Herat. They do not recognise the authority of the Amir of Kábul, and should the Czar, who is about to assume the title of "Emperor of Central Asia," claim the allegiance of this outlying Central Asiatic tribe, here will be a fruitful source of future complications. Their submission would at once advance the Russian frontier far into Afghan territory and up the Murgháb valley to within easy distance of Herat from the north. The route in this direction is well known, and constantly traversed by traders from Khiva, Bokhara, and Samarkand. It appears to present no greater difficulties than the more westerly route crossing the Barkhut ridge recently surveyed by Lessar.

There remain to be mentioned the KATAGHÁNI USBEGS, who form the bulk of the population in Afghan Turkestán. They belong to the same ethnical group as the Usbegs of the Khanates, and have even some settlements in Bokhara beyond the Oxus. They are mostly agriculturists and traders, Sunnite Mohammedans of pure Turki speech, and bear with reluctance the hard yoke of their Afghan masters. Their sympathies are entirely with their northern kinsmen, and as the country (Kunduz, Balkh, Maimene) belongs geographically to the Aralo-Caspian basin, it is difficult to see how further rectifications of frontier can ultimately be prevented in this direction. Exponents of advanced public opinion in Russia already openly claim the whole of this region to the crest of the Hindu-Kush as properly belonging to the ruler of Central Asia, and their arguments are largely based on ethnological grounds.

Table of the North Afghan Border Tribes

	Tribe	*Locality*	*Population*[1]
	CAUCASIC STOCK		
Galchas	Siah-Posh	Kafiristán	150,000
	Badakhshi	Badakhshán	160,000
	Wakhi	Wakhán	3,000
	Shugnáni	Shugnán	25,000
Iranians	Kohistáni	Kohistán	?
	Firuz-Khoi... ...	Prov. Herat, Murgháb Valley	30,000 tents
	Jemshidi	Prov. Herat, Khushk Valley	12,000 families
	Tajiks...	Herat, Balkh, &c.	200,000 ?
	Afghans	Herat...	100,000 ?
	MONGOLIC STOCK		
Mongols	Hazarahs	Hezáraját ... ... Koh-i-Baba, Safed-Koh ...	300,000
	Aimaks	Ghor, Herat, Khorasán ...	350,000
Tatars	Salor Turkomans	About-Martshag, Murgháb Valley	30,000
	Katagháni Usbegs	Afghan Turkestán, Bokhara	600,000

A. H. KEANE

[1] Population mostly conjectural.

ANTHROPOMETRIC PER-CENTILES

I SEND the following Table, partly to exemplify what I trust will be found a convenient development of a statistical method that I have long advocated, and partly for its intrinsic value, whatever that may be. It will at all events interest those of the 9337 persons measured in my Anthropometric Laboratory at the late International Health Exhibition, who may wish to discover their rank among the rest.

Its meaning is plain, and will be understood by the help of a single example, for which I will take the line referring to Strength of Squeeze among males. We see that a discussion was made of 519 measurements in that respect, of men whose ages ranged between 23 and 26; that 95 per cent. of them were able to exert a squeeze with their strongest hand (the squeeze was measured by a spring dynamometer) that surpassed 67 lbs. of pressure; that 90 per cent. could exert one that surpassed 71; 80 per cent. one that surpassed 76; and so on. The value which 50 per cent. exceeded, and 50 per cent. fell short of, is the Median Value, or the 50th per-centile, and this is practically the same as the Mean Value; its amount is 85 lbs. This line of the Table consequently presents an exact and very complete account of the distribution of strength in one respect among the middle 90 per cent. of any group of males of the tabular ages similar to those who were measured at the laboratory. The 5 per cent. lowest and the 5 per cent. highest cannot be derived directly from it, but their values may be approximately inferred from the run of the tabular figures, supplemented by such deductions as the Law of Error may encourage us to draw. Those who wish to apply this law will note that the probable error is half the difference between the 25th and the 75th per-centile, which can easily be found by interpolation, and they will draw the per-centiles that correspond respectively to the median value *minus* twice, three times, and three-and-a-half times the probable error, at the graduations 8·7, 2·4, 0·8, and those that correspond to the median value *plus* those amounts, at the graduations 91·3, 97·6, and 99·2. The Table is a mere statement of observed fact; there is no theory whatever involved in its construction, beyond simple interpolations between values that differ little from one another and which have been found to run in very regular series.

It may be used in many ways. Suppose, for example, that a man of the tabular age, viz. above 23 and under 26, and who could exert a squeeze of 80 lbs., desired to know his rank among the rest, the Table tells him at once that his strength in this respect certainly exceeds that of 30 per cent. of those who were measured, because if it had been only 79 lbs. it would have done so. It also tells him that his strength does not exceed that of 40 per cent. of the rest, since it would have required a pressure of 82 lbs. to have done this. He therefore ranks between the 30th and the 40th per-centile, and a very simple mental sum in proportion shows his place to be about the 33rd or 34th in a class of 100.

The Table exhibits in a very striking way the differences between the two sexes. The 5th male per-centile of strength of squeeze is equal to the 90th female per-centile, which is nearly but not quite the same as saying that the man who ranks 5th from the bottom of a class of 100 males would rank 10th from the top in a class of 100 females. The small difference between the two forms of expression will be explained further on. If the male per-centiles of strength of squeeze are plotted on ruled paper, beginning with the lowest, and if the female per-centiles are plotted on the same paper, beginning with the highest, the curves joining their respective tops will be found to intersect at the 7th per-centile, which is the value that 7 of the females and 93 of the males just surpass. Therefore, if we wished to select the 100 strongest individuals out of two groups, one consisting of 100 males chosen at random, and the other of 100 females, we should take the 100 males and draft out the 7 weakest of them, and draft in the 7 strongest females. Very powerful women exist, but happily perhaps for the repose of the other sex, such gifted women are rare. Out of 1657 adult females of various ages measured at the laboratory, the strongest could only exert a squeeze of 86 lbs. or about that of a medium man. The population of England hardly contains enough material to form even a few regiments of efficient Amazons.

The various measurements of males surpass those of females in very different degrees, but in nearly every particular. A convenient way of comparing them in each case is that which I have just adopted, of finding the per-centile which has the same value when reckoned from the lower end of the male series, and from the higher end of the female series. When this has been done, the position of the

ANTHROPOMETRIC PER-CENTILES

Values surpassed, and Values unreached, by various percentages of the persons measured at the Anthropometric Laboratory in the late International Health Exhibition

(*The value that is unreached by n per cent. of any large group of measurements, and surpassed by* 100–*n of them, is called its* n*th percentile*)

Subject of measurement	Age	Unit of measurement	Sex	No. of persons in the group	Values surpassed by per-cents as below: 95	90	80	70	60	50	40	30	20	10	5
					Values unreached by per-cents. as below: 5	10	20	30	40	50	60	70	80	90	95
Height, standing, without shoes ...	23–51	Inches	M.	811	63·2	64·5	65·8	66·5	67·3	67·9	68·5	69·2	70·0	71·3	72·4
			F.	770	58·8	59·9	61·3	62·1	62·7	63·3	63·9	64·6	65·3	66·4	67·3
Height, sitting, from seat of chair ...	23–51	Inches	M.	1013	33·6	34·2	34·9	35·3	35·4	36·0	36·3	36·7	37·1	37·7	38·2
			F.	775	31·8	32·3	32·9	33·3	33·6	33·9	34·2	34·6	34·9	35·6	36·0
Span of arms ...	23–51	Inches	M.	811	65·0	66·1	67·2	68·2	69·0	69·9	70·6	71·4	72·3	73·6	74·8
			F.	770	58·6	59·5	60·7	61·7	62·4	63·0	63·7	64·5	65·4	66·7	68·0
Weight in ordinary indoor clothes...	23–26	Pounds	M.	520	121	125	131	135	139	143	147	150	156	165	172
			F.	276	102	105	110	114	118	122	129	132	136	142	149
Breathing capacity	23–26	Cubic inches	M.	212	161	177	187	199	211	219	226	236	248	277	290
			F.	277	92	102	115	124	131	138	144	151	164	177	186
Strength of pull as archer with bow	23–26	Pounds	M.	519	56	60	64	68	71	74	77	88	82	89	96
			F.	276	30	32	34	36	38	40	42	44	47	51	54
Strength of squeeze with strongest hand	23–26	Pounds	M.	519	67	71	76	79	82	85	88	91	95	100	104
			F.	276	36	39	43	47	49	52	55	58	62	67	72
Swiftness of blow.	23–26	Feet per second	M.	516	13·2	14·1	15·2	16·2	17·3	18·1	19·1	20·0	20·9	22·3	23·6
			F.	271	9·2	10·1	11·3	12·1	12·8	13·4	14·0	14·5	15·1	16·3	16·9
Sight, keenness of—by distance of reading diamond test-type	23–26	Inches	M.	398	13	17	20	22	23	25	26	28	30	32	34
			F.	433	10	12	16	19	22	24	26	27	29	31	32

per-centiles arranged in order of their magnitude are as follows:—Pull, 4; Squeeze, 7; Breathing capacity, 10; Height, 14; Weight, 26; Swiftness of blow, 26; Keenness of sight, 37. We conclude from them that the female differs from the male more conspicuously in strength than in any other particular, and therefore that the commonly used epithet of "the weaker sex," is peculiarly appropriate.

The Table was constructed as follows:—I had groups of appropriate cases extracted for me from the duplicate records by Mr. J. Henry Young, of the General Register Office. I did not care to exhaust the records, but requested him to take as many as seemed in each case to be sufficient to give a trustworthy result for these and other purposes to which I desired to apply them. The precise number was determined by accidental matters of detail that in no way implied a selection of the measurements. The summarised form in which I finally took them in hand, is shown in the two upper lines of the following specimen:—

Height, Sitting, of Female Adults, Aged 23–50, *in inches*

29–	30–	31–	32–	33–	34–	35–	36–	37–	
2	8	52	116	226	227	108	31	5	Total 775
2	10	62	178	404	631	739	770	775	Abscissæ 0 to 775
30	31	32	33	34	35	36	37	38	Corresponding Ordinates

The meaning of the two upper lines is that in a total of 775 observations there were 2 cases measuring 29 and under 30 inches, 8 cases measuring 30 and under 31 inches, and so on. The third line contains the sums of the entries in the second line reckoned from the beginning, and is to be read as follows:—2 cases under 30 inches, 10 cases (= 2 + 8) under 31 inches, 62 cases (= 2 + 8 + 52) under 32 inches, and so on.

I plotted these 775 cases on French "sectional" paper, which is procurable in long and inexpensive rolls, ruled crossways by lines 1 millimetre apart. I counted the first line as 0° and the 776th as 775°. Supposing the measurements to have been plotted in the order of their magnitude, in succession between these lines, the first would stand between 0° and 1°, the second between 1° and 2°, and so on. Now we see from the Table that the second measurement was just short of 30 inches, consequently the third measurement was presumably just beyond it, therefore the abscissa whose value is 2°, and which separates the second from the third measurement, may fairly be taken to represent the abscissa of the ordinate that is equal to 30 inches exactly. Similarly, the abscissa whose value is 10° divides the measurement that is just under 31 inches from that which is presumably just above it, and may be taken as the abscissa to that ordinate whose precise value is 31°, and so on for the rest. The fourth line of the Table gives the ordinates thus determined for the abscissæ whose values are entered above them in the third line. I dotted the values of these ordinates in their right places on the sectional paper, and joined the dots with a line, which in every case, except the breathing capacity, fell into a strikingly regular curve. (I cannot account for this one partial exception, save on the supposition of the somewhat irre-

gular mixture of town and country folk, and of sedentary and active professions among the persons measured, but I have not yet verified this surmise.) Per-centiles were then drawn to the curve corresponding to abscissæ that were respectively 5 per cent., 10 per cent., 20 per cent., &c., of the length of the base line. As the length of the base-line was 275, these per-centiles stood at the graduations 13°·8, 27°·5, 55°·0, &c. Their values, as read off on the sectional paper, are those which I have given in the Table.

It will be understood after a little reflection that the 9th rank in a row of 10, the 90th rank in a row of 100, and the 900th rank in a row of 1000, are not identical, and that none of them are identical with the 90th per-centile. There must always be the difference of one half-place between the post which each person occupies in a row of n individuals, numbered from 1 to n, and that of the corresponding graduations of the base on which they stand, and which bear the same nominal value, because the graduations are numbered from 0 to n and begin at a point one half-place short of the first man, and end at one half-place beyond the last man. Consequently the graduations corresponding to the posts of the 9th, 90th, and 900th man in the above example, refer to the distance of those posts from the beginning at 0 of their several base lines, and those distances are related to the lengths of the base lines in the proportions of 8·5 : 10, 89·5 : 100, and 899·5 : 1000, which when reckoned in per-cents of the several base lines are 85, 89·5, and 89·95 respectively. The larger the number of places in the series, the more insignificant does this half-place become. Moreover, the intrusion of each fresh observation into the series separates its neighbours by almost double that amount, and propagates a disturbance that reaches to either end, though it is diminished to almost nothing by the time it has arrived there. We may therefore ignore the existence of this theoretically troublesome half-place in our ordinary statistical work.

There is a latent source of error that might affect such statistics as these, as well as many others that are drawn up in the usual way, which has not, so far as I know, been recognised, and deserves attention. It is due to uncertainty as to the precise meaning of such headings as 30–, 31–, &c. If the measurements, no matter whether they were made carefully or carelessly, are read off from the instruments with great nicety, then a reading such as 30·99 would fall in the column 30–, and the mean of all the entries in such a column might fairly be referred to a mean value of 30·5.

But if the instruments are roughly read, say, to the nearest half inch, the reading of a real instrumental value of 30·99, and even that of a real value of 30·76, would both be entered in the column 31–. The column 30– would then contain measurements whose real instrumental values ranged between 29·75 and 30·75, and the column 31– would contain those that ranged between 30·75 and 31·75; consequently, the means of all the entries in those columns respectively should be referred, not to 30·5 and 31·5, but to 30·25 and to 31·25. An error of a quarter of an inch in the final results might easily be occasioned by the neglect to note the degree of minuteness with which the instruments were read, and I strongly suspect that many statistical tables are affected by this generally unrecognised cause of error. The measurements at my laboratory were read to the nearest tenth of an inch and to a fraction of a pound, so I can afford to disregard this consideration. There was, however, a slight bias in favour of entering round numbers, which should have been, but were not (because I neglected to give the necessary instructions), rateably divided between the columns on either side.

A fuller description of the results of the measurements at the laboratory will appear next February or March in the forthcoming number of the *Journal* of the Anthropological Institute, at which place the original data will ultimately be deposited.

FRANCIS GALTON

NOTES

IT having become known to some of the friends of the late Mr. Henry Watts, the well-known chemist, whose death occurred very suddenly on the 30th of last June, that his widow and family are in very straitened circumstances, an informal meeting was recently held at the Royal Institution. Those present resolved to form themselves into a committee, with power to add to their number, in order to collect a fund for the benefit of Mrs. Watts and those of her children who are not of an age to provide for their own support. Dr. Atkinson consented to act as secretary, and Dr. Perkin, President of the Chemical Society, as treasurer. Among the names on the committee are those of Sir F. A. Abel, Prof. H. E. Armstrong, Mr. William Crookes, Dr. Warren De La Rue, Prof. James Dewar, Prof. G. C. Foster, Dr. J. H. Gladstone, Prof. A. G. V. Harcourt, Dr. Hugo Müller, Dr. William Odling, Dr. W. H. Perkin, Dr. B. W. Richardson, Prof. W. Chandler Roberts, Sir H. E. Roscoe, Dr. W. J. Russell and Prof. A. W. Williamson. Mr. Watts's public labours for the advancement of chemical science may be said to have begun with the translation of Gmelin's "Handbook of Chemistry," the admirable English edition of which was prepared and edited for the Cavendish Society by him. This work occupies eighteen large octavo volumes, of which the first appeared in 1849, and the last in 1871. A work scarcely, if at all, inferior to this in magnitude, and one which has perhaps been of even greater service to English chemists, both scientific and industrial, is Watts's great "Dictionary of Chemistry," which appeared from 1863 to 1881, in eight volumes, containing altogether nearly 9700 pages. Mr. Watts also edited and largely added to the second volume of the late Prof. Graham's "Elements of Chemistry," published in 1858; he prepared several editions of Fownes's well-known "Manual of Chemistry," which he almost entirely re-wrote and made into virtually a new work; and in conjunction with Mr. Ronalds and Dr. Richardson, he prepared for Messrs. Baillière an elaborate treatise on chemical technology. Up to the time of his death, and for about thirty years previously, Mr. Watts was editor of the *Journal* of the Chemical Society, and in this capacity, as well as in that of librarian to the Chemical Society, he became personally known to and gained the friendship of very many among the Fellows of the Society. But although Mr. Watts's life was one of unremitting labour, the money return for his work was barely sufficient to enable him to provide for the daily wants of a delicate wife and a numerous family. It was not possible for him to provide for their future needs. But if he could not leave behind him pecuniary resources, he accumulated esteem and affection among all who knew him, which, it is confidently hoped, will prove a valuable legacy for those who were dependent on him. The facts of the case show that there is great need of whatever practical proof of their regard for him and appreciation of his labours Mr. Watts's friends, and English chemists generally, may be willing to make. For many years Mrs. Watts has been in ill-health, so that she cannot do anything for her own support and that of her family. One son is a permanent invalid, and the four youngest children have still to be educated. A considerable expenditure is therefore unavoidable for a good many years to come, if the children are to have a fair chance of a start in life. A considerable sum has already been promised in the way of subscriptions, but much more will have to be done in order that any substantial benefit may accrue to Mrs. Watts and her young family. Subscriptions will be received and acknowledged