

Animated Essays

for Human Biologists and Health Professionals

A conceptually based animated essay series to instruct, involve and inspire computer users.



ISBN 1-894351-02-9
© No. 491478 Canada
Rosscraft Innovations Inc.

© ROSSCRAFT / TeP Surrey BC Canada 2003
www.rosscraftreferencelibrary.com

Human Variability
Status & Change
Body Composition
Allometry & Dimensionality
Energetics
BMI: conspiracy of ignorance
Iconometrographics
The Phantom Nose
Iconologics
Craig's Quotes

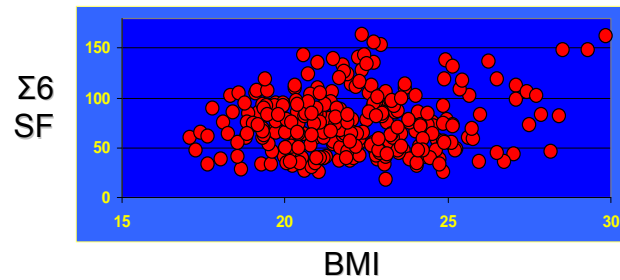
A compendium
of what's what
and why . . .



BMI: A Conspiracy of Ignorance

An Animated Essay for Human Biologists & Health Professionals

William D Ross



BMI prediction of sum of skinfolds and other myths.

© ROSSCRAFT / TeP Surrey BC Canada 2003

ISBN 1-894351-02-9 © No. 491478 Canada

www.rosscraftreferencelibrary.com

BMI: A Conspiracy of ignorance

A shareware sampler to encourage
copying and attribution by independent
“netizens”

Any net citizen anywhere.

Editor <rosscraft@shaw.ca>

BMI: Body Mass Index

a critique of its use in human biology
and the health professions.

A wry presentation based on a paper by

WD Ross and OG Eiben

Children and Youth at the Beginning of the 21st Century
7th International Symposium on Human Biology

Köszeg, Hungary

25-28 April 2001



1974 Altair 8800: a new scientific era

Year One PC*

- 100 years after the death of Adolph Quetelet. First personal computer entered the market.
- Phantom Stratagem Altair 8800: no operating system, no keyboard, mouse, or monitor
- Richard Nixon resigns and Gerald Ford becomes President. Only 256 bytes memory. It was programmed with switches and toggles.
- West Germany wins Football World Cup for the second time. Results were read from on and off lights on a binary board.

***1974 AD**



Commemorative stamp 100th anniversary of death of Adolph Quetelet (1796-1874)

RECHERCHES
 SUR
LE POIDS DE L'HOMME
 AUX DIFFÉRENS AGES,

PRÉSENTÉES

A LA SOCIÉTÉ DE MÉDECINE DE BRUXELLES LE 20 JANVIER 1842.

PAR A. QUETELET,

MEMBRE DE L'ACADÉMIE ROYALE DE MÉDECINE DE BRUXELLES, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE LIÈGE, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE GAND, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE BRUXELLES, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE LILLE, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE BORDEAUX, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE NANTES, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE STRASBOURG, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE TOULOUSE, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE LYON, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE MONTPELLIER, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE NÎMES, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE PERPIGNAN, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE TARASCON, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE VALENCE, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE GRENOBLE, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE DIJON, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE BESANCON, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE LYONS, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE SAINT-ÉTIENNE, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE CLERMONT-FERRAND, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE LIMOGES, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE ANGERS, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE TOURS, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE NANTES, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE RENNES, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE CAEN, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE NANCY, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE METZ, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE STRASBOURG, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE COLMAR, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE MULHOUSE, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE BESANCON, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE DIJON, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE YVERDON, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE GENEVE, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE LAUSANNE, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE BÂLE, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE BASEL-LEST, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE BASEL-OUEST, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE BERNE, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE Fribourg, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE GENEVE, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE LAUSANNE, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE NICHOLS, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE SION, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE YVERDON, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE GENEVE, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE LAUSANNE, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE NICHOLS, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE SION, DE LA SOCIÉTÉ ROYALE DE MÉDECINE DE YVERDON.



BRUXELLES,
 M. HAYEZ, IMPRIMERIE DE L'ACADÉMIE ROYALE.
 1842.

Quetelet, 175 years before 2008

7° Après le développement complet des individus des deux sexes, les poids sont à peu près comme les carrés des tailles.

In adult males and females weight is nearly the square of height

Quetelet, A., Recherches sur Le Poids de L'Homme Aux Différens Ages, présentées a la séane du 5 Mai et lues dans la séance du 3 Juin 1832, L'Académie Royale, Bruxelles, 1833

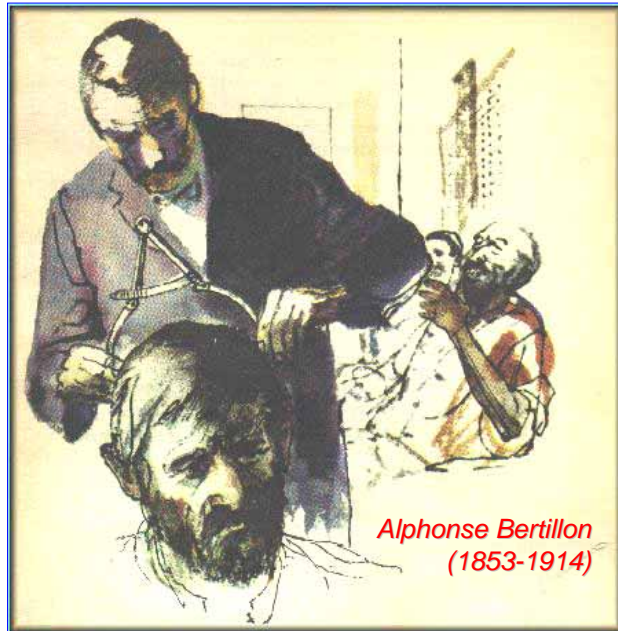
Assumption & leap of faith

$$\text{If, } [W] = H^2$$

The assumption is that dividing W by H^2 yields a ponderosity index and that this is a function of the relative fatness of the individual.

Quetelet absolved

- Quite the opposite, Quetelet recognized the uniqueness of human physique and inspired Alphonse Bertillon (1853-1914) to develop a criminal identification system based on the principle that no two individuals were alike.
- Quetelet never made this assumption. This is a contemporary perception.

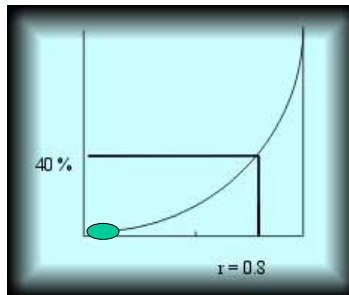


*Alphonse Bertillon
(1853-1914)*

There may be some matching

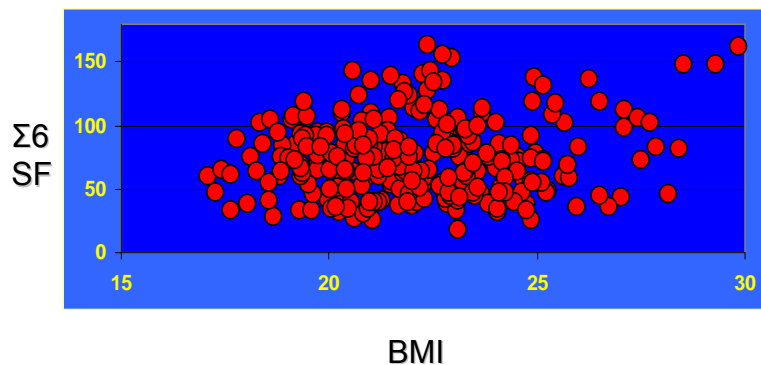
- However, the human physique is as individualistic as one's finger prints.
- Finger printing, replaced Bertillonage, and this is giving way to DNA profiling.
- The principle of individual uniqueness has never been repudiated (*except by those who make unwarranted assumptions of convenience*)

Panic button for BMI advocates



The predictive index for $r = .80$ is only 40 % better than pure chance. BMI correlations with the sum of skinfolds are less than 15% . ● Much lower and mostly trivial with other health risk factors.

BMI (x) Sum of 6 Skinfolds (y) 215 males and 175 females

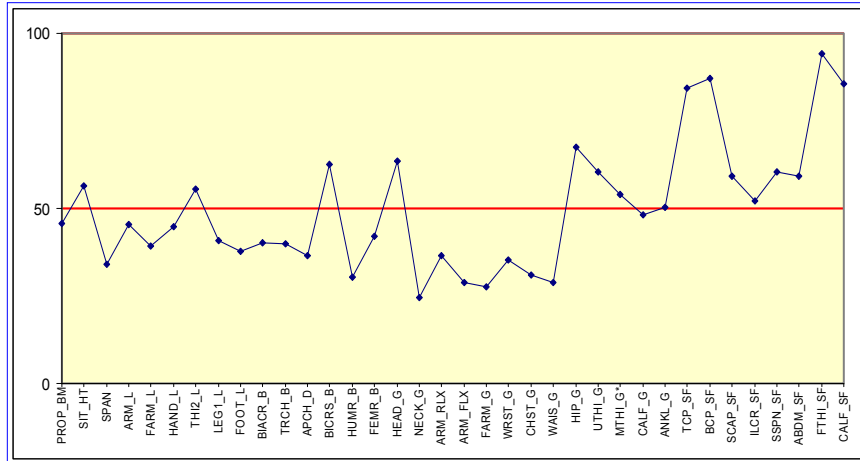


Predictability? Nonsense!

Systematic gender difference

- This interactive in the Excel Charts but not in the PDF version on the next slide.
- From PPT presentation mode. Press ESC to get to the Excel construction mode.
- When activated, and click on any point in the series.
- e.g. Series 1 Point "PROP_BM" Value 46
(female is proportionally lighter than the male Value 50)

Sexual dimorphism in aquatic sport, 455 female and 464 male competitors in the 1991 World Championships, Perth, Australia (Carter & Ackland 1994)



50 proportionally identical, > 50 female females larger, < 50 they are smaller.

Non-overlapping standard errors



Significance: General Formula

$$\text{IF}((M1-M2) \geq (se1+se2), "+",$$
$$\text{IF}((M2-M1) \geq (se1+se1), "-", ""))$$

F proportionally > M

Sitting Height	Triceps sf
Biiliocrisal Breadth	Biceps sf
Hip Girth	Subscapular sf
Head Girth	Abdominal sf
Upper Thigh Girth	Front Thigh sf
Medial Calf Girth n/s	Medial Calf sf
Ankle Girth n/s	

M proportionally > F

Body mass	AP Chest Depth
Span	Humerus Breadth
Arm Length	Femur Breadth
Forearm Length	Neck Girth
Hand Length	Arm Girth
Leg Length	Forearm Girth
Foot Length	Wrist Girth
Biacromial Breadth	Waist Girth
Trans Chest B	Ankle Girth n/s

Common Scale for Men and Women

- This is a mathematical artifact.
 - One should not combine samples that differ allometrically with size.
- “Even when two million people believe a stupid thing, it still is a stupid thing”***

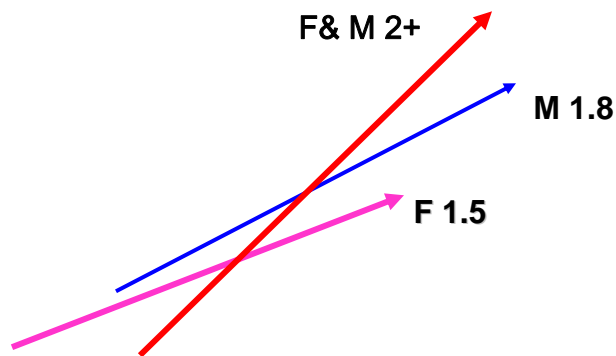
Bailey et al YMCA LIFE 1981

Yrs	nM	nF	nM&f	bM	bF	bM&F
20	1028	1279	2307	1.92	1.66	2.46
25	1871	1365	3236	1.76	1.68	2.61
30	2355	1084	3439	1.77	1.73	2.64
35	1857	718	2575	1.59	1.54	2.51
40	1476	635	2111	1.97	1.47	2.54
45	1370	494	1864	1.91	1.48	2.42
50	1041	433	1474	1.67	1.37	2.31
55	715	304	1019	1.62	1.50	2.25
60	332	178	509	1.61	1.60	2.15
65	147	-	147	1.46	-	-
20-70	12191	6490	18681	1.74	1.52	2.14

Canada Fitness Survey 1981

Yrs	nM	nF	nM&f	bM	bF	bM&F
20	819	873	1692	1.82	1.70	2.42
25	820	899	1719	1.82	1.32	2.36
30	756	858	1614	2.06	1.73	2.41
35	652	708	1360	1.89	1.68	2.38
40	477	515	992	1.79	1.27	2.19
45	412	482	894	1.87	1.75	2.24
50	349	421	770	2.02	1.38	2.04
55	299	396	695	1.60	1.42	1.73
60	247	296	543	1.98	1.58	1.92
65	208	238	446	1.63	1.14	1.88
20-70	5039	5686	10725	1.73	1.31	2.14

Combining exponents that differ allometrically with size



Illustrative, not to scale

Sad but true

The log-log exponent, in the combined sample of men and women, does not represent the true relationship in either sub-sample.

Weeds in professional bouquets?

“The same cut off points for the Body Mass Index, Wt (kg)/ Ht^2 (m), are appropriate for both men and women 20 to 65 years of age.”

Report of an Expert Group, convened by the Health Promotion Directorate, Health Services and Promotion Branch. Health and Welfare Canada, Santé et Bien-être Social Canada 1988.

Estimated Muscle, Bone, Fat

- **MUSCLE** – Sum skinfold corrected girths (arm girth minus triceps skinfold and calf girth minus medial calf skinfold).
- **BONE** – Sum humerus and femur breadths
- **FAT** – Sum skinfolds (triceps, biceps, subscapular, supraspinale, and medial calf)

Prediction better than chance

- In the YMCA LIFE sample of 12,282 men and 6,693 women, age 20 to 70 years, the predictive indices for muscle, bone and fat were 18.5, 14.0 and 13.6 percents.
- The BMI was more a function of muscle and bone mass than fatness.
- None of the relationships were remotely high enough for individual prediction.

$$PI = 100 * (1 - ((1 - r^2)^{0.5}))$$

Gross misclassification

In the combined sample, 26% of those rated extremely lean (BMI < 20), had skinfold totals above the 50th percentile. At the other end of the continuum, 16% of those rated fat (BMI > 27) had skinfold totals that were below the 50th percentile.

Ross et al. 1988

Commonsense

Let us consider two subjects a male and female, 170 cm tall, both having a BMI 27, i.e. body mass 78 kg. It is ludicrous to conclude they would have the same level of adiposity and health risk. Indeed, for each increment in stature, there is about a 4.5 kg sexual dimorphic difference in body mass

It should be obvious

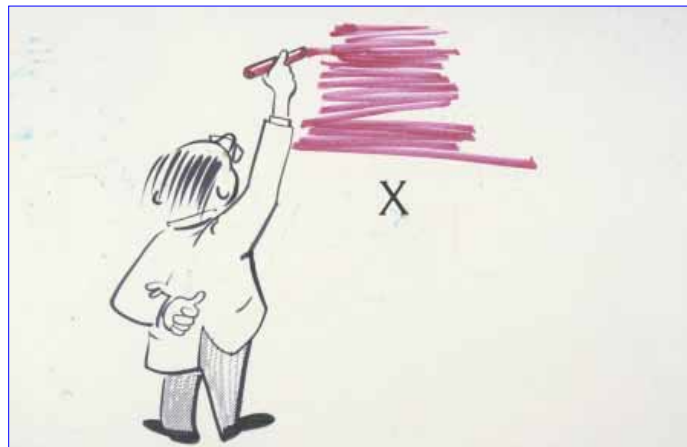
Two hundred men and women the same height and weight, young and old, fit and unfit have the same BMI. They do not have the same level of adiposity and health risk.

Durnin (1985)

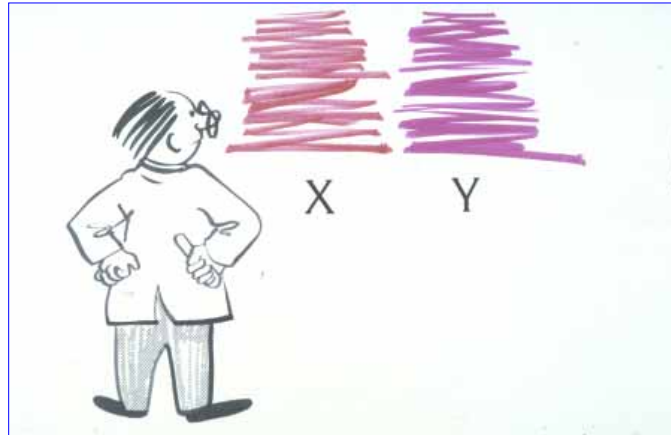
Ratios

- Ratios are neither as simple or as informative as they seem.
- Let's look at some embarrassing facts condemning BMI for use as an index of adiposity to ascribe an ideal body weight.

Variability of X



Variance of X and Y



Ratio mixing variance



Dominated by the variable with greatest variance

Correlation of ratios



Correlation coefficient itself is a variance ratio

Multi-variate analysis



*Suicide from inextricable
spurious relationships*

Variance and the BMI

- Coefficient of variation
 - body mass is 12%
 - height is 4%
- Ratio of variance of weight to height is 9:1

BMI contrives evidence based on an erroneous assumption of biological constancy

BMI must be valid

- BMI correlates highly with body density that is the "gold standard" for estimation of percent body fat.
- Indeed, there is overwhelming confirmation in the literature?

Amazing isn't it?

We refute the two compartment model assumptions, but NOT that:

Density (M/V), correlates highly with the BMI (M/H^2)

Let's get a grant or write a doctoral dissertation to prove conclusively that Body Mass correlates highly with itself.

“Mit diesem Trank im Leibe sieht man eine Helena in jedem Weibe”

The BMI has perhaps become the Mephistophelian drink where, with this drink in the belly, one sees the face of Helen of Troy in every woman. Its use is pervasive. Critics rare. A recent 2008 search of Pub Med, a service of the National Library of Medicine, revealed 23,900,900 citations of the BMI. /

Epigrams

- Epidemiology n. A methodology in which randomly-occurring statistical associations are elevated to a cause-and-effect status (Milloy, 1995)
- 66% of all the heavyweight world boxing champions since John L Sullivan had BMI's greater than 27 when they were lean and mean and won the title.

The world turns, heedlessly

- Tanner JM (1949)** Fallacy of per-weight and per-surface area standards and their relation to spurious correlation. J Appl Physiol 2: 1-15.
- Packard GC and Boardman TJ (1988)** The misuse of ratios, indices and percentages in ecophysiological research. Physiol Zool 61: 1-9.

They were right then and now.

What is the health risk of dieting to some individually inappropriate BMI level?

Loss of muscle mass and bone mineral content?

FRAGILITY
OSTEOPOROSIS

Cited Literature

Ackland, TR and Carter, JEL (1994) Kinanthropometry in Aquatic Sports: Champaign, IL: Human Kinetics.

Bailey DA (1968) The Saskatchewan Growth and Development Studies. Saskatoon: University of Saskatchewan.

Boxing: <http://www.ibhof.com/ibhftape.htm>

Gould, SJ (1981) The Mismeasure of Man. New York: WW Norton.

Health and Welfare Canada (1988b) Canadian guidelines for healthy weights. Minister of Supply and Services Canada, Cat No H39-134/1988E.

Health and Welfare Canada (1991) Report of the Task Force on the Treatment of Obesity. Minister of Supply and Services Canada, Cat No H39-201/1991E.

Keys A, Fidanza F, Karvonen MJ, Mirmura M and Taylor HL (1972) Indices of relative weight and obesity. *J Chron Dis* 25: 429-343.

Koestler A. (1964) *The Act of Creation*. London, Hutchinson.

Martin R (1928) *Lehrbuch der Anthropologie* (3 Volumes). Jena: Gustav Fischer.

Milloy SJ (1995) *Science Without Sense*, Washington DC: Cato Institute.

Packard GC and Boardman TJ (1987) The misuse of ratios to scale physiological data that vary allometrically with body size. In: ME Feder, AF Bennett, WW Burggren and RB Huey (eds) *New Directions in Ecological Physiology*, Cambridge: Cambridge University Press, 216-239.

Packard GC and Boardman TJ (1988) The misuse of ratios, indices and percentages in ecophysiological research. *Physiol Zool* 61: 1-9.

Quetelet, A (1833) *Recherches sur Le Poids de L'Homme Aux Différens Ages, présentées a la séane du 5 Mai et lues dans la séance du 3 Juin 1832, L'Académie Royale*, Bruxelles: M Hqyez, Imprimeur de l'Académie Royale.

Ross WD, Crawford DA, Kerr DA, Ward R, Bailey DA, Mirwald RM (1988) Relationship of the body mass index with skinfolds, girths, and bone breadths in Canadian men and women aged 20-70 years. *Am J Phys Anthropol* 77:169-173.

Ross WD (1996) Administrando o caos dados biológicos. *Arts Rev Fis Desp* 17:81-95.

Ross WD (1997) On combining samples that differ allometrically with size. *Rev Bras Med Esporte* 3 (4): 95-100.

Ross WD, Carr RV, Carter JEL (1999) *Anthropometry Illustrated*. Surrey: Turnpike Electronic Publications. CD.

Tanner JM (1949) Fallacy of per-weight and per-surface area standards and their relation to spurious correlation. *J Appl Physiol* 2: 1-15.

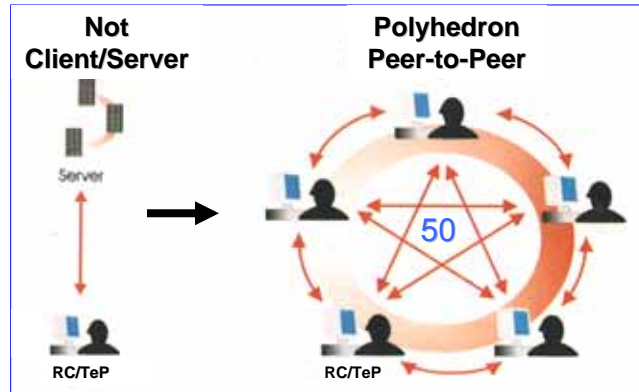
rosscraft@shaw.ca

The BMI is a travesty.

Gresham's Law, "Bad money ousts good", may be applied to researchers using the BMI to drive out the true scientists (those who look at the nature of things and the consequence of misjudgment in the conduct of human affairs).

PEER-TO-PEER: an awesome geometrical progression

50 → 2,500 → 6,250,000 → everyone



Polyhedron Organizational Plan

Our strength and versatility is from our mobile, many-sided, flexible, structure; our respect for our co-workers and our willingness to apprentice ourselves to one another. Our dedication to human biology and the health professions is serious business. This does not exclude humor, fun, laughter and good fellowship. The personal interaction among friends within the polyhedron is the catalyst for our individual growth and our collective power of accomplishment.

Mary L Ross, President

Anthropometry Illustrated

A browser based interactive textbook and learning system

WD Ross, PhD

RV Carr, PhD

JEL Carter, PhD

Featuring thousands of
Interactive Illustrations,
Graphs & Links



ISBN 1-894351-00-2
O No. 474007
Produced in Canada

Turnpike Electronic Publications Inc.
The Human Animal Series, Volume 1
tep2000@home.com

Anthropometry Fundamentals

PowerPoint Based Guide

WD Ross, RV Carr, JM Guelke, JEL Carter

Over the
shoulder
views

Explicit
images

Detailed
instructions




ISBN
1-894351-01-0
© 491386
2003
Canada

Rosscraft / Turnpike Electronic Publications
The Human Animal Series, Volume 2

rosscraft@shaw.ca

Quality starts with precise and accurate data.

Here is your own hard working on-the-job-all-the-time personal tutor or teaching assistant featuring: two hours of explicit over-the-shoulder views of locating landmarks, marking, positioning the subject, elegant use of tapes and callipers, transition from site to site, pinning, leveling and applying the right tension.




Visit us online at www.rosscraft.ca
Sales & Service at: rosscraft@afalamedia.ca


ANTHROPOMETRY TECHNIQUE

ROSSCRAFT
Innovations Incorporated

*Anthropometry
Technique*



A Menu Driven Instructional Movie
by RV Carr & WD Ross



Are you with us?



*We always have a place for talent
and dedication to excellence*

