interested in our work may be given the advantage of seeing many of the experiments which form the basis of instruction daily given to our students. In the Department of Physiology were to be found exhibits and experiments from both the Departments of Anatomy and Physiology. Each exhibit was in charge of two or three students who were wholly responsible for setting up the apparatus, conducting the experiments, and explaining them to the Public, and if one can judge by the numbers of people who saw the exhibits, as well as the numbers that were unable to gain entrance, the trouble taken by the students and departmental staff was well repaid by public interest.

Below we give a short description of the various exhibits, and an explanation of their significance, written in each case, by the students named, in charge of the exhibit.

EXHIBIT I.

Carbohydrates—Woo Pak Foo and Foo Chee Guan.

The Carbohydrates form a large group of compounds, especially abundant in plants; the amount present in animals is comparatively very small. In appearance they are different from each other. Some of them, for example the sugars, are readily soluble in water, and crystallised very easily, and have a sweet taste. Others, starch, cellulose, and gum are insoluble in water, possess no characteristic taste, and have not been obtained in crystalline form. The latter are very complex compounds.

In general, carbohydrates are compounds consisting essentially of carbon, hydrogen, and oxygen, the latter named elements being in the proportion in which they occur in water. As their physical properties—appearance, solubility, taste are different, no proper classification can be formed from them. But, however, they are classified according to their complexity into Monosaccharides, Disaccharides, and Polysaccharides.

Monosaccharides and disaccharides are comprised chiefly of sugars, while polysaccharides are comprised of starch, cellulose, and dextrin. The first class is of physiological interest and importance because it is the only type of carbohydrates which can be absorbed by the intestine; and therefore, the conversion of di-and polysaccharides into mono saccharides involves the different processes of carbohydrate digestion in the alimentary canal. The ultimate result of which is to convert the former (di-and polysaccharides) into glucose, which is oxidised in the tissue into carbonic acid and water.

Sugars are conveniently divided into reducing and non-reducing sugars. Glucose, lactose, and maltose afford typical examples of the reducing type; sucrose or cane sugar of the non-reducing. When the reducing sugars are heated with Fehling's or Benedict's solution (Fehling's solution is a mixture of copper sulphate, caustic soda, and Rochelle salt; and Benedict's solution of copper sulphate, sodium carbonate, and sodium citrate) a precipitate is formed which exhibits a series of characteristic colours, ranging from red to yellow or green, depending, of course, on the amount of sugar present. The reaction is due to the formation of cuprous hydrate or oxide by reduction. The non-reducing sugars have no such action on these reagents, but a positive reaction is obtained by hydrolysing it with 25% sulphuric acid. As to the method of distinguishing and identifying the different sugars various chemical tests have been devised, but the osazone crystal test is the one usually employed.

Polysaccharides behave differently from the sugars. Each has its own characteristic property. Vegetable starch gives an intense blue colour with very dilute iodine. Animal starch or glycogen gives a brown colour while dextrin a brownish red with iodine; therefore, there is some similarity between glycogen and dextrin. But they can be separated by saturation with ammonium sulphate, which renders glycogen completely precipitate, and dextrin partially. Another feature of polysaccharides, with the exception of cellulose, is that they all undergo a process of hydrolysis with 25% sulphuric acid, resulting in the formation of reducing sugars.

EXHIBIT II.

Osazone Test for Sugars—C. K. Wong and C. Y. Lee.

Various methods have been introduced and practised in distinguishng sugars of one kind from those of another, and the best of any is the Osazone Test. It can be applied to most of the reducing sugars, and in fact, it is found that it is applicable to glucose, lactose, and maltose.

Osazone crystals are prepared by the addition of 1 c.c. of phenylhydrazine, 1 c.c. of glacial acetic acid, and 10 c.c. of water to 0.5-1 gm. of sugar in a clean test tube, which is placed in a water-bath at 100° C. for 30-60 minutes. The glucosazone will separate out from the hot solution as a yellow precipitate first. The lactosazone will separate out only on cooling. The maltosazone is the most tedious of all three in separation. It will come out only after long cooling, and even then the crystals are often amorphous. In such a case, the following must be carried out, so as to convert the amorphous state into definite crystals: the precipitate is dissolved in hot alcohol, and diluted with water, followed by boiling to expel the alcohol. On cooling, crystals separate out.

The precipitates thus obtained are filtered, and are prepared on slides for microscopic examination.

For sugars in solution, 5 c.c. of it is taken with 1 decigm. of phenyl-hydrazin hydrochloride, and 2 decigms. of sodium acetate. The mixture is then placed in a water-bath at 10° C. for 30-60 mins. as before; and the condition for crystallization is identical.

The principle of the test depends on the action of phenyl-hydrazin ($C_6H_5.NH.NH_2$) on the sugars. Take glucose as an example: when glucose is heated with phenyl-hydrazin it yields hydrazone:

(1) $CH_2OH\ (CH\ (OH)\ )_3.CH\ (OH)\ CHO\ C_6H_5NH.NH_2$
(glucose) (phenyl-hydrazin)
$= {}^*M.CH\ (OH)\ CH - H_2ON - NH\ (C_6H_5)$
(hydrazone)

The hydrazone, when heated with excess of phenyl-hydradin, undergoes oxidation, the < CHOH group being transformed into < CO, by the loss of hydrogen, the hydrogen reduces some of the phenyl-hydradin to aniline and ammonia:

$$C_6H_5\ NH.NH_2 - 2H = C_6H_5NH_2 - NH_3$$
(aliline)

(2) $^*M.CH\ (OH)\ CH = {}^*M.CO.CH = M.C$ ———— CH
$N - NH\ (C_6H_5)$ $N - NH\ (C_6H_5)$ $C_6H_5.NH.N$
$N - NH.C_6H_5$ (osazone)

The ketone thus formed then reacts with a second molecule of phenyl-hydrazin, forming osazone.

$$^*M = CH_2OH\ (CH\ (CH)\ )_3$$

EXHIBIT III.

A Demonstration on Salivary Digestion—S. S. Mak and H. A. Stanley.

Salivary Digestion may be defined as the process of breaking down the insoluble starchy foods into their constituent simple sugars by virtue of its being mixed with the saliva in the mouth. Saliva is produced by the three large salivary glands, the parotid, the sub-maxillary and the sub-lingual, and the small glands of the lips, cheeks, and tongue; it is a colourless or slightly turbid viscous fluid with a faintly alkaline reaction to litmus and phenolphthalein and of low specific gravity, and exercises a twofold function. First, it has a mechanical action moistening the mouth and the food and thus aiding mastication and swallowing by securing the formation of a proper bolus of food; it also assists by binding the particles together, an action of special importance when the food is dry. Second, the enzyme ptyalin exerts an action in digestion on part of the carbohydrates of the diet. The starches or polysaccharides are broken down, first of all to the simple dextrins and then to the still more simple disaccharids, maltose. Ptyalin acts best at a temperature of about 40° C. and in a neutral or faintly alkaline medium, its action being inhibited by the presence of even very dilute mineral acids and by heat.

Salivary secretion is a reflex action under normal conditions. The food excites the nerve endings (afferent). The impulse passes to a salivary centre, and then along the efferent nerves of the gland. But under certain conditions the secretion is a psychical one because the smell and the taste of food excite the afferent nerve endings, and cause the secretion.

The action of ptyalin on starch is best studied by following the changes in the colour produced with iodine. The first stage in the reaction is the production of soluble starch, which, like starch itself gives a blue colour, but which does not form a jelly when heated with water. The second stage is the production of maltose and erythrodextrin which gives a red colour; the third that of maltose and achroodextrin which gives no colour, and the last that of maltose only.

The total constituents dissolved in saliva may be classified as:

(I) Organic: (*a*) mucin: precipitated by acetic acid;
(*b*) ptyalin: maltose;
(*c*) protein: in a nature of globulin: violet colour to Biuret Test; white precipitate which changes to red on heating to Millon's Test.

(II) Inorganic: (*a*) sodium chloride: white precipitate to a drop of silver nitrite solution;
(*b*) Other salts: sodium carbonate, calcium phosphate, calcium carbonate, magnesium phosphate, and potassium chloride.

EXHIBIT IV.

Proteins—C. H. Yeang, H. L. Ozorio and Willy Heng.

Proteins are nitrogenous substances which contain carbon, hydrogen, oxygen, nitrogen, and sometimes phosphorus and sulphur. They form the characteristic constituents of animal tissues and fluids. They are essentially complicated combinations of amino acids and their derivatives. The following is a list of the more commonly occurring amino acids:

(*a*) Glycine: present in serum globulin, gelatin, and wheat.

(*b*) Leucine: and (*c*) Glutamic: present in serum albumin and globulin, egg, gelatin, milk, maize, and wheat.

(*d*) Tyrosine: present in all the above (b & c) except in gelatin.

(*e*) Tryptophane: present in all the above (b & c) except in gelatin and maize.

(*f*) Cystine: like (e).

(*g*) Arginine: present in milk, gelatin, and wheat.

(*h*) Lysine: present in egg-albumin, caseinogen, and gelatin.

Examples of important members of proteins are albumin and globulin in eggs, legumin in peas and beans, gluten in bread, casein in cheese, and myosin in dead muscles.

The composition of proteins varies because the amino acids are present in different proportions and combinations. Tryptophane, tyrosine, and lysine are the three amino acids which have been found to be absolutely essential for the growth and the maintenance of the body weight. If the former two are omitted from the diet of an animal, the animal dies. Lysine is an amino acid of a rather peculiar importance. It seems to be necessary for growth because animals fed on a lysine-free diet will not increase in size. Certain proteins are found to have a low content of these amino acids, and even an entire absence of them.

The presence of amino acids in proteins is detected by colour tests. They are

(*a*) The Biuret Test: an addition of a trace of copper sulphate, and excess of sodium hydroxide gives a red-purple or a blue-purple colour to a protein which has in it a CONH group.

(*b*) The Millon's Test: Millon's Reagent, a mixture of two nitrates of mercury containing excess of HNO , gives to a protein containing a tyrosine group a white precipitate, which turns to brick-red on heating.

(*c*) The Xanthoproteic Test: On heating the white precipitate produced by nitric acid on a protein containing a benzine ring, it turns to yellow. It becomes orange on addition of ammonium hydroxide.

(*d*) To a protein containing a tryptophane radicle, an addition of one-third of its volume of glyoxylic acid and excess of sulphuric acid will give a purple ring.

On the demonstration day, albumin and gelatin were used to carry out the above tests. The former gave positive results to all the above tests, but in the case of the latter, the buiret test was the only one which gave a positive colour reaction, and the rest being negative.

EXHIBIT V.

A Demonstration on Gastric Digestion—R. H. G. Lee and Wu Ki Lim.

No digestion of proteins takes place in the mouth, the saliva acts only as a lubricant to facilitate their passage down the oesophagus.

Gastric digestion is brought about by the action of the gastric juice, which is a clear watery, colourless and strongly acid fluid with a specific gravity of about 1,003, in the stomach. It contains an enzyme, pepsin, which converts proteins into complex poly-peptides, known as peptones and proteoses. It acts only in the presence of a mineral acid-normally hydrochloric acid, which is formed by the activities of certain gland cells in the middle region of the stomach, and the fact that it does not exist as such in the blood proves that it is formed within the cells.

The action proceeds best at a temperature of about 37° C. This temperature was maintained in the experiment shown on the day by means of circulating heated water from a glass flask, which was connected to both ends of a small but long tank—the front and the bottom glassed—in which was fixed a thermometer, its temperature being read from time to time. Five small glass flasks, each of which contained a tube of coagulated albumin, were placed inside the tank.

To the first flask .2% hydrochloric acid was added; the second, pepsin; the third, pepsin and .2% hydrochloric acid; the fourth, boiled pepsin and .2% hydrochloric acid; and the fifth, pepsin and sodium bicarbonate.

In the first and second flask, no digestion took place because neither pepsin nor hydrochloric acid could act on the albumin alone; in the third flask, digestion took place showing that pepsin is active in a fairly strong acid medium; but neither the fourth nor the fifth flasks showed signs of digestion, for the tube of albumin in both cases remained unchanged, proving that when pepsin was boiled, even in the presence of a mineral acid, its digestive power was thereby destroyed; and that pepsin in an alkaline medium remained inhibited.

Some of the liquid was taken from the third flask in which digestion took place and it was demonstrated that protein, as the result of digestion was changed into peptones and proteoses. The peptone gave a biuret reaction which was rose-red in colour; the proteoses were precipitated by nitric acid, the precipitate being soluble on heating, and reappearing when the liquid cooled. The primary proteoses were precipitated by saturation with ammonium sulphate.

EXHIBIT VI.

Milk—Ng Bow Kwee and B. F. Yong.

Milk is a white opaque fluid, usually very slightly acid in reaction, containing as its chief constituents a sugar (lactose) and a protein (caseinogen) in solution, and fats in suspension. It also contains two other proteins—lactalbumin and lacto-globulin, in smaller amounts, and salts (calcium phosphate). The emulsion is partly due to finely divided fat particles, and partly to the calcium salt of caseinogen. These fat particles of varying sizes were shown under the microscope as a number of minute particles floating in a clear fluid.

The specific gravity of normal cow's milk varies from 1.028 to 1.034. It was taken with a specially graduated hydrometer. When the fat, the lightest constituent of milk is removed by skimming the specific gravity rises from 1.033 to 1.038.

The characteristic of caseinogen is that nearly all the amino-acids which enter into the composition of the various proteins are represented in its structure. The only necessary amino-acid absent from caseinogen is glycine. Very little cystine is present in caseinogen, but its absence is remedied by the presence of lactalbumin.

When acted on by "rennet" ferment, the caseinogen of milk is thrown down in the form of a flocculent precipitate, casein. This was done in the demonstration by the addition of a few drops of rennet to a test-tube containing milk which was placed in a water bath, kept at a temperature of 40° C. When it was allowed to cool a curd or junket was formed with a little liquid residue, which is called whey. In another test-tube containing all the above substances, potassium oxalate was added, and no curdling took place. This was due of course, to the oxalate, which had precipitated the calcium salts, the necessary factor for coagulation.

The presence of lactose, phosphates, and chlorides in milk was demonstrated by the following tests:

(*a*) The whey was filtered from the first test. To the filtrate was added Fehling's solution, which, on boiling, reduced to a red colour by the lactose.

(*b*) To another portion of the same filtrate nitric acid and an equal volume of ammonium molybdate were added. After warming for some time, a yellow precipitate of ammonium phosphomolybdate was formed.

(c) Nitric acid and silver nitrate were added to another portion; a greyish white precipitate of silver chloride was formed, the silver nitrate being reduced.

EXHIBIT VII.

Blood—Khoo Soo Lat, Ooi Kee Wan and A. J. Moonshi.

Haemin is the hydrochloride of haemoglobin (haematin and globulin). When haemoglobin is hydrolysed by acids it is changed into haematin, an iron containing pigment, and globin, a coagulable protein.

On the demonstration day, haemin crystals were separated by boiling a fragment of dried blood with a drop of glacial acetic acid on a slide. On cooling, dark brown crystals were seen under a microscope. In the case of an old blood stain, it is necessary to add a crystal of sodium chloride.

The specificity of crystalline haemin is often found of use in medico-legal work for identifying the origin of blood stain.

Blood was examined spectroscopically by taking a few drops of blood in each test tube and water was added up to the following dilutions: 1 in 10, 1 in 20, 1 in 40, 1 in 80, 1 in 100, and I in 1,000. Each was examined through a spectroscope. Normally, when sunlight is allowed to pass through the prism the colours are seen: red, orange, yellow, green, blue, indigo, and violet. There was seen between these bands of colour a few vertical lines called Frauenhofer's lines. They were perfectly constant. The most prominent ones—A, B, and C—are seen in the red, D in the yellow, E and F in the green, and G and H in the violet. From the experiment, it was seen that two dark bands could be made out between the D and F line, i.e. between the yellow and green band. These bands were very prominent at certain dilutions. It was found that the best dilution was between 1 in 80, and 1 in 100. In the 1 in 1,000 solution, the bands begin to disappear. This experiment proved the presence of oxyhaemoglobin in the solution.

EXHIBIT VIII.

Muscles.

(a) Simple Muscle Curve—G. Ribeiro.

After the apparatus had been properly arranged and connected the experiment proceeded by dissecting out the gastrocnemius muscle of a frog, great care being taken to preserve the Sciatic Nerve. The preparation thus obtained is called a muscle-nerve preparation.

A thread was then tied to the tendon of the muscle, which was fixed to the myograph-board, and was attached to the lever of the myograph. It was made to touch the smoked drum tangentially. The drum was made to revolve, and a base line was recorded. After stopping it, the lever was drawn away, which, after the necessary electrical connection arranged, was again adjusted to touch the drum.

When the electrical circuit was complete ("making" the circuit) a stimulus was produced to the nerve; as the result of which the muscle contracted causing the lever to kick up. The muscle contracted again, producing a muscle curve, after the time striker completed the circuit of the freely running drum.

It was noted that the muscle did not contract immediately after the application of a stimulus. The period between the point of application of a stimulus and the point of contraction is called the latent period. The period elapsing between the time of the first contraction and the highest point of contraction is called the period of contraction; and that between the latter (highest point of contraction) and the point of relaxation is called the period of relaxation. The remaining portion of the muscle curve is due to the momentum of the lever acquired during the relaxation period.

(h) The Effect of Several Successive Stimuli—E. G. Tan.

The muscle contracts every time that it is stimulated, and it has to relax after each contraction. Consequently, if, after performing a previous contraction, a second stimulus is sent into the muscle while it is relaxing, a second contraction will take place. If the stimuli are applied one after another rapidly, the muscle has little chance to relax. As the rapidity is increased, the muscle contracts with increased rapidity until there is practically no indication of relaxation when the muscle is said to have gone into a tetanus.

It is in this way that we send messages through our nerves to our muscles to contract in performing every voluntary movement, and the experiment that follows is to demonstrate how the muscle reaches the tetanised state.

The nerve-muscle preparation is set up as usual, a vibrating and being introduced to make or break the primary circuit of the induction coil the rate of vibration of the reed depends upon its length, and hence the interval of successive stimuli may be varied by adjusting its length. Contact is made at every 1/10 of a second, and the curve is traced on the revolving drum. As the period between the two stimuli is decreased, the curve indicates less sign of relaxation; and there comes a state when the muscle shows no relaxation at all. The muscle is said to be tetanised.

(c) The Effect of Fatigue on Muscles—K. L. Koe.

A muscle-nerve preparation is made. The string, attached to the tendon of the muscle, is tied to a lever, which is provided with a tracer, and the muscle is placed on and pinned to the board in such a position that there is a slight tension on the string.

A base line is drawn on a revolving drum, which carries a smoked paper. Below the drum there is a 'make' and 'break' pointer. After marking the 'point of stimulation,' the muscle is stimulated by passing an electric current of suitable strength through the sciatic nerve. Every time a make and break current is produced, the muscle contracts and traces a curve on the drum. If the muscle is repeatedly stimulated, the contraction becomes weaker, so that the height of the contraction, including the 'latent' period, is prolonged; finally the muscle may not contract in response to further stimulation. This condition is due to fatigue of the muscle.

EXHIBIT IX.

Soxhlet Apparatus—Yang Ke, Santos.

This apparatus is used for automatic continuous extraction of fat from a mixture. By first of all weighing the mixture and afterwards weighing the fat that has been separated the percentage of fat can be calculated.

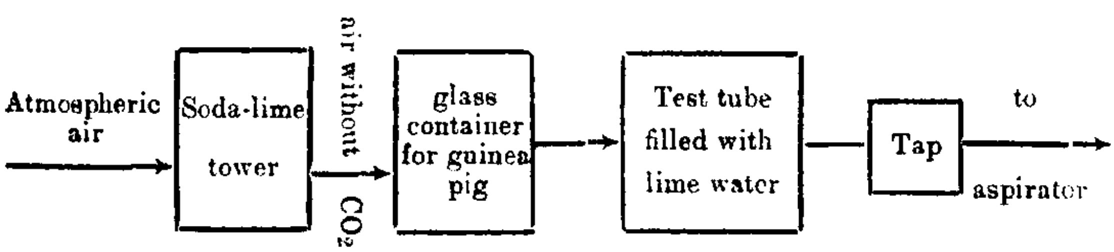
A substance which dissolves fat, e.g. ether, is placed in the bottom flask and gently heated. The ether vapour passes out into the side tube, through the extracting tube and into the condenser, where it is reconverted into liquid and drops down into the thimble lying in the extracting tube. In this thimble is placed the fat-containing substance, from which the fat passes into solution in the ether. The level of the ether continually rises in this chamber until it is higher than the top of the small side tube which is fixed to the bottom of the extracting tube. At this instant the ether contents of this tube syphon over into the flask carrying with it the fat in solution. By repeating this process the whole of the fat is transferred to the bottom flask, from which it can later be isolated (by evapourating the ether) and weighed.

EXHIBIT X.

Respiratory Changes in Small Animals—Lucien A. Tjon.

This exhibit attracted much attention especially from the lady visitors, due to the fact that a guinea-pig was concerned in the experiment.

The experiment was put up as shown below:—



The object was to prove that animals including ourselves give out amongst other things carbon dioxide when they exhale. Now carbon dioxide turns lime water milky due to the formation of a precipitate of calcium carbonate thus:—

$$Ca\ (OH)_2\ CO_2 - CaCO\ \ H_2O$$

If therefore air drawn from B turns the lime water in C milky we must conclude that CO_2 was present in it.

By means of an aspirator fixed to tube E a current of air was obtained, on opening tap D, in the direction indicated by the arrows. The air drawn into A was there purified of the carbon dioxide present in it by lime which absorbs the latter gas. Hence our guinea pig in B breathed in air devoid of any CO_2 and any CO_2 therefore that reached C from B must have come from the animal and from nowhere else.

As the experiment proceeded we noticed that the lime water did turn milky and concluded therefore that animals oxidised their carbon with the evolution of CO_2 which they expelled in their expired air.

EXHIBIT XI.

Respiration Apparatus.

(a) Douglas Bag.

This is a rubber-lined canvas bag, fitted with shoulder straps so that it can be used to collect expired air from a subject under varying conditions, at rest, walking, working, etc. The bag connected to a face mask by corrugated rubber tubing and fitted with valves so that all the air breathed out over an accurately measured period of time can be collected in the bag. Later by passing the enclosed air through a meter, its volume may be accurately measured.

(b) Haldane Gas Analysis Apparatus.

By means of this apparatus, the percentage composition of air may be estimated, the principle being that a known volume of the air to be tested is enclosed in the burette, and first of all the CO_2 absorbed by caustic potash, and then the oxygen absorbed by pyrogallol. The diminution in volume in each case is measured and the percentage composition of the air estimated. By using a sample of an from the expired gas in a Douglas bag the composition of expired air can be ascertained.

EXHIBIT XII.

Blood Cells—Kan Lai To and Khoo Shu Ngoeh.

(a) Blood Cells.

Slides were exhibited under the microscope demonstrating differences between the red blood cells of the frog and man, and also the different types of red cells found in normal human blood. Previous exhibits which dealt with the chemistry and spectroscopy of the blood, and this present exhibit shows how we may obtain further evidence as to the possible source of a recent blood stain.

(b) Haemolysis and Fragility of Red Blood Cells.

Test tubes containing varying strengths of salt solution were put up in a rack and a drop of human blood added to each. In certain of the tubes the red cells were haemolysed and the haemoglobin liberated, causing the salt solution to be coloured pink, whereas in others, the osmotic pressure was not sufficient to burst the red cell envelope, and hence in these cases the corpuscles sank to the bottom of the tube uninjured, leaving a clear solution above. In this way the strength or fragility of the red cell envelope may be determined.

EXHIBIT XIII.

Capillary Circulation—Kong Sau Yui and Racazo.

EXHIBIT XIV.

Blood Grouping—L. T. Ride and Ling Ke Dich.

Experiments may be performed to show how the red cells of some people are caused to clump together or agglutinate when mixed with blood sera mixed with blood sera of other people. This phenomenon is explained by the presence on the corpuscle of agglutinogens, and in the serum of agglutinins. Generally speaking there have been demonstrated two agglutinogens named A & B and a sample of blood is typed according to whether neither of these agglutinogens is present (Group O), whether A alone is present (Group A), whether B alone is present (Group B) whether both are present (Group AB). The percentage incidence of these four groups differ in different races and these percentage have been used extensively as the basis of an ethnological classification of human races.

In the exhibit, graphical representations of these percentages were demonstrated for English, Chinese, Australian Aboriginals, and North American Indians.

EXHIBIT XV.

Papillary Ridges on The Palm—L. T. Ride.

The fine papillary ridges which cover the friction surface of both hands and feet are physiologically very interesting and important. Of late it has been recognised that the ridges on the palm of the hand form certain fairly definite and constantly occurring patterns. Work recently carried out in this department tends to show that the distribution of these lines differs in different races, and this exhibit showed the characteristic distributions on a European palm, on a Southern Chinese palm, and on a Borneo palm.

EXHIBIT XVI.

Demonsrtation of the Action of the Valve of the Heart—T. Naidu, Kwok Ku Chang and Hernandes.

EXHIBIT XVII.

Model of Circulation—Miss T'so Lai Kei and Teng Ping Hui.

EXHIBIT XVIII.

Demonstration of the Model of the Eye—Yeung Wai Wah.

A model of the eye-ball was provided which consists of the following structures:—

The outermost or protecting coat is the sclera with the six muscles, four recti and two obliques, attached to it for controlling movements of the eye. This coat is modified in front to form the transparent Cornea.

Immediately within the sclera is the nutritive coat, the chorioid, with the Iris in continuation of it behind the cornea. The chirioid coat ends in front in the ciliary processess which are radiating plaits consisting of blood vessels, fibrous connective tissue and pigment corpuscles. The ciliary processess terminate at the margin of the lens. The ciliary muscle takes origin at the corneo-sclerotic junction. It is a ring of muscle and the fibres run in three directions; viz, meridionally near the sclera they pass to the chorioid, radially they are inserted into the chorioid behind the ciliary processess and circularly and more internally they constitute a sphincter.

The Iris is a fibro-muscular membrane perforated by a central aperture, the pupil, with the Sphincter Pupillae for regulating the regulating the admission of light.

Within the chorioid again is the retina where light energy is transformed into nervous impulses to produce the perception of vision. The retina apparently ends in front, near the outer part of the ciliary processess in the ora serrata, but is really represented by the uvea to the very margin of the pupil. In the centre of the retina is a yellowish elevated spot, having the fovea centralis in the centre, called the macula lutea. To the inner side of the macula lutea is the optic disc where the optic nerve leaves the eye ball. The optic nerve fibres are the axons of the nerve cells of the Retina.

The model also marks the different histological layers of the retina. From within outwards they are the membrana limitans interna, the optic nerve fibres, the layer of ganglion cells, the inner molecular layer, the inner nuclear, layer, the outer molecular layer, the external nuclear layer, the membrana limitans externa, the layer of rods and cones and the pigment cell layer, The interior of the eye-ball is filled by the aqueous and vitreous humours and the crystalline lens.

The lens is situated behind the iris and is supported in place by the suspensory ligament. The suspensory ligament is derived from the hyaloid membrane, which encloses the vitreous humour.

By means of the peculiar physical structures of the eye rays of light from external objects are focussed upon the retina and there set up nervous impulses that are transmitted by the fibres of the optic nerve and optic tract to the visual cortex.

EXHIBIT XIX.

Kuhne's Eye—Yeung Wai Wah.

The Kuhne's eye consists of a rectangular box to represent the cavity of the eye-ball in which are placed the following parts:—

1. An iron plate with a hole of moderate size in the centre to represent the iris and the pupil.

2. A convex lens corresponding to the lens in the human eye.

3. A glazed glass plate as the retina and

4. The box is filled with a coloured fluid to represent the aqueous and vitreous humours.

In front of the box is a segment of a spherical glass ball to act as the cornea.

This instrument is to show that the eye is an optical instrument. For experimental work a source of light is put in front of the cornea as an object. An image of the lamp is obtained on the retina, when light rays are allowed to pass through the cornea, the pupil and the vitreous humour. The iris is essential in the eye to cut off spherical and achromatic abberration.

In order to show a case of emmetropic eye the lens and the retina are so adjusted that a distinct image of the lamp is falling on the retina.

By the use of the Kuhne's eye the defects in the optical apparatus of the eye can be shown.

In the case of myopia it is due either to the eye-ball being too long or the lens being too convex. Thus a blurred image is produced for the lamp is brought to a focus in front of the retina. In order to show the mechanism the rectina is shifted behind the point which produces an emmetropic eye. (The convexity cannot be changed as there is only one lens provided in the instrument). A blurred image falls on the retina and in order to make it clear the instrument must be shifted to approach the source of light. This proves that a person suffering from myopia can only see objects that are close up.

In the case of hypermetropia, it is either due to the eye ball being too short or the lens being not convex enough. This phenomenon is shown by shifting the retina near to the cornea from the point where emmetropia is produced. A blurred image is again obtained for the lamp is brought to a focus behind the retina. In order to get a distinct image the apparatus has to be shifted away from the source of light. This experiment proves that a person with hypermetropic eye cannot see objects distinctly close up.

In the case of astigmatism, one axis of the lens system of the eye refracts to a greater or less degree than the axis at right angles. In order to show this phenomenon a part of a cylindrical vessel containing water is placed in front of the box to represent an astigmatic cornea.

The distinct image as obtained in the emmetropic eye can no longer be of the same shape as the lamp but only a straight line of light can be produced on the retina for the vertical and horizontal foci are not in coincilence and only one of them can be brought into focus at a time.

EXHIBIT XXI.

Snellen's Types—The Perimeter E. Gosano and Kho Pek Po.

ANATOMY.

EXHIBIT XXII.

The Growth of Bones.

Bone being a rigid substance, can only grow by apposition of fresh layers of bone on its surface. It is therefore advantageous that they should be formed first of cartilage, a tough but slightly elastic substance which can be replaced later by hard bone. During the period of childhood and adolescence most bones contain a considerable amount of this cartilage in wdich growth actually occurs. Replacement by bone is slightly more rapid than the growth of cartilage, so that finally all the cartilage is replaced. At this point the bone will have reached its full adult shape and size, will be firmly knit together, and will cease to grow. These specimens illustrate this method of growth in cartilage and replacement by bone in the hip bone. The specimens of sacrum show how bones which are multiple in the child may become consolidated into one mass in the adult.

EXHIBIT XXIII.

An apparatus for drawing accurate profile views and for measuring certain dimensions and angles of skulls. These drawings and measurements are often of value in describing precisely the differences between different types of skull.

EXHIBIT XXIV.

A Comparative Series of Vertebrate Brains.

The first two specimens (the shark and the gecko, a reptile) show the vertebrate brain still in a fairly generalised condition. They illustrate its main subdivisions into fore-brain, connected with smell, the mid-brain, connected with sight, and the hind-brain with hearing and the control of equilibrium or balance. The mammalian specimens show a type of brain in which all sensory impressions, smell, sight, touch, etc., have gained representation in the fore-brain, which has now become the dominant part of the nervous system. In the fore-brain is lodged the chief power of forming complex associations between these sensations, of learning from experience, and of initiating behaviour which can adapt itself much more precisely and advantageously to a complex environment. The series, passing through monkeys to man, shows fore-brains which have developed increasing complexity and size and dominance over the rest of the nervous system. This process has obviously gone further in man than in any of the other species, and it is in man that we find the functions of the fore-brain mentioned above developed in their highest degree.

EXHIBIT XXV.

A Series of Skulls.

This series show the skull of a dog, a fairly generalised mammal, skulls of the two Asiatic anthropoid apes, and of man. Arranged as they are here, they show a gradual increase in the size of the cranium (which contains the brain) and a gradual decrease in the size of the nose and jaws. They therefore illustrate a process which must have occurred in the evolution of man. A gradual recession of the snout accompanied by the diminishing importance of the sense of smell, and an increase in the size of brain on which all the character istically human activities depend.

EXHIBIT XXVI.

Plastic Casts of the Inside of the Cranial Cavities of the Skulls in Exhibit.

The cranial part of the skull developes round the brain, and in mammals fits the brain very closely. As a consequence casts of the cranial cavities not only show the shape and disposition of the main subdivisions of the brain but also markings which indicate more or less of the irregularities (grooves and fissues) on the surface of the brain, and many of the bloodvessels which supply it. In this way much has been learnt of the brains of extinct mammals and man of which only the skulls are known. This series should be studied in conjunction with the next.

EXHIBIT XXVII.

A foetal brain, an infant brain and an adult brain set side by side to show the enormous growth which occurs in the brain during childhood. This slow development and prolonged childhood of man, in striking contrast to all other mammals, is an exceedingly important characteristic. Instead of being born in a fairly mature state and with a necessarily stereotyped behaviour, he is born immature and can be educated during childhood to a far more varied and plastic type of behaviour than could be acquired by any other means.

EXHIBIT XXVIII.

Remains of Extinct Forms of Man.

Although the fossilised remains of man are scanty, several forms have come to light, particularly of recent years, which throw some light upon his ancestry. Probably none of them is in the direct line of descent. They are side branches which have become replaced by more efficient types of which modern man is the only surviver. They show in rather greater detail some of the stages in recession of the snout, the dimination in the importance of the sense of smell and the enlargement of the fore-brain which have been illustrated by the preceding series.

EXHIBIT XX.

The Ear—Ng Yew Seng.

The ear is among one of the important sensory organs in vertebrate animals. In some species the mechanism of hearing is very highly developed, while in men it is equal in importance to other senses, like taste, smell, sight, etc.

The ear is composed of three principal parts namely :—The outer, middle and inner ear. Each plays a part in contributing towards the sensibility of a sound.

The outer ear consists of a flap of cartilage, some muscles and skin attached to the side wall of the shell and called Pinna. It is interesting to note the perculiar development found in different species of animals—its size, shape, structure and moveability are characteristics of its owner. In the elephant it resembles that of a big fan on both sides of the head. In rabbit it is pointed and concave. In cat it is much reduced in size and shape, while in man its moveability is totally lost and consequently the head and not the ear is turned towards the course of a sound.

From the pinna the external auditory meatus ends at the tympanum—a membrane composed of connective tissues covered externally by the modified skin lining the meatus and internally by mucuos membrane continuous with the lining of the middle ear. The wall of the meatus is covered with hairs and skin which secretes a ceruminous fluid obnoxious to insects thus acting as a protective mechanism for the delicate ear drum.

Sound waves are collected by the external auditory meatus and directed to the tympanic membrane which being aperiodic could not identify the sound. But vibrations of definite frequencies possessed by the bombarding sound wave are set up and transmitted to a system of levers composed of three bony ossicles—Malleus, Incus, Stapes, situated in the middle ear, and finally into the Inner ear where sound is analysed.

The middle ear is a chamber besides containing the three bones mentioned above also two small muscles—Stapeonis and Tensor Tympani. The former is attached to the neck of Stapea and antagnonises the action of the latter which is inserted in the handle of the Malleus and ultimately increases the tension of the tympanic membrane. In order to accommodate the displacement of air pressure in the chamber caused by the bombardment of atmospheric pressure on the tympanum, the middle ear is connected by the Eustachian tube to the nasopharynx which is also in direct contact with the surrounding air pressure. This connection also acts as safety valve for sudden explosion of loud sound which otherwise would rupture the ear drum.

We come now to the most important part of the ear called the Inner Ear, or labyrinth. In consists of three semicircular canals which are arranged at right angles to each other and open into the Utricle which in turn is connected with the Saccule. These two last mentioned structures lie in the Vestibule which has an oval foramen into which the stapes ends and sealed in by the annular ligament. The semicircular canals, saccule and utricle are important in that they give information of the body in space of three dimensions—horizontal, vertical and oblique. These sensory impulses originate from the hair cells of the Macula in Utricle and Saccule, and Cristal Acoustical in the semicircular canals. The impulses are carried by peripheral fibres of Scarpa's ganglion innervating the cells, and the axons from the Vestibular division of the VIII nerve, which ends in principal nuclei on the floor of the 4th Ventricle. Fibres are given off by the cells to the Cerebellum which is responsible for the posteral reflexes, and also to the Cortex evoking consciousness.

Its importance is seen when the structures are removed as seen in the cat which will not be able to right itself when falling from a height, i.e., feet first as in normal response. However, if certain time is allowed to relapse, the cat is able to fall on its feet because of the substitute by Visual posterial reflexes.

The sound is analysed by another structure called cochlea which is part of the Labyrinth. It is a tube which circles round a central core and a half round. The tube is divided by two membrances called Reissuer and Basilar forming 3 compartments one membranous called Scala Media and contain Endolymph. The other two osseous called Scala Vertibuli and Scala Tympani and contain Perilymph. The two are connected together at the apex. The vestibuli open into the Foramen ovale and the tympani into Foramen Rotundum which is covered by a membrane. Any change in the pressure of the Perilymph at the ovale is counteracted by the bulging of the membrane into the middle ear. The Scala Media is connected to the Saccule by the Rennien duct. The Basilar membrane is specially constructed with sensitive nerve endings on the cells which is bathed by the Endolymph. Any change in the fluid pressure will create an impulse which is conducted by fibres of the Cochlear division of the 8th nerve. This change of fluid pressure in the Scala Media is the ultimate result of linking of Stapes in Vestibule, which displace the Perilymph in Scala Vestibule and Scala Tympani, both of which we know are intimately connected to the Media and Endolymph.

In short we may say that sound travels as waves which when in contact with Tympani membrane is changed into vibratory pressure and transmitted by the chain of bony ossicles to the Vestibule where fluid pressure representing the sound wave travels along the Perilymph and is picked up by the specialised cells in the Basilar membrane, setting up an impulse of the particular sound and carried by the Cochlear nerve to its nucleus thence to the Cerebral Cortex and other reflex centres.

MEDICAL EXHIBITS.

The coming of age exhibition of the University of Hong Kong was a most successful affair. The clinical section of the Medical Exhibits with which we are concerned were housed in the School of Pathology and Tropical Medicine. Thousands of interested spectators and friends of the University were present throughout the morning, and demonstration classes were conducted by the clinical students for the benefit of the crowd which showed gratification as well as an intelligent interest in the Exhibits.

Among the things displayed were :—

1. Electrocardiograph.

2. Sphygmomanometers. Quite contrary to expectations the blood pressure apparatus turned out to be most popular, a large number of interested folk anxiously waited to have their blood pressures recorded while others were being done. This kept our few students with the fewer sphygmomanometers at their disposal continually occupied. A wide variety of sphygmomanometers depicting the various evolutionary stages in its development, ranging from Riva-Roccis original pattern, the Roger's modification with the aneroid down to the modern New Nicholson Prince's were displayed.

3. Apparatus for inducing artificial pneumothorax.

4. Radiology. In this section we were limited down to roentgenograms which could be easily appreciated by the lay mind. The selected films shown for the instruction of the public were those depicting typical pathological conditions, the diagnosis of which has been so much facilitated and in some cases only made possible since the introduction of X-ray photography. Our thanks are due to Dr. Pringle.

5. Malariological Exhibits. Due to the kindness of Dr. A. B. Jackson the Government malariologist, a most comprehensive selection of exhibits cleverly depicting the life history, habitat and minute anatomical differences of the numerous kinds of mosquitoes were laid on view. Of the things shown were breeding places with larvae, apparatus for collecting, hatching and despatching larvae and adults, exhibits in phials and cups, larvae and pupae in incubators. Under entomological microscopes were shown various species of adult mosquitoes and minute parts of mosquitoes

6. Parasitological section. Dr. G. H. Thomas, lecturer in Tropical Medicine kindly arranged a display of a wide variety of protozoal and metazoal parasites.

LIM GIM KHEANG.

It will be of interest to members to note that at the 4th Committee Meeting of the Society it was decided to have the bust of the late Prof. C. Y. Wang placed above the fire place in the Medical Library, School of Pathology.

We congratulate Dr. K. D. Ling on being appointed Hon. Treasurer of the Society.

Mr. R. A. Evans has kindly consented to take up duties as Business Manager to this journal. We extend to him our thanks we are sure he will be able to carry on the business side most efficiently.

Congratulations to Mr. Chew Poh Heng on being elected to the Union Council. It is gratifying to note that there are no less than seven members of this society on the Union Council. The other members of this society on the Union Council are Miss Cisssy Wong, Messrs. G. K. Kim, Yeung Wai Wah, Lee Hua Ngak, K. C. Lam and Ong Ewe Hin.

We congratulate Prof. L. T. Ride on being elected Chairman of the Blood Grouping Division at the Pacific Science Congress.

To Dr. H. C. Ku we extend our heartiest congratulations on having won the Chinese Boxer Indemnity Fund Scholarship. He was one of the two successful candidates out of 162 who sat for the examination.

We welcome Dr. K. Mackenzie who has been appointed acting Professor of Physiology. He is also a very keen photographer and specializes in infra red rays. We hope to have lectures from him soon.

Dr. J. L. Shellshear one of our Vice-Presidents is back now with us after a well earned leave in Europe. We are sure he will continue to give the Society his valuable support.

The Society held a very successful launch picnic on the 11th of May to Castle Peak. Over 100 members and friends were present.

HONG KONG UNIVERSITY MEDICAL SOCIETY.

PRIZE ESSAY

"The Contrast between Modern Medicine and Ancient Chinese Medicine."

1. The competition is open only to undergraduate members of the Hong Kong University Medical Society.
2. The essay shall be limited to approximately 5,000 words.
3. Essays to be submitted must reach the Editor, The Caduceus, Hong Kong University on or before 1st March, 1934.
4. The prize winning essay shall be published in the Caduceus, if sufficiently creditable.
5. Essays must be typed with double or treble spacing.
6. The Society reserves the right to withhold the award.
7. The Editor's decision shall be final.

Acknowledgments

1. New Zealand Medical Journal v. XXXII, No. 169 (June, 1933).
2. Bulletin of the New York Academy of Medicine v. IX, No. 5 & 6.
3. Bristol Medico-Chirurgical Journal v. L, No. 188.
4. Health & Empire v. VIII, No. 2.
5. Birmingham Medical Review v. VIII, No. 2.
6. Japanese Journal of Experimental Medicine v. XI, No. 3. (June, 1933).
7. Revista de la Facultad de Medicina—Bogota v. I, No. 11. (April, 1933).
8. Lingnan Science Journal v. 12, No. 3.
9. Ulster Medical Journal v. II, No. 3. (July, 1933).
10. Fukuoka-Ikwadaigaku Zasshi v. XVI, No. 6 & 7.
11. Journal of Bone & Joint Surgery v. XV, No. 3.
12. Mitteilungen Aus Der Medizinischen Akademie zu Kioto v. VIII, No. 3.
13. University College Hospital Magazine v. XVIII, No. 3.
14. Abhandlungen der Medizinischen Fakultaet der Sun Yat Sen Universitaet, Canton v. III, No. 1 & 2.
15. St. Mary's Hospital Gazette v. XXXIX, No. 4 & 5.
16. Queen's Medical Magazine v. XXX, No. 6.
17. The Hospital v. XXIX, No. 6 & 7.
18. Keijo Journal of Medicine v. 4, No. 2.
19. Memorias do Oswaldo Cruz—Rio de Janeiro—Manquinhos v. XXVII, No. 1.
20. Chiba-Igakkai-Zasshi v. XI, No. 5, 6 & 11.
21. Tohoku Journal of Experimental Medicine v. XXI, No. 3-4. (July, 1933).
22. Okayama-Igakkai-Zasshi v. 45, No. 5.
23. St. Bartholomews Hospital Journal v. XL, No. 9 & 10.
24. Medical Journal of Australia v. I, No. 21, 23-25, v. II, No. 1-5. (1932).
25. Epidemiological Report of the Health Sect. of the Secretariat. League of Nations v. 12, No. 5-6.

Review of Books

"*The Clinical Aspect of Chronic Poisoning by Aluminum and Its Alloys.*" By Leo Spira, M.D. Foreword by Prof. H. H. Meyer. London: John Bale, Sons & Danielsson Ltd., 1933. Pp. 28. Price 2/6.

"Experiment is the interpreter of Nature. Experiments never deceive. It is the judgement that sometimes deceives itself because it expects results that experiments refuses." Leonardo da Vinci: "De Natura."

The question of toxicity of aluminum and its alloys and salts has become a matter of considerable public interest during the last few years. Aluminum is third on the list of the most common constituents of our earth, and represents nearly 9% of the total of the globe. By modern technique the metal can readily be extracted from its ores, and its properties of lightness, tenacity and ductility make it extremely valuable for us as cooking utensils, for the canning of food and for many other domestic uses. The amphoteric and hydrolytic properties of its salts have led to its frequent use in baking powders; an alum base, combined with a suitable proportion of phosphate, being used in place of tartaric or citric acid. Its use is increasing cumulatively as its price falls and new lines of utility are explored. Hence the question of aluminum toxicity is of importance.

In the present book Dr. Spira makes a powerful attack upon the use of aluminum in the preparation of food for human consumption, whether it involves the use of alum salts or the mere contact with aluminum cooking utensils. He describes various types of "symptom-complex" including impaired appetite, nausea, vomiting, passing through graver complaints such as anaemia and low blood pressure to derangements such as cancer. By a process of elimination he determined that the effect was "probably due to a mineral or metallic poison." (p. 6). He then eliminated the aluminum utensils from his kitchen. And the result? "It is true that the described condition was not *entirely* cured by the elimination of aluminum utensils"—though some mitigation of the symptom complex was observed. But by the use of diet excluding tap water, and its replacement by mineral water, and a liberal regiment of raw fruit, jacket potatoes and eggs, the complex entirely disappeared.

Now the analyses published by the reviewer and others have conclusively proved that mineral waters contain considerably more aluminum than natural tap water in the majority of cases, and that the aluminum found in the potato is almost entirely concentrated in the jacket. Thus Dr. Spira appears to have defeated his own end, and to have cured himself of the aluminum, poisoning by taking it in much enhanced doses.

It is unnecessary to follow the author into his discussions on the aluminum alloys, which, he points out, contain copper, sodium, silicon and fluorine. The toxic effect of copper is well established, and that of fluorine has recently been confirmed. Moreover, Dr. Spira observes that aluminum is made by a fusion process in cells lined with carbon, prepared by baking coke with mineral oils—the very oils which have been shown to produce cancer in the human subject if applied over the body over long period. But how the cancerous properties of these oils survive a temperature if 1,000° C. and are conveyed into the molten aluminum, there to form a potential source of cancer among the users of the material, is a matter which Dr. Spira does not explain.

The quotation cited from Leonardo da Vinci can be aptly applied to this little book. Dr. Spira proposes, by means of his pamphlet containing a report of six cases and a complete lack of scientific evidence, to overthrow a mass of work which has been published in the scientific journals of the world—work that has never been seriously questioned —which shows conclusively that aluminum, whether in the form of the pure metal or its salts, is entirely innocuous to the human organism. If the present reviewer were alone in this view, he would undoubtedly display some diffidence in denouncing Dr. Spira's book as superficial and unsound. But with the majority of scientific opinion on his side, he has no hesitation in dismissing it as worthless.

K. M.

"*The Theory and Practice of Massage and Medical Gymnastics.*" By B. M. Goodall-Copestake. Published by H. K. Lewis & Co., Ltd., 136, Gower Street, W.C.1. Pages 332, 118 Illustrations including 22 plates. Price 12s. 6d. net.

To have run into the Fifth Edition in 16 years shows not only that there is a demand for this excellent book but also that there is a marked attempt by the author to keep it up to date and abreast of the times.

As already stated the book is excellent especially the first sections where the author has kept to the straight and narrow path of the subject under discussion. But one cannot help wondering after finishing reading it, whether it is wise to try and give massage students a smattering of so much medicine and surgery. Pages are given up to such conditions as anaemias, peptic ulcers, etc., which are, one ventures to suggest, slightly out of place in a book for massage students.

Similarly much space is wasted talking about Newton's Law of Motion, nerve fibres and so on. When all this type of knowledge is treated in a book of this size it must of necessity be treated badly, and one is not surprised to find foolish statements such as "The brain is the human centre" and if a limb does not fall freely on to the bed when unsupported, "nerve tension is keeping it there."

No, it would be better to stick to the subject matter of the book implicitly, so that the massage student may learn massage and leave the questioning of the confined patient concerning her lochia to the doctor and nurse.

Nevertheless, the book is to be recommended especially to medical people away from massage centres. The volume is well got up and the photographs are excellent.

L. T. R.

"*Whitla's Pharmacy, Materia Medico and Therapeutics*" 12th Edition pp. xii—645; Figs. 16. Bailliere, Tindall & Cox. 7 & 8,

Henrietta Street, Convent Garden, London.

It is now over 50 years since the first edition of this book was brought out and it is therefore no mean task for Prof. Gunn and his two assistants to try and bring this twelfth edition up to date without the loss of the individuality of the original author.

The book is divided into 5 parts. The first is devoted to Pharmacy which is dealt with in eighty odd pages in great detail. Examples of this detail are the description of Isotonic Solution standards on page 72, standardization of size of powders on page 74 and percentage solutions on page 80.

The second part is devoted to prescription writing and the same thoroughness is seen here even to the extent of giving the reader a few pages of rules of Latin syntax. It is however hard to understand why the Groups of Therapeutic Agents are in this part and not in Part IV. which is devoted to Therapeutics. This part with its occasional prescriptions and up to date notes should be of great value to senior students (on page 369 the use of the word "excreted" in reference to hydrochloric acid of the stomach should be altered).

Part V gives a long list of non-official remedies and index to poisons, the book being completed with a good index.

The twelfth is undoubtedly a worthy successor of the other editions.

L. T. R.