*THE HEAD MEASUREMENTS IN LIVING KOREANS

(In relation to age, weight and stature)

(Part Two)

by

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HEAD MEASUREMENTS

II. HEAD BREADTH

The materials, data, and methods were as previously reported in part I. (The Journal of Severance Union Medical College, Vol. II, No. 1.)

1. Frequency of distribution of the head breadth:

The frequency of distribution of head breadth in 2320 Korean males and 1855 females aged from 1 to 75 years, and the maximum and minimum head breadth is shown in Tables No. XII, and XIII. It is quite apparent that the apparent fluctuation in the head breadth at ages under 5 and over 23 is due to the small number of individuals. The middle values of the distribution of the groups of the head breadth gradually rise according to the increase in age whether we consider male or female. The average between maximum and minimum head breadth is 10 to 40 mm. in both males and females. Generally speaking the difference between maximum and minimum at any age is about 30 mm. in either male or female. It is little greater than the difference between maximum and minimum of the head length. Details are shown in Tables XIV, and XV.

Table XII. Frequency-distribution of Head Breadth in 2320 Korean Males.

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*Article No. 128 B. Research Department, Severance Union Medical College, Seoul, Korea (Chosen)
Table XIII. Frequency-distribution of Head Breadth in 1855 Korean Females.

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Age

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31-35 | 36-39 | 40-44 | 45-49 | 50-54 | 55-59 | 60-64 | 65-69 | 70-74 | 75-79 |

2. Mean values of the head breadth:

In Table XIV is shown the mean values of the head breadth at different ages. The mean values of the head breadth show a gradual rise from 131.29 (at one year) to 154.95 after 18 years of age. The growth ratio for each year averages about 0.95% in males. The standard deviation of the head breadth is from 5.32 to 7.73 and the coefficient of variation is from 2.38 to 5.30. Figure VIII clearly indicates the head breadth at the various ages from 1 to 75 years old. In general the development of the head breadth follows a curve similar to that for head length. Thus from 1 to 5 years old the average variation is comparatively rapid at 1.85% per year, and in the period from 6 to 10 years of age it is slightly less than 0.65% per year. From 11 to 18 years development occurs averaging 0.60% per year which is a slight decrease. After the age of 18 years the breadth of the head is practically fixed in males at 154.95 ± 0.24 (M), 6.52 (σ), 4.20 (v), 169.00 Max. and 148.00 Min. Therefore the lateral growth of the head seems to be complete rather earlier that is the growth of the head in length.

The mean values of the head breadth in 1855 females is shown according to their ages in Table XV. The mean values of the head breadth show a gradual rise from 127.89 (at one year) to 148.83 after 16 years and the growth during each year interval averages about 1.03%. The standard deviation of the head breadth varies from 4.41 to 7.46 and the coefficient of variation from 3.02 to 5.83. The development of the head breadth from year to year (as shown in figure IX) follows a definite curve in both male and female. Thus from 1 up to 5 years growth is fairly rapid averaging 1.76% per year while from 6 to 10 years it averages only 0.63% per year and from 11 to 15 years the average is slightly increased at 0.70% per year. From 16 years the breadth of the head is practically fixed at 148.83 ± 0.21 (M), 5.66 (σ),

(2)
3.80 (v), 165.00 Max. and 150.00 Min. Also the growth of the head laterally seems to be complete rather earlier than growth of the head in length, in the female.

Table XIV. (1)

Mean values of Head Breadth according to age in Males

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<th>σ</th>
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<th>Max.</th>
<th>Min.</th>
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<td>148</td>
</tr>
</tbody>
</table>

Table XIV. (2)

Mean values of Head Breadth according to age in Females

<table>
<thead>
<tr>
<th>Age</th>
<th>M ± m</th>
<th>σ</th>
<th>V</th>
<th>Max.</th>
<th>Min.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>127.89 ± 2.06</td>
<td>7.46</td>
<td>5.83</td>
<td>135</td>
<td>118</td>
</tr>
<tr>
<td>2</td>
<td>131.85 ± 1.16</td>
<td>5.57</td>
<td>4.22</td>
<td>140</td>
<td>120</td>
</tr>
<tr>
<td>3</td>
<td>137.00 ± 1.39</td>
<td>4.41</td>
<td>3.21</td>
<td>143</td>
<td>133</td>
</tr>
<tr>
<td>4</td>
<td>136.50 ± 1.15</td>
<td>4.48</td>
<td>3.28</td>
<td>146</td>
<td>125</td>
</tr>
<tr>
<td>5</td>
<td>140.44 ± 1.10</td>
<td>4.55</td>
<td>3.23</td>
<td>148</td>
<td>125</td>
</tr>
<tr>
<td>6</td>
<td>139.44 ± 0.82</td>
<td>4.90</td>
<td>3.51</td>
<td>146</td>
<td>123</td>
</tr>
<tr>
<td>7</td>
<td>138.18 ± 0.58</td>
<td>4.78</td>
<td>3.44</td>
<td>149</td>
<td>125</td>
</tr>
<tr>
<td>8</td>
<td>140.11 ± 0.52</td>
<td>5.49</td>
<td>3.91</td>
<td>154</td>
<td>127</td>
</tr>
<tr>
<td>9</td>
<td>141.40 ± 0.51</td>
<td>5.17</td>
<td>3.65</td>
<td>155</td>
<td>130</td>
</tr>
<tr>
<td>10</td>
<td>142.62 ± 0.54</td>
<td>6.04</td>
<td>4.23</td>
<td>170</td>
<td>137</td>
</tr>
<tr>
<td>11</td>
<td>143.91 ± 0.49</td>
<td>5.54</td>
<td>3.84</td>
<td>160</td>
<td>130</td>
</tr>
</tbody>
</table>

(3)
3. Comparison of males with females as regards breadth of the head:

The details are shown in Table XV. Thus up to 6 years there is no marked difference between male and female but after that a marked
difference appears. Thus after this age the male rapidly develops while the female shows no such acceleration. This is well shown in Graph X. The male head is in fact always wider than the female head at each age and the final difference after full growth amounts to 6.12 ($\frac{M_1-M_2}{m.\;dif.}$). Under 5 years the rate of development is only slightly greater in the male averaging 1.85% per year as compared with 1.76% per year in the female. Thus the development of the head laterally in both the male and female finishes earlier than growth of the head in length. As a result the adult average is reached at 18 years in the male and at 15 years in the female while the length of the head increases up to 20 years in the male and up to 18 years in the female.

Table XV. Ratio of Difference of two Means ($\delta$, $\varphi$) to the Probable error of the Head Breadth.

<table>
<thead>
<tr>
<th>Age</th>
<th>$M_1-M_2$</th>
<th>m. dif.</th>
<th>$\frac{M_1-M_2}{m.;dif.}$</th>
<th>$&gt; 3$</th>
<th>Age</th>
<th>$M_1-M_2$</th>
<th>m. dif.</th>
<th>$\frac{M_1-M_2}{m.;dif.}$</th>
<th>$&gt; 3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.40</td>
<td>2.42</td>
<td>1.40</td>
<td>$&lt; 3$</td>
<td>17</td>
<td>4.09</td>
<td>0.72</td>
<td>5.68</td>
<td>$&lt; 3$</td>
</tr>
<tr>
<td>2</td>
<td>5.23</td>
<td>1.75</td>
<td>2.98</td>
<td>$&lt; 3$</td>
<td>18</td>
<td>5.15</td>
<td>0.70</td>
<td>7.35</td>
<td>$&lt; 3$</td>
</tr>
<tr>
<td>3</td>
<td>4.00</td>
<td>2.15</td>
<td>1.89</td>
<td>$&lt; 3$</td>
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<td>7.01</td>
<td>0.88</td>
<td>7.96</td>
<td>$&lt; 3$</td>
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<tr>
<td>4</td>
<td>3.50</td>
<td>1.68</td>
<td>1.93</td>
<td>$&lt; 3$</td>
<td>20</td>
<td>8.50</td>
<td>1.14</td>
<td>7.45</td>
<td>$&lt; 3$</td>
</tr>
<tr>
<td>5</td>
<td>3.41</td>
<td>1.63</td>
<td>2.09</td>
<td>$&lt; 3$</td>
<td>21</td>
<td>6.94</td>
<td>1.61</td>
<td>4.43</td>
<td>$&lt; 3$</td>
</tr>
<tr>
<td>6</td>
<td>1.29</td>
<td>0.84</td>
<td>2.74</td>
<td>$&lt; 3$</td>
<td>22</td>
<td>4.47</td>
<td>1.34</td>
<td>4.82</td>
<td>$&lt; 3$</td>
</tr>
<tr>
<td>7</td>
<td>4.62</td>
<td>0.94</td>
<td>4.93</td>
<td>$&gt; 3$</td>
<td>23</td>
<td>6.49</td>
<td>1.74</td>
<td>2.72</td>
<td>$&lt; 3$</td>
</tr>
<tr>
<td>8</td>
<td>2.81</td>
<td>0.92</td>
<td>3.05</td>
<td>$&gt; 3$</td>
<td>24</td>
<td>4.82</td>
<td>1.83</td>
<td>2.63</td>
<td>$&lt; 3$</td>
</tr>
<tr>
<td>9</td>
<td>3.60</td>
<td>0.84</td>
<td>4.28</td>
<td>$&gt; 3$</td>
<td>25</td>
<td>3.52</td>
<td>2.42</td>
<td>1.45</td>
<td>$&lt; 3$</td>
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<td>3.23</td>
<td>1.00</td>
<td>3.23</td>
<td>$&gt; 3$</td>
<td>26</td>
<td>4.07</td>
<td>2.61</td>
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<td>11</td>
<td>3.46</td>
<td>0.75</td>
<td>4.61</td>
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<td>27</td>
<td>2.91</td>
<td>2.39</td>
<td>1.27</td>
<td>$&lt; 3$</td>
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<td>2.40</td>
<td>0.74</td>
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<td>7.19</td>
<td>1.67</td>
<td>4.30</td>
<td>$&lt; 3$</td>
</tr>
<tr>
<td>13</td>
<td>2.18</td>
<td>0.74</td>
<td>2.94</td>
<td>$&gt; 3$</td>
<td>29</td>
<td>4.25</td>
<td>3.40</td>
<td>1.30</td>
<td>$&lt; 3$</td>
</tr>
<tr>
<td>14</td>
<td>1.75</td>
<td>0.70</td>
<td>2.50</td>
<td>$&gt; 3$</td>
<td>30</td>
<td>14.00</td>
<td>3.56</td>
<td>2.93</td>
<td>$&lt; 3$</td>
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<tr>
<td>15</td>
<td>3.59</td>
<td>0.65</td>
<td>5.52</td>
<td>$&gt; 3$</td>
<td>31-75</td>
<td>6.21</td>
<td>1.66</td>
<td>3.74</td>
<td>$&lt; 3$</td>
</tr>
<tr>
<td>16</td>
<td>3.69</td>
<td>0.57</td>
<td>6.47</td>
<td>$&gt; 3$</td>
<td>31-75</td>
<td>(19-75)</td>
<td>6.12</td>
<td>1.00</td>
<td>$&lt; 3$</td>
</tr>
</tbody>
</table>

Fig. X.

Graph showing influence of Sex on Head Breadth according to Age

4. Rate and types of development of the head breadth.

A. Rate of development of the head breadth:
From Table XVI. and Figure XI. we can ascertain the absolute and relative increase in head breadth during each year of life and also the mean values. The rate of development of the head breadth averages 0.95% per year in the male up to 18 years and 1.03% per year in the female up to 15 years. But as the age rises the rate of increase of the head breadth gradually diminishes. Therefore the maximum rate of increase always occurs in infancy in both the male and female and minimum rates occur just before the male or female head reaches adult dimensions. The male shows no evidence of growth after 18 years and the female no evidence of growth after 15 years (The rate is -0.12% in the male and -0.09% in the female).

Table XVI. Ratio of Differences of the Developmental rate of Head Breadth between Male and Female

| Ratio (Age) | δ | ϕ |  | Ratio (Age) | δ | ϕ |
|-------------|---|---|  |-------------|---|---|
| 1-2 | 5.79 | 4.41 | 3.96 | 3.09 | 17-18 | 1.98 | 1.29 | 0.92 | 0.61 |
| 2-3 | 2.92 | 2.15 | 1.55 | 3.90 | 18-19 | 0.65 | 0.42 | -1.18 | -0.78 |
| 3-4 | -1.00 | -0.71 | -0.50 | -0.26 | 19-20 | 0.25 | 0.16 | -1.24 | -0.83 |
| 4-5 | 4.85 | 4.20 | 3.94 | 2.88 | 20-21 | -0.13 | -0.08 | 1.43 | 0.97 |
| 5-6 | -1.12 | -0.77 | -1.00 | -0.71 | 21-22 | 0.51 | 0.32 | 0.98 | 0.65 |
| 6-7 | -0.23 | -0.16 | -1.26 | -0.90 | 22-23 | -1.82 | -1.16 | -1.82 | -1.21 |
| 7-8 | 0.42 | 0.29 | 1.93 | 1.39 | 23-24 | 1.53 | 0.99 | 3.20 | 2.16 |
| 8-9 | 2.08 | 1.45 | 1.29 | 0.92 | 24-25 | -0.57 | -0.36 | 0.73 | 0.48 |
| 9-10 | 0.55 | 0.88 | 1.24 | 0.86 | 25-26 | 2.15 | -1.38 | -2.70 | -1.77 |
| 10-11 | 1.02 | 1.04 | 1.29 | 0.90 | 26-27 | 1.06 | 0.69 | 2.22 | 1.48 |
| 11-12 | -0.37 | -0.25 | 0.69 | 0.47 | 27-28 | -1.42 | -0.92 | -5.70 | -3.76 |
| 12-13 | 1.04 | 0.70 | 1.26 | 0.87 | 28-29 | 0.87 | 0.56 | 3.81 | 2.61 |
| 13-14 | 1.24 | 0.83 | 1.67 | 1.14 | 29-30 | 2.75 | 1.78 | -7.00 | -4.68 |
| 14-15 | 2.29 | 1.53 | 0.46 | 0.30 | 30-31 | -3.77 | -2.40 | 4.02 | 2.82 |
| 15-16 | 0.13 | 0.08 | 1.06 | 0.71 | | | | | |
| 16-17 | 0.23 | 0.15 | -1.17 | -0.11 | | | | | |

Fig. XI.

Graph showing Difference of Developmental rate of the Head Breadth in Male and Female

B. The curve of the rate of development of the head breadth:
This curve indicates that there are three cycles before the adult size is reached. In both male and female the first period is up to 5 or 6 years during which time the average rate is 1.85% in the male and 1.76% in the female. The second period for both male and female is up to 10 or 11 years during which time the average rate is 0.64% in the male and 0.63% in the female. And the third period for both the male and female is up to 15 years in the female and to 18 years in the male, the average rate being 0.60% in the male and 0.70% in the female. In the female the third period is shorter which explains why the rate of development in the female during this period is 0.1% greater than in the male. The development of the head laterally in both male and female thus runs almost parallel. The actual increase per year is almost the same but in the female the development is completed in a shorter number of years. Comparing with the development of the head in length the growth of the head laterally is rather more rapid but ceases rather earlier. In both male and female the first period is one of rapid growth, while the middle period is one of quite slow growth. Growth in the last period is again more rapid. Experimental and calculated figures for the breadth of the head based upon my empirical formula have previously been reported in The Journal of Severance Union Medical College, (Vol. II, No. 1.) as follows:

\[ y = \frac{a}{1 + be^{-cx}} \]

The details are shown in Table XVII. and Figure XII.

<table>
<thead>
<tr>
<th>Sex</th>
<th>Age</th>
<th>Experimental</th>
<th>Calculated</th>
<th>Experimental</th>
<th>Calculated</th>
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<td>127.89</td>
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<td>131.85</td>
<td>129.83</td>
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<td>137.00</td>
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<td>142.92</td>
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<td>140.11</td>
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<td>148.00</td>
<td>141.40</td>
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<td>145.85</td>
<td>149.33</td>
<td>142.63</td>
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<td>145.71</td>
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<td>151.98</td>
<td>145.86</td>
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<td>153.94</td>
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</table>
5. Comparison with other races:

The Korean head breadth is a little greater than that of other races about which we have information. I think this is a significant feature of the Korean head. Anyhow the Korean head is wider than the American white, or the European head breadth. On the other hand, the length of the Korean head is less than that of either the American or European both during development and after attaining maximum growth.

Comparing the adult Korean with other Asiatic races we find the breadth of the head to be rather less than that of the Manchu, Buriat or Kirgis tribes and larger than that of any other Asiatic races of which we have information. In Europe only the Danes have a slightly larger head than the Korean male and female. All others are less than the Korean. The Africans and Amerinds are all less than the Korean. Details are shown in Table XVIII. and Figure XIII.
Table XVIII. Comparison of development of the Head Breadth with other Races both Male and Female

<table>
<thead>
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<th>White</th>
<th>European</th>
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<td>Kajimura</td>
<td>West</td>
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</table>

Fig. XIII.

Graph showing the Developmental rate of the Head Breadth Compared with other Races both Male and Female.

( 9 )
<table>
<thead>
<tr>
<th>Races</th>
<th>Ẹ</th>
<th>Ọ</th>
<th>Observer</th>
<th>Races</th>
<th>Ẹ</th>
<th>Ọ</th>
<th>Observer</th>
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<tbody>
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