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Consistent Set of Running Times

In earlier papers (*1, 2*) it has been shown that a logarithmic relationship exists between various types of racing events. It was pointed out that a consequence of the linear log-log relationship between distance and time was a linear correspondence between the log of the average rate for a given distance and the log of the distance. This phenomenon applies not only to running events but to all types of racing—for example, walking, swimming, bicycle racing, and horse racing. The slope of the latter plot was defined as an "exhaustion constant" since it is a measure of how the average rates decrease with distance. The present communication shows how the log rate-log distance plot can be used to derive a consistent set of running times based on the best efforts to date.

When $\bar{r}$ (the average rate for a given distance) is plotted against the distance d, as has been done previously (*1, 2*), it is very difficult to decide which records are actually "best efforts," for the exact shape of the curve through the points has not been determined. However, this difficulty is removed when log $\bar{r}$ is plotted against log d. Since this plot must be linear (*2*) it is easy to determine which records are not consistent with the "best efforts," for all "best efforts" must fall in a straight line, and all other records below. To determine the times in which all records below the line should be performed to put them on the line it is necesary merely to divide the distance by the rate on the line.

In order to prepare a table of consistent times for running events, a plot of log $\bar{r}$ versus log d was made for all the world records. The plot was divided into two parts for convenience, one plot for the records for distances up to 1 mile and another for the records from 1 mile to the 2-hour run.

Table 1 presents a set of times for running events that has been derived from the linear log $\bar{r}$ versus log d plots. The 100-yard and 100-meter events have not been considered because of the strong effect of the start on these events which causes a considerable deviation from the straight-line function. It is obvious that the 220-yard, 1-mile, and 1-hour records are all equivalent performances and "best efforts," and that all other records need improvement to make them consistent.

Table 1. Consistent times for running events.

Distance	Time (hr: min: sec)	Consistent time (hr: min: sec)	Δt (sec)	Δt for present Olympic records (sec)
220 yd	0:0:20.1	0:0:20.1	0	
440 yd	0:0:46.0	0:0:45.8	0.2	
880 yd	0:1:48.6	0:1:44.5	4.1	
1 mi	0:3:58.0	0:3:58.0	0	
2 mi	0:8:40.4	0:8:22.1	18.3	
3 mi	0:13:14.2	0:12:57.6	16.6	
6 mi	0:27:59.2	0:27:19.8	39.4	
10 mi	0:48:12.0	0:47:23.3	48.7	
15 mi	1:16:26.4	1:13:22.4	184.0	
200 m	0:0:20.2	0:0:20.0	0.2	0.7
400 m	0:0:45.8	0:0:45.5	0.3	0.4
800 m	0:1:46.6	0:1:43.7	2.9	5.5
1,000 m	0:2:19.5	0:2:15.3	4.2	
1,500 m	0:3:41.8	0:3:39.1	2.7	6.1
2,000 m	0:5:07.0	0:5:01.0	6.0	
3,000 m	0:7:58.8	0:7:45.8	13.0	
5,000 m	0:13:40.6	0:13:27.3	13.3	38.7
10,000 m	0:28:54.2	0:28:24.3	29.9	52.7
15,000 m	0:44:54.6	0:43:43.2	71.4	
20,000 m	0:59:51.7	0:59:51.5	0.2	
25,000 m	1:16:34.6	1:16:11.9	22.7	
30,000 m	1:35:23.8	1:32:40.7	163.1	
12 mi, 809 yd	1 hr	1 hr	12 mi, 809 yd*	
22 mi, 418 yd	2 hr	2 hr	23 mi, 1373 yd*	

* Consistent distance.

The amount of improvement necessary (Δt) is indicated in column 4 of Table 1. The last column of Table 1 shows the amounts (Δt) by which the present Olympic records can be bettered to bring them into line with the best efforts to date.

It should be strongly emphasized that the rates which fall on the straight-line plots are in no sense "ultimates." The rates will be increased by better training methods, better nutrition, and improved tracks and equipment. However, the underlying logarithmic relationships will be maintained so that at any time it will be possible to show which records are out of line when compared with the best efforts.

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Comparison of Pinch-Caliper and X-ray Measurements of Skin plus Subcutaneous Fat

Although numerous studies of subcutaneous fat have appeared, only one previous report has dealt with the relationship between its roentgenogrammetric measurement and its measurement by spring-loaded pinch calipers in males (*1*).

In the present study (*2*) the thickness of the fat-plus-skin layer, at the level of the lowest rib at the midaxillary line, was measured by both techniques. Pinch-calipers exerting a force of 300 g over a 30 mm² area (*3*) were used to measure a double "fatfold," while measurements of the single-thickness shadow were made on standardized teleoroentgenograms (*4*).

Agreement between the two methods was high ($r = 0.88$) for 65 young men aged 21 to 22 years, thus confirming Baker's findings for thigh and arm fat (*1*). The median pinch-caliper value was 12.0 mm, while the median roentgenogrammetric measurement was 9.3 mm. On this basis, the actual pinch-caliper values were 65 percent of the true double-fold thickness (18.6 mm).

The possibility that the skinfolds were reduced 35 percent throughout the entire range was tested by comparing the distribution of pinch-caliper values to the roentgenogrammetrically determined values multiplied by 1.3. Using the Kolmogorov-Smirnov test (*5*), the two distributions were not significantly different at the 5-percent level (Fig. 1).

The two methods of measuring skin

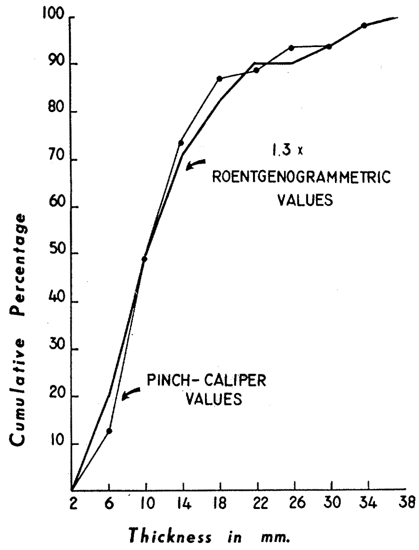

Fig. 1. Comparative cumulative frequency distributions of pinch-caliper thicknesses (dotted line) and roentgenogrammetrically determined thicknesses (heavy line). Since the roentgenogrammetric values multiplied by 1.3 are in close agreement with the pinch-caliper values, it is likely that reduction of the true values by compression is a constant 35 percent.

plus subcutaneous fat thus agree well at this particular site. Percentage compression appears to be constant over the full range of pinch-caliper values obtained (*6*).

Note added in proof: Correlations ranging between 0.8 and 0.9 were obtained by W. H. Hammond (*7*) for boys and girls of unspecified age.

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Chamber for Microelectrode Studies in the Cerebral Cortex

One of the problems encountered in recording action potentials from single cells in the cerebral cortex is the prevention of undesired movements of the exposed cortex. These movements, chiefly of cardiac and respiratory origin, are large enough to cause significant displacements of a cortical nerve cell relative to a fixed microelectrode tip, and they make it difficult to record the activity of the cell for extended periods of time. Thus, some method is needed for immobilizing the exposed cortex when a microelectrode is in the cortical tissue. It has been known for a long time (*1*) that the cortical pulsations become negligible if volume changes of the exposed brain are prevented by sealing over the opening in the skull with a rigid cover, such as a glass window, and filling the space underneath with liquid. A chamber formed in this manner would be useful for extracellular or intracellular recording if a microelectrode could be brought inside the enclosure through a movable liquid-tight joint.

Li and Jasper have employed this principle for microelectrode recording in the cortex (*2*). They used a chamber with which the microelectrode could be located over a single spot on the cortex and with which the depth of insertion into the cortical tissue could be controlled by a separately mounted micromanipulator.

A somewhat different approach has been adopted in the chamber described here, which is a modification of one used for the study of oxygen gradients at the cortical surface (*3*). In this chamber, as shown in Fig. 1, a small micrometer drive for controlling the depth of insertion of the electrode is directly mounted on the glass window, which is movable. Thus the electrode, which is mounted in the shaft of the microdrive (*4*), may be located over any desired point on the exposed cortex, without opening the chamber, by sliding the window manually. The mode of attachment of the microdrive also gives more stability than would be obtained if its mounting were independent of the skull.

Although it is designed for electrophysiological work on the cortex, the chamber employs a novel form of microdrive that would be useful in many other situations. The rigid attachment of the micrometer to a movable glass plate allows micromanipulations to be performed with good visibility and mechanical stability inside a completely closed chamber. This would be useful, for example, in such fields as chick-embryo work (with shell intact), tissue-culture work in general, or in physics and engineering where micromanipulations in vacuum chambers are necessary.

As Fig. 1 shows, the wall of the chamber consists of a Plexiglas ring attached to the skull around a ½ in. trephine hole by means of a dental impression compound. The ring is ⅜ in. high, a height sufficient to permit observation of the microelectrode tip with a dissecting microscope at as small an inclination from the vertical as practicable. Two side tubes, normally closed, serve for introducing either a 0.9-percent NaCl solution or paraffin oil. The window, which forms the top of the chamber, is a circular glass disk 1¼ in. in diameter; it is made from a microscope slide and has a hole in its center for mounting the microdrive. A two-pronged spring fork serves to keep the disk pressed against the Plexiglas ring. The prongs of the fork are not attached to the microdrive, but they touch the disk at points over the ring. Leakage at the joint between the glass and the machined surface of the ring was prevented by melting a thin layer of the dental impression compound to the top of the ring and molding it flat with a hot, wet microscope slide. The window could still be moved, but it was leakproof.

The microdrive is made entirely of stainless steel, with the exception of the setscrew and key. For those parts that are in contact with the liquid in the chamber, it is preferable to use 18-8 SMO stainless (*5*). The barrel is sealed to the glass disk with DeKhotinsky cement and is secured mechanically with a nut. The shaft is made of 18-gage stainless steel hypodermic tubing; it fits closely into the barrel, forming a bearing with a nominal clearance of 0.0001 in. The bearing is made liquid-tight by a lubricant with a viscosity that is intermediate between that of Vaseline and beeswax.

The advancement of the shaft is indicated by a lower pointer, which shows the number of turns of the thimble, and an upper pointer, which indicates fractions of a turn. The pitch of the thread on the barrel is 1/64 in. The lower end of the thimble has four longitudinal slots for adjusting thread tension in order to

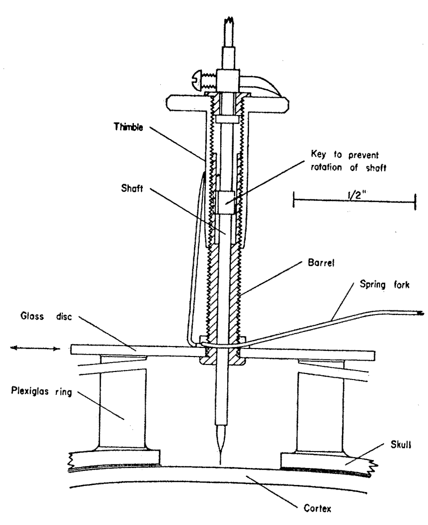

Fig. 1. Cortical chamber with attached microdrive.