MEASUREMENT NEWS

May | 1990 | Issue #41

BOB BAUMEL, puts the "Jones" counter on the wheel of his bicycle. Bicycles and the counter are used for determining the shortest possible distance a runner can cover road running courses. The course is measured several times and the data processed. Baumel has certified a number of courses in Oklahoma and the United States, plus overseeing certifiers in the western part of the nation. (News Photo by Louise Abercrombie)

Bob Baumel last appeared on our cover in November 1987. Since then he has become recognized as RRTC's deep thinker, having clarified several knotty problems, including tackling the effect of wind and slope on running performance. In this issue you'll find his most recent burst of creativity, as well as an article about him which appeared in his local paper.

MEASUREMENT NEWS

#41 - May 1990

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NEW APPOINTMENT

Michael Franke has been appointed TAC National Certifier for the state of Iowa. He has demonstrated great competence in the past and we are sure he will continue to do so as "Final Signatory."

LET'S KEEP OUR STANDARDS HIGH

Certificates - I see all the certificates that come to Joan for listing. The mapwork varies, as we would expect, with the better people doing the better work. However, we certifiers are all supposed to be good at what we do. You would not know this from looking at some certificates. A certificate is of little value if it cannot be read. Here are some suggestions:

1) Be sure your handwriting or printing is neat and legible. Don't scrawl out the certificate as fast as you can.

2) If your pen skips or writes poorly, buy a new one and use it.

3) Fill the space available. Don't write with little tiny letters.

4) Don't reduce text beyond the point of legibility.

The certificate is a reflection on you and RRTC. Others will judge us by the appearance of our work. Show you are proud of it by delivering to the measurer a first-class certificate.

Calculating Drop - Net drop is calculated between elevations of start and finish, NOT between the course's high and low elevations. This can be tricky, so check your work.

HOW WE DID IN 1989

The 1989 courses are all in, except for last-minute strays. Accordingly, here is a breakdown of how things went last year:

Most active certifier: Wayne Nicoll - 114 courses certified (101 last year)

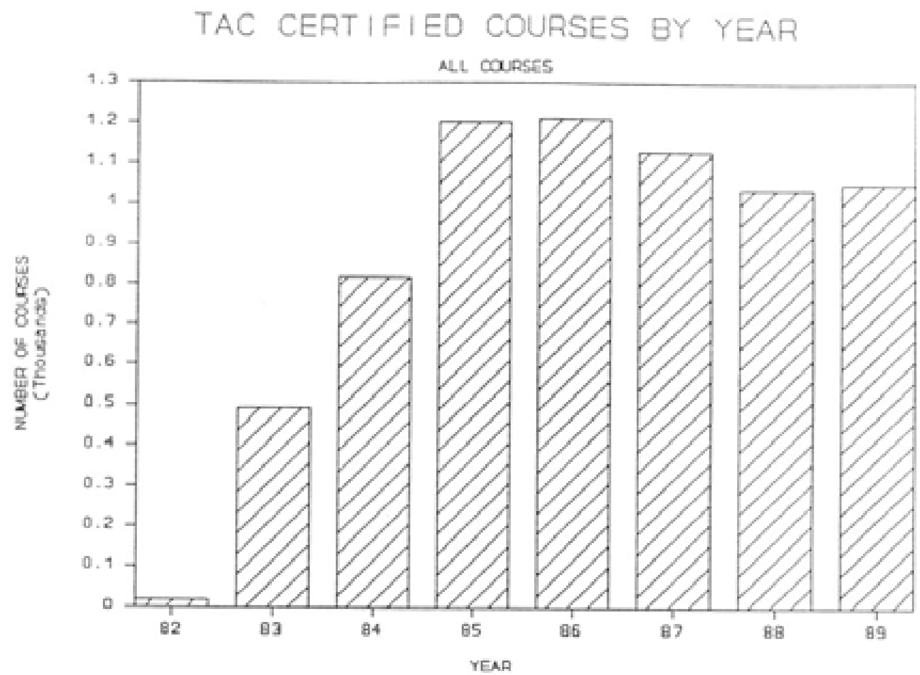
Most active measurer: A. C. Linnerud with 43 courses measured (42 last year)

Measurers active in 1989: 314 (292 last year)

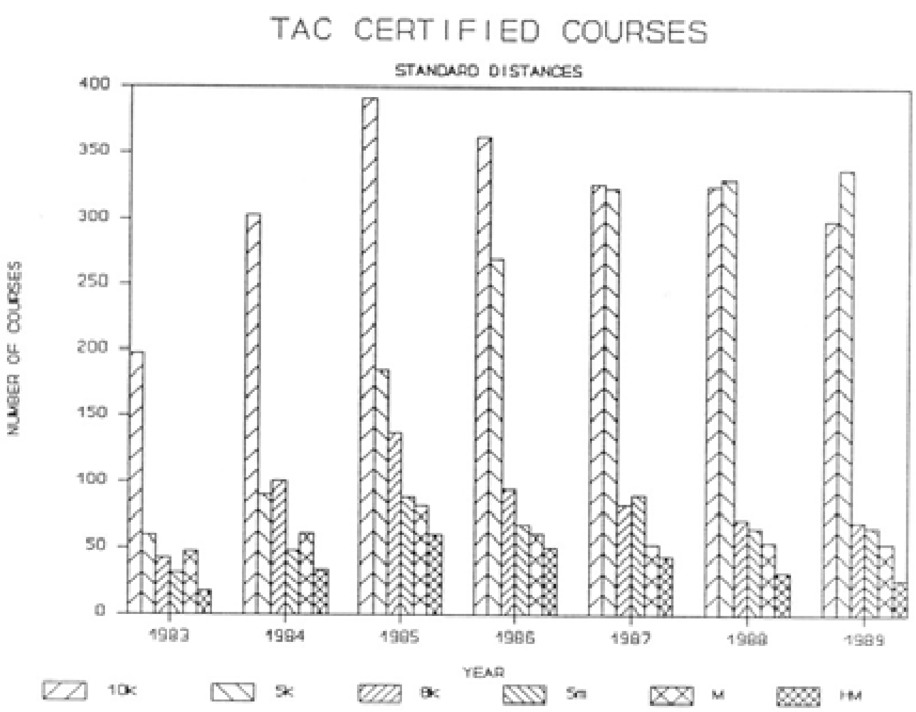
State with greatest number of active measurers: California, with 31

Courses certified in 1989: 1050 (1039 last year)

25 people measured 10 or more courses in 1989, accounting for half (517) of the courses certified this year



STANDARD DISTANCE TAC CERTIFIED COURSES	1983	1984	1985	1986	1987	1988	1989
10k	198	303	392	363	327	325	299
5k	59	91	185	270	324	330	338
8k	42	101	137	95	83	72	70
5M	31	48	89	68	91	65	66
Mar	47	61	82	61	53	55	54
HMar	17	34	60	51	44	32	26
total	394	638	945	908	922	879	853



COURSES CERTIFIED IN STATE IN 1989	
CA	122
TX	71
OH	64
FL	63
OK	50
IL	50
PA	48
NC	48
NY	44
SC	35
MA	34
NJ	33
WA	29
GA	27
CT	24
AL	23
CO	23
IA	20
KS	20
MN	18
MI	18
VA	17
DE	13
ME	12
NH	11
OR	10
AZ	10
NM	9
RI	9
TN	9
MO	8
IN	8
AR	8
MD	7
MS	7
UT	6
KY	6
LA	5
NE	5
AK	5
SD	4
VT	4
DC	4
WV	3
WI	2
ID	1
NV	1
HI	1
MT	1
SUM	1050

ACTIVE MEASURERS IN STATE IN 1989	
CA	31
NY	21
FL	21
TX	17
MA	13
OH	13
IL	12
SC	11
GA	10
IA	10
KS	9
WA	8
CT	8
PA	7
ME	7
VA	6
AR	6
AL	6
OR	6
MO	5
TN	5
NC	5
MI	5
CO	5
NJ	5
IN	4
MD	4
OK	4
NM	4
NE	4
MN	4
NH	4
SD	4
MS	3
LA	3
UT	3
AK	3
VT	3
DE	2
KY	2
WV	2
WI	2
HI	1
AZ	1
DC	1
MT	1
RI	1
ID	1
NV	1
	314

COURSES CERTIFIED BY CERTIFIERS IN 89	
WN	114
ETM	72
RS	61
PR	58
BB	55
RE	54
BH	54
CW	53
JW	50
ACL	50
DB	38
BS	31
AM	28
BG	28
MR	27
JD	23
DP	23
DR	22
RT	22
MW	21
SH	18
FC	18
RR	18
DL	16
GN	13
LB	13
JL	12
MF	11
DLP	8
TK	8
FH	6
BT	5
JS	5
FW	5
BN	3
DK	2
WG	2
KU	1
TF	1
KL	1
BC	1
	1050

MEASURERS WITH 10 OR MORE	
A Linnerud	43
G Lafarlette	42
M Courtney	38
W Nicoll	36
E McBrayer	35
D Brannen	32
R Scardera	26
J Knoedel	21
D White	21
C Wisser	19
D Standish	19
R Nelson	17
S Berglund	17
R Recker	16
R Thurston	15
F Shields	14
D Connolly	13
M Wickiser	13
J Wight	13
R Hickey	13
- GuidoBros	12
S Hubbard	11
B Harrison	11
F Cichocki	10
C Ensz	10
	517

Larger vs. Average Constant

by Bob Baumel

Since the publication of TAC's *Course Measurement Procedures* manual early in 1985, standard course layouts in the United States have used the "Larger Constant" method, where the "Constant for the Day" is *either* the Working constant or Finish constant, whichever is *larger*. In case you didn't know, I originated this idea in early 1984. As there is still debate on this subject internationally, I will discuss its history and the reasoning behind it.

Recently in standardizing its measurement procedures, the IAAF has adopted most of the same methods as TAC, **except** that they opted for the *Average* constant instead of the Larger constant in course layout. I will show in this essay that a system using the same procedures as TAC, but with average constant instead of larger constant, is logically inconsistent.

Background

When I proposed the larger constant idea in 1984, certification procedures had been massively overhauled during the previous two years. We realized that, for one reason or another, most courses measured previously were short. While acknowledging that all measurements are limited in accuracy, we resolved to do everything possible to ensure that courses would be *at least* the correct distance, thereby laying the foundation for genuine road-running *records* (as officially established by TAC in 1983).

At the time I became a certifier (1982), many US measurers used the average constant, although some made no quantitative use at all of their post-cal data; i.e., they just laid out a course using the Working constant, and then checked to see if the Finish constant was "close" to the Working constant. I know that nobody in Oklahoma made post-recalibration adjustments to the race course until I arrived on the scene. I introduced post-recalibration adjustments in Oklahoma when I became the certifier for that state in 1982.

Ironically, whereas all the *other* changes adopted around 1982–83 tended to make race courses longer, the introduction of post-recalibration adjustments usually made courses *shorter*! That's because most course measurements in Oklahoma (as well as most other places) are done early in the day, as temperatures increase. Thus, Finish constants are usually less than Working constants (so *Average* constants are usually less than Working constants).

The Problem

I found this situation disturbing. But it was just one aspect of a much bigger question: how to deal with errors resulting from large changes between the pre-cal and post-cal. Ideally, every potentially large source of error ought to be controlled. Variations between Working and Finish constants can certainly be large. (I've seen differences as great as 40 counts/km, making the measured length of the race course uncertain by about 4 m/km.)

The *Average* of the Working and Finish constants may be regarded (in the absence of additional information) as a "most likely" value for the true calibration while riding the race course. For an "average course measurement", it's probably a good accurate choice. But is it really the most accurate choice for *any particular* course measurement?

In real measurements, long delays often occur between the pre-calibration and the race course measurement, or between the race course measurement and the post-cal. Sometimes tires lose air between the pre-cal and post-cal (not always at a uniform rate). Often the race course measurement is not centered, either in time or temperature, between the pre-cal and post-cal.

One way to control errors due to calibration variation would be to define a maximum allowable difference between Working and Finish constants. In fact, in the early 80's, some certification authorities in Canada did impose such a limit (specifically 5 counts/km). In principle, this is a legitimate approach for limiting errors from calibration variation (while continuing to use the average constant). But is it workable and enforceable in practice?

Suppose that, at the end of a long day of measuring, you recalibrate and find that your Finish constant differs by 7 or 8 counts/km from your Working constant. Would you really throw out your whole day's measuring and start over? (Or might you be tempted to fudge your data instead of doing all the measurements over again?)

Clearly, we don't want a procedure that causes measurers to approach recalibration with dread (for fear that they might have to throw out a whole day's measuring). But how can we limit the damage caused by large calibration variations? I was troubled by this question ever since I became a certifier in 1982. The answer came to me in January 1984:

The Solution

If we are unwilling to limit the *actual amount* of error due to calibration variation, we can nevertheless limit the damage due to this type of error by pushing its effect *all to one side*. The true constant during riding of the race course is almost always *somewhere* in the range between the Working and Finish constants. If we define the Constant for the Day as the *Larger* of the Working and Finish constants, we can feel confident that we are not creating a short course, no matter where the true constant lies in this range.

The larger constant method is consistent with the other changes introduced into the certification procedures during that 1982-84 time frame. For example, we no longer average the two or more measurements of a race course; we simply pick the measurement that makes the course longer. Similarly, we no longer average the Working and Finish constants; we use *either* the Working or Finish constant, whichever produces the longer course.

For that majority of measurements performed early in the day as temperatures increase, use of the larger constant usually eliminates the need for post-recalibration adjustment. Measurements done late in the day do generally require final adjustment (lengthening) based on the Finish constant, making the course just as safe as one laid out in the morning.

How Much Extra Does it Add?

A scan of 148 measurements analyzed with my computer program during the past few years reveals a median difference between Working and Finish constants of 0.037% (about 3.5 counts/km). Using the larger (rather than average) constant lengthens the final laid-out course by only half this difference (typically less than 0.02% or 0.2 m/km).

The larger constant would not be worth much if it added only 0.02% to each course. But, unlike the standard 0.1% Short Course Prevention Factor, the larger constant is a "smart" safety factor intended to address one specific problem. Thus, it adds significant amounts only in those measurements that suffer from greater uncertainty because of large calibration variations.

For 50% of measurements, the larger constant adds less than 0.2 m/km. But for 10% of measurements, larger constant adds more than 0.5 m/km. These 10% are among the measurements we'd have to reject entirely if we limited the allowable calibration variation. Larger constant doesn't make these measurements any more accurate, but it makes them *acceptable* because we can feel confident that the error doesn't make the course short.

(Note: More than 30% of the 148 measurements in my data set actually had differences between Working and Finish constant exceeding 5 counts/km.)

The people who complain loudest about larger constant are often very skilled riders, who think they don't need so many safety factors. These measurers should understand that large calibration variations can afflict skilled riders just as readily as unskilled riders. The larger constant method protects us against a source of error that measurers have no control over.

What About Post-Race Measurements?

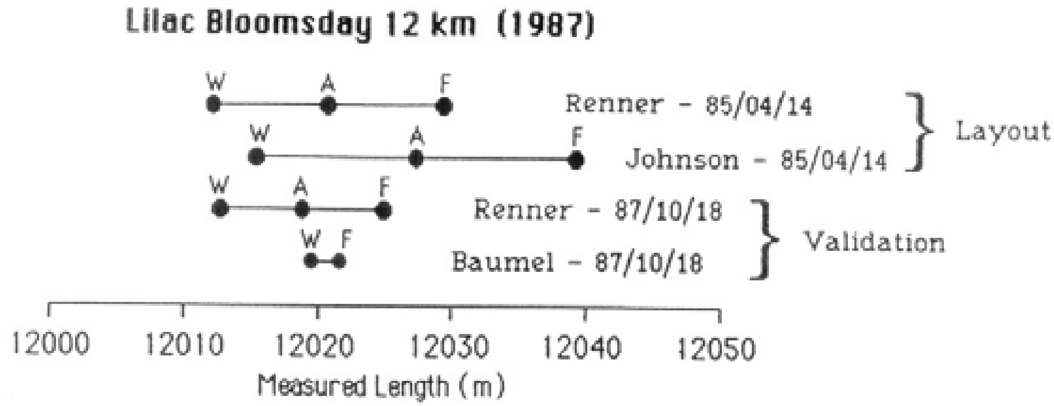
When I proposed the larger constant idea in 1984, Ken Young raised an objection that deserves some discussion. Ken generally liked the idea, as he had helped bring about most of the other changes during that 1982-1984 period (including the 0.1% factor and the principle of using the longer measurement instead of average measurement). But Ken didn't like the notion of having to use different official constants for pre-race and post-race measurements.

Ken was right that it wouldn't be proper to use larger constant for post-race measurement checks (i.e., validations), as this would unfairly increase the chance of finding courses short. So if we use larger constant in pre-race course layouts, we must use a different method in post-race validations.

It would be nice if, as Ken wished, we could use exactly the same methods for evaluating pre-race and post-race measurements. What makes this impractical is the fact that measurements are never exact, but always have some error. For this reason, and also because pre-race layout measurements and post-race validation measurements serve very different purposes, we must use different methods in evaluating these two types of measurements.

The purpose of a pre-race layout measurement is to generate a course that, with high probability, is at least the intended distance. The purpose of a post-race validation is simply to answer a yes/no question as to whether the course was acceptable for record purposes.

Actually, even if the results of pre-race and post-race measurements must ultimately be evaluated differently, nothing stops us from doing identical *calculations* for both types of measurements, so that we may compare them properly. The best method of doing this was devised by Tom Knight in 1983 and is known as the "Knight diagram." An example follows:



This diagram displays four measurements (two pre-race and two post-race). Each measurement is calculated three ways: by the Working constant (W), Average constant (A), and Finish constant (F). (I've omitted the "A" point when the "W" and "F" points are very close to each other.) As is customary in Knight diagrams, all distances are calculated *without* a 1.001 factor in the constant; thus, the 1.001 factor shows up explicitly in the measured distance (e.g., a 12 km course should measure at about 12012 meters).

Note: Knight's original version of the Knight diagram required the plotting of five points per measurement, but the present simplified version with just three points per measurement contains most of the same information.

The Knight diagram displays an "error bar" for each measurement, reflecting the fact that the true constant may be anywhere between the Working and Finish constant. (The left edge of the error bar is the distance calculated by *larger* constant; the right edge is the distance calculated by *smaller* constant.) This error bar reflects only one source of error, namely calibration variation, so it does **not** account for other sources of inaccuracy such as riding errors. But the Knight diagram provides a handy side-by-side display for multiple measurements of a course—especially for measurements done by different people and/or on different days.

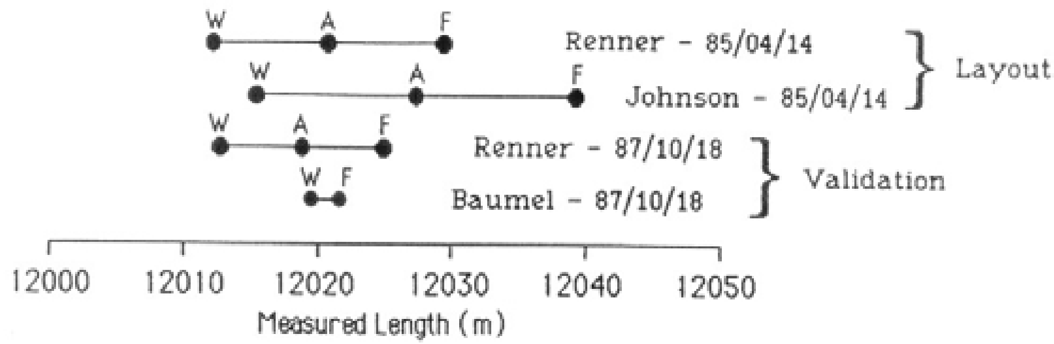
The larger constant method, for pre-race layout measurements, is easily visualized in terms of the Knight diagram: It simply consists of adjusting the race course so that the entire error bars for both layout measurements lie to the right of the intended race distance (× 1.001). Thus, in the above Lilac Bloomsday example, Mike Renner's "W" point (i.e., the left edge of his error bar) from his 85/04/14 measurement is at exactly 12012 meters.

The official validation result for this Lilac Bloomsday example was the "A" point of Baumel's measurement of 87/10/18 (since Baumel was the official validator, and validation measurements have conventionally been calculated by average constant). But no matter how we calculate the validation result, examination of all the error bars in the above Knight diagram indicates excellent agreement between the pre-race and post-race measurements.

An example that didn't work out as happily was the following:

properly. The best method of doing this was devised by Tom Knight in 1983 and is known as the "Knight diagram." An example follows:

Lilac Bloomsday 12 km (1987)



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An example that didn't work out as happily was the following:

AGE/SEX GRADING

Alan Jones

In the early days of road racing there was one set of awards -- for the first runners -- period. Females were not allowed in the races and there were almost no runners over 40 years of age. When masters runners were first recognized there were typically two classes of awards -- open and masters. If a masters runner won an award in the open class it was great. More power to him.

Then later we had masters, seniors, females, etc. As races grew in size we went from 10-year age-groups to 5-year age-groups. This was proper, particularly for the older classes, since the difference in ability between, say, a 51 year-old runner and a 59 year-old runner is much greater than between 30 and 39 year-old runners. At the same time that the number of age and sex classes was increasing we began to see the appearance of age-groups in the age span which had been considered "open." That is, we began to see 20-24, 25-29, and 30-34 age-groups. This didn't make any sense to me and still doesn't. We have a lot of data that shows there is very little difference between runners from age 20 through 34 or so. The addition of these "open" classes brings about situations as described by Joe McDaniel, Oklahoma TAC Record Keeper, in an excellent packet of material he has prepared for Oklahoma race directors:

> This inequity can be illustrated in a recent race with a large women's field. Six of the top ten women were age 35-39. In this particular race the first 20-24 runner finished 76th overall among women, but first in her age bracket. Now keep in mind that there is no ability gap to speak of in the 20-34 group, but in this particular event three of the top ten female runners did not receive an award, but the 20-24 female received a big age bracket trophy!! What could be more unfair than this?

Joe believes, and I do too, that there should be open awards which anyone in the race can win and then the age-group awards. If a person wins an open award and also an age-group award he/she gets two awards. Why not? It was earned because the person had the handicap of being of an age which should not be able to compete evenly with the open runners. But the runner prevailed anyway.

AGE/SEX GRADING

Joe has provided me with tables generated by the Masters Newsletter which represent their best estimate of the slowdown one expects for those runners outside the 20-34 range. I feel that at the present time, we do not have enough data to predict different slowdown factors for different distances. The Masters Newsletter apparently feels the same because they use exactly the same factors for all distances from 5 km through 25 km.

Since others have attempted to derive similar tables or formulas, I thought it might be interesting to compare them. The ones I'm comparing are:

1. Masters Newsletters age-correction factors for male runners for distances of 5 km through 25 km. (See Appendix.)

2. A formula generated by Peter S. Riegel, Chairman of TAC's Road Running Technical Committee based on the TACSTATS 1988 record book. The formula for 5 km is:

time in minutes = 13.5+.045x(ABS(Age-29))^1.3

3. Ben Buckner's book, Planning Road Races for the Competitive Runner. Ben has an interesting graph showing the expected time for male runners based on age for a 5 mile distance. Based on the fact that the ability changes more rapidly the older one gets, he estimates what should be the "fair" age-brackets. For example, he suggests age-brackets of 3 years over age 50.

4. TACSTATS Performance Guidelines. These Performance Guidelines are published each year by TACSTATS for the different standard distances. They are used for screening performances. Anyone who exceeds a guideline will have the performance listed in the TACSTATS record book for the year. The graph is generated using the TACSTATS 10 km table.

I have normalized each of the above grading methods by giving the best performance (usually about age 27) a value of 1.00 and have plotted the results on the two graphs shown. Figure 1 plots the expected change in time and Figure 2 the expected change in speed with age. The Masters Newsletter gives the correction factor only for ages 35 and above. Don Munro of British Columbia has extended these tables, using no known scientific method, to the ages 19 and under and 30 to 34.

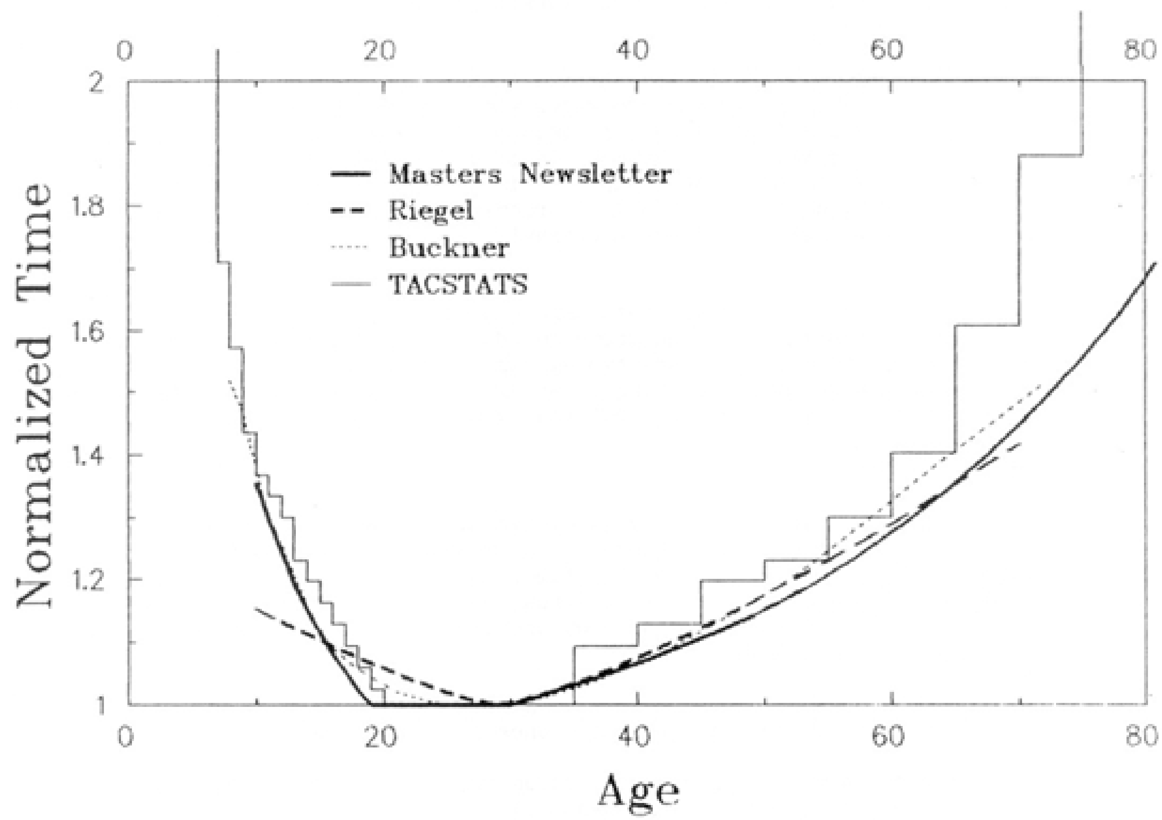

Figure 1 -- Normalized times adjusted for age

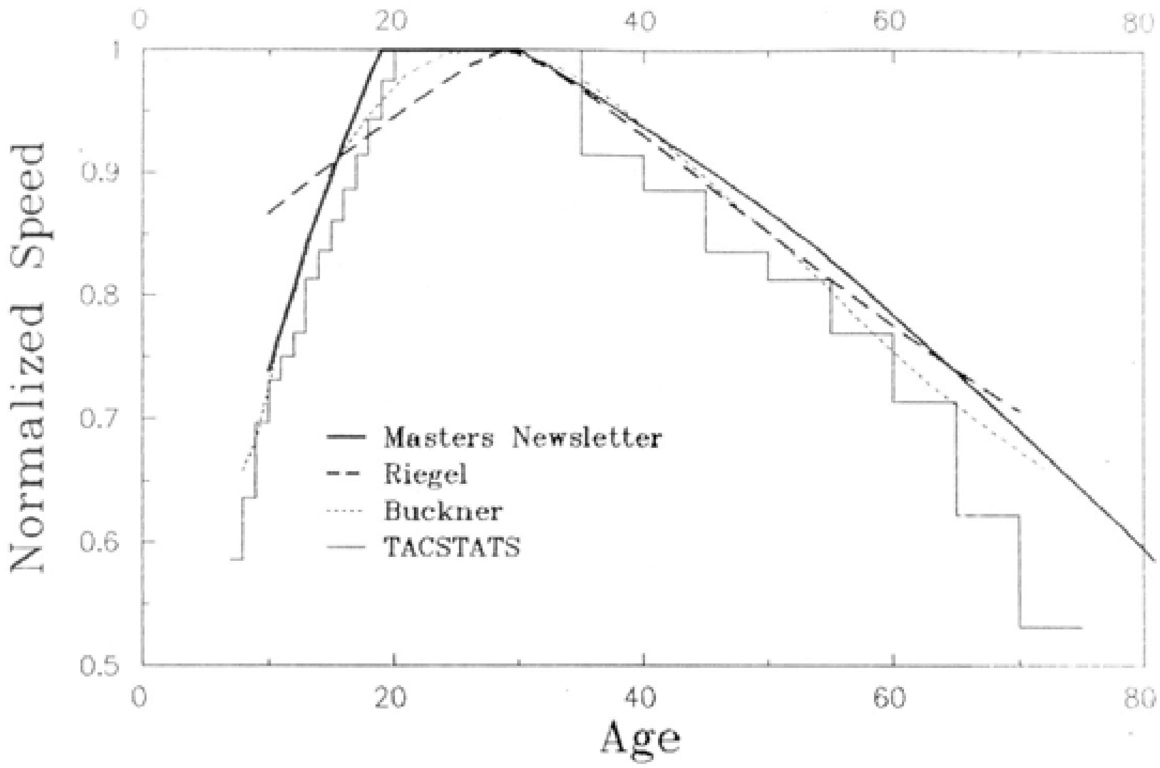

Figure 2 -- Normalized speeds adjusted for age

By observing the plots, one can see that the Masters Newsletter tables, Riegel's formula, and Buckner's chart are fairly close for the 35 and over ages. The TACSTATS are consistently slower than the others but this is to be expected since, I assume, TACSTATS attempts to make it easier to have a recognized performance for the older age-groups since there are so many fewer runners.

Buckner's and the Masters Newsletter data fall just about on top of each other for the 10-17 age-groups but deviate some for the 18-24 year old group. Riegel's is quite a bit different than the others for the younger ages but when you look at the data he was attempting to fit, it is obvious that he concentrated on the ages greater than 30.

I thought it might be interesting to take the results of races and "re-run" them based on age-grading. In addition to age-grading I took a look at sex-grading. By comparing the times of open male and female runners in the Masters Newsletter charts, it seems that the female speeds are rather consistently about 0.901 as fast at the male times. Therefore, I used the Masters Newsletter correction factors (as extended by Munro) and applied an additional factor of 0.901 for females. That is, I multiplied the female times by 0.901 before multiplying by the correction factor for the age.

I did this correction for five races which were in my computer from 1989 for our club's grand prix series of races. The results were interesting. Our 15 km race was "won" by 60-year-old Ed Stabler who is one of the nation's better age-group runners. Ed's raw time of 56:59 translated to 45:48. Also, in the race was Tom

Carter a local fine runner who was 36 at the time. Tom won the race. His time of 48:39 translated to 46:44. I sent these results to Ed. His reply was, "It's fun to see my name above Tom Carter's." The other top performances also "seemed" right to me since I know most of these runners.

Here are the results of the 15 km race with sex- and age-grading:

Sixteenth Annual FORKS XV
FIFTEEN KILOMETER ROAD RACE
Triple Cities Runners Club
TAC/RRCA Certified. Registration No. NY-84013-AS
Chenango Forks, NY April 2, 1989 2:00 P.M. Weather: Sunny, windy, 50 deg

PLACE	NAME	AGE	S	TOWN	ST	TIME	AGEGRAD
1	Ed Stabler	60	M	N. Syracuse	NY	0:56:59	0:45:48
2	Tom Carter	37	M	Binghamton	NY	0:48:39	0:46:44
3	Lee Anderson	32	M	Endwell	NY	0:48:39	0:48:06
4	Margret Betz	53	F	Conklin	NY	1:04:28	0:49:04
5	Sam Graceffo	53	M	Syracuse	NY	0:57:44	0:49:35
6	Dale Teed	33	M	Owego	NY	0:50:56	0:50:05
7	Bob Pulz	31	M	Johnson City	NY	0:50:25	0:50:08
8	Gary Fancher	28	M	Binghamton	NY	0:50:16	0:50:16
9	Paul Natelli	46	M	Endwell	NY	0:55:33	0:50:21
10	Reinhold Wotawa	41	M	Ithaca	NY	0:54:05	0:50:40
11	Bob Huddle, Jr.	42	M	Elmira	NY	0:54:33	0:50:47
12	Jim Walsh	26	M	sidney	NY	0:50:58	0:50:58
13	Rob Vieyra	49	M	Endwell	NY	0:57:34	0:51:04
14	Dan Kane	25	M	Endicott	NY	0:51:17	0:51:17
15	Gary Youmans	34	M	Endicott	NY	0:52:49	0:51:38

Note Margret Betz in 4th place. Margaret is also a nationally ranked age-group runner.

DISTANCE CORRECTION

Since I had results for runners at several different distances, it occurred to me to use another formula that Pete Riegel derived some years ago to give a measure of "performance factor" based on time and distance. If you run a race at a certain distance in a give time, Pete's formula can be computed backwards to predict your time at any other distance. Years ago Pete developed a cute little device to perform the computation. You would dial in your time and distance, get your performance factor, and then go to the new distance and read your time. (An interesting side note is that Bob Letson, a very active course measurer in the 70s and early 80s, developed a very similar device about the same time. Neither of them knew about the other's device until I got them together.) Pete's formula for performance factor is (although I'm sure Pete won't recognize it in this form):

$$PF = (141100/t) \times d^{1.0689}$$

where t is the time in seconds and d is the distance in kilometers.

It works out that a world class performance has a value of about 1000.

So, now in addition to an age and sex leveling factor, we now have a distance leveling factor. With these two effects taken into account we could, theoretically, roll all the races in the world into one and see who did the best. Well, as I'm sure you've already concluded, it isn't that simple. When you compare between different races through the use of a formula, you end up neglecting the toughness of the course and the weather conditions of the day. So, with that in mind, I took the five Grand Prix races and scored them as one big race. It turned out that Ed Stabler not only had the best adjusted time for the 15 km race, he had the best adjusted time for the entire series of five races:

Triple Cities Runners Club 1989 Grand Prix Races

Place	Name	Race	Age	S	Town	ST	TIME	AGEGRAD	PerF
1	Ed Stabler	Forks XV	60	M	N. Syracuse	NY	0:56:59	0:45:48	928
2	Tom Carter	Forks XV	37	M	Binghamton	NY	0:48:39	0:46:44	910
3	Tom Carter	October F.	37	M	Binghamton	NY	0:31:36	0:30:21	908
4	Brian Clas	Dick's 10K	17	M	Endicott	NY	0:15:19	0:14:37	899
5	Tom Carter	Dick's 10K	37	M	Binghamton	NY	0:15:15	0:14:39	897
6	Lee Anderson	Forks XV	32	M	Endwell	NY	0:48:39	0:48:06	884
7	Tom Carter	Peace Run	37	M	Binghamton	NY	0:25:37	0:24:36	883
8	Marty Beauchamp	October F.	27	M	Oneonta	NY	0:31:17	0:31:17	881
9	Margret Betz	October F.	53	F	Conklin	NY	0:41:17	0:31:25	877
10	E. Richard Hoebeke	Dick's 10K	40	M	Trumansburg	NY	0:15:55	0:15:00	876

HOW TO USE THE MASTERS NEWSLETTER TABLES

To age- and sex-grade a race is quite simple -- particularly if you have a computer. Take each runner's time in seconds and multiply by the adjustment factor (see Appendix). If you want males and females scored together, multiply each female time by the additional factor of 0.901. Then sort on the new times.

DISCUSSION

Some organizations are using the Masters Newsletter tables to adjust only the masters times (ages 35 and above) in order to determine masters awards. In this case the times from 34 on down are not used. Or, one can use the entire table to score the entire race with everyone's times age and/or sex adjusted.

One could argue that the times from 30 to 34 should not be adjusted since these times are in the "open" bracket. I believe it depends on what you are attempting to do. If you goal is to lump all the masters together and give out one set of awards, then one should only include those from 35 and above. However, if your goal is to lump ALL runners together into one age/sex-graded race, then I believe the 30-34 adjustment factors should be used since it does not make sense for their to be a jump in adjustment between the 34- and 35-year old runners.

APPENDIX -- Age graded table from Masters Newsletter

Below are the male and female age-graded tables which apply for distances from 5 km to 25 km. The ages below 35 years have been added by Don Munro.

AGE	MALE	FEMALE	AGE	MALE	FEMALE	AGE	MALE	FEMALE	AGE	MALE	FEMALE
10	0.7622	0.7384	40	0.9430	0.9373	58	0.8201	0.8021	76	0.6670	0.6337
11	0.7912	0.7703	41	0.9370	0.9307	59	0.8120	0.7932	77	0.6582	0.6241
12	0.8215	0.8036	42	0.9310	0.9241	60	0.8038	0.7842	78	0.6495	0.6144
13	0.8517	0.8369	43	0.9249	0.9174	61	0.7956	0.7752	79	0.6406	0.6047
14	0.8804	0.8684	44	0.9187	0.9106	62	0.7874	0.7661	80	0.6318	0.5950
15	0.9064	0.8970	45	0.9125	0.9037	63	0.7790	0.7569	81	0.6230	0.5853
16	0.9310	0.9241	46	0.9064	0.8970	64	0.7706	0.7477	82	0.6141	0.5755
17	0.9549	0.9504	47	0.9002	0.8902	65	0.7622	0.7384	83	0.6052	0.5657
18	0.9790	0.9760	48	0.8938	0.8831	66	0.7537	0.7290	84	0.5963	0.5559
31	0.9945	0.9941	49	0.8872	0.8759	67	0.7451	0.7196	85	0.5874	0.5461
32	0.9890	0.9880	50	0.8804	0.8684	68	0.7365	0.7101	86	0.5785	0.5363
33	0.9834	0.9819	51	0.8735	0.8608	69	0.7279	0.7006	87	0.5695	0.5264
34	0.9779	0.9758	52	0.8664	0.8530	70	0.7192	0.6911	88	0.5606	0.5166
35	0.9724	0.9696	53	0.8591	0.8450	71	0.7106	0.6816	89	0.5516	0.5068
36	0.9666	0.9633	54	0.8517	0.8369	72	0.7019	0.6721	90	0.5427	0.4970
37	0.9608	0.9568	55	0.8441	0.8285	73	0.6932	0.6625			
38	0.9549	0.9504	56	0.8362	0.8198	74	0.6844	0.6529			
39	0.9490	0.9439	57	0.8282	0.8110	75	0.6757	0.6433			

BOB BAUMEL SENT THIS. IT'S FROM TAC/OKLAHOMA NEWSLETTER, MARCH 1, 1989.

HE ALSO SENT THIS DISCLAIMER. DO YOU BELIEVE HIM?

I was NOT the runner who phoned this in → Honest!

Last Minute Item:

From a participant in the Groundhog Day 15 km State Championship race in Ponca City on March 3 via phone: This event gave me a new reason for participating. I have never used anything but miles to gauge my pace in a race and never expected anything but mile splits. I heard in advance about this event having each km marked. I decided to gauge my pace accordingly just to try something different. Its great. The entire distance was divided into 15 equal parts and all well marked. As a result I ran the race at a very even pace of 4 minutes and 18 seconds per km. I hope every race in the state at least marks every km on their course.

Ponca Citian's Findings on Marathon 'Not Popular' in Boston

By LOUISE ABERCROMBIE
News Staff Writer

A flap going on about whether or not the Boston Marathon will be certified as an official road running course is a familiar subject for Bob Baumel, Ponca City.

Baumel, Western Region Vice Chairman of the Road Running Technical Committee of The Athletics Congress (TAC) of the USA, and Alan Young of New York have issued an opinion that the hilly course cannot be included in the official records. The ruling on the course, known world-wide for Heartbreak Hill, was based on countless hours of analyzing data, plus a new TAC rule.

The Road Running Technical Committee is responsible for course measuring standards for road running course certification in the United States.

The ruling that the Boston Marathon Course is not certifiable because of the "drops" which aid runners, is not popular in Boston or with the Boston Globe newspaper. The 94 year-old marathon course is not certifiable by rules adopted at the December 1989 TAC Convention.

Controversy centers on the amount of aid a runner receives because of the hills. The drop in the course is shown at 3.22 meters per kilometer. The Boston course starts 141 meters above sea level and finishes 5 meters above sea level, for a net drop of 3.2 meters per kilometer.

This exceeds the two meters per kilometer of the old rule of TAC as well as the one meter per kilometer of the rule adopted by the convention. As an aside, Baumel, a former Canadian resident, is sold on the metric system and is dedicated to seeing the United States convert to the system.

Although Baumel is mostly concerned these days with certification, he began as a runner and continues to run when he has the time and opportunity. So contrary to the Boston Globe's opinion that the rules are made by bureaucrats, all members of the TAC road running certification committee are runners, as were those voting at the convention, according to Baumel.

Baumel came to Conoco in 1981 with the Geophysics Research Division, where he was deeply involved in the conversion of the seismic processing system to the Cray Computer.

Currently a senior research scientist, he is researching the inversion theory, determining what is in the subsurface, based on seismic data. A native of New York City, Bob majored in physics at Cooper Union in New York, and was a graduate student at Princeton. He was a post doctorate student at the University of Western Ontario.

Oklahoma Courses

Oklahoma has more certified road running courses per capita than any other state in the nation, according to Baumel.

Oklahoma has 362 certified courses, which is 5.87 percent of the United States' total of 6,160 courses. In actual numbers Oklahoma ranks fourth behind California, which has 677 courses, Texas, 379, and North Carolina with 365.

A number of the courses in Oklahoma have been certified by Baumel. G. Lafarlette of Tulsa certifies a lot of the courses in Oklahoma, Arkansas, Missouri and Texas.

The course of the Pioneer Woman Run is the oldest certified course in the state, according to Baumel, who is responsible for the certifiers in the western half of the nation. Part of the responsibility is training new certifiers. He also analyzes the certifiers' data to see if the course has been measured accurately.

Baumel spends a lot of time with his computer, drawing road running courses and processing data.

He says certification serves two purposes. "One, it gives every runner who just goes out and sees if he can set a personal best record on the course, the knowledge that his time is meaningful because the course is measured accurately."

The other purpose is that there are official road running records. The record keeping became official in 1983. These records at the present only exist in the United States, but Baumel thinks world road running records will be coming soon.

From the beginning the argument has been made that road running records wouldn't be too meaningful as every course is different because of terrain variation, Bob said.

Baumel said when road running became popular the rules were set up. "Basically we found that an awful lot of the variation between different courses was not really because of the terrain but because nobody measured the distances accurately in the old days.

"Runners' times on different courses became much more consistent when the distances were measured accurately. In 1983 we got the certification program up to a point that we could say we're really getting accurate courses and we can establish road running records."

Baumel noted other factors include weather and altitude. The person most responsible for establishing road running record keeping is Ken Young of Arizona, a professor of astro physics at the University of Arizona in Tucson. He set up an organization called the National Running Data Center. The center remained active from the early 1970s until 1986, when it was taken over by the official body of TAC called TACSTATS, which now keeps all of the statistics.

Young also helped get the certification rules tightened to a point the courses are accurate. Baumel said it was a mammoth job pushing through legislation at TAC convention that got the official road running records.

One key problem was dealing with courses that drop down hill a lot, or courses where the start and finish are separated or there is a big tail wind.

"The Boston Marathon course drops enough that by about any criteria you would set it gets excluded," Baumel said.

Baumel said two sets of records had been kept, the "real records" and something called point to point records, which could be used on a course with a big separation of start and finish or on a downhill course.

This situation has been cleaned up and only "real" records are kept. This means there are certain courses that are ineligible to appear on the records list.

Baumel said it was "pretty hairy" getting the legislation through the convention. He said all of the committees had agreed with the exception of the men's long distance running committee, which wanted to "grandfather in" the Boston Marathon.

The runner's information can still appear in the rankings and can still be approved as a notable performance.

Car odometers are not accurate enough to measure courses, according to Baumel. A small device, the Jones bike odometer, which has a digital counter attached to the front wheel of a bicycle, is used most often. The courses are ridden at least four times. The course measurement is taken again after the race for validation.

Other measuring methods include steel tape or electronic measurers. The course measurement procedures manual published by the Athletics Congress of the USA, gives specific details on measuring. This includes measuring straight down the middle of a curving road, and turning the corners at the correct angle.

Bob is a regular contributor to the bi-monthly news letter. The articles are usually of a technical nature. He says the technical aspect of road running has intrigued him from the onset.

Measuring the 1992 Olympic Marathon

A Proposal by Bob Baumel

The measurement of every Olympic Marathon course from 1976 onwards (with the possible exception of the 1980 Moscow course), has been precedent-setting. The 1976 course (Montreal) was the first Olympic course measured by bicycle and Jones counter, although the old-fashioned surveying method was still used as a backup. The 1984 course (Los Angeles) was measured entirely by bicycle, by a team of 13 expert riders, and also introduced the use of multiple baselines (standard cal course at each end, plus 6 en-route baselines). The 1988 measurement (Seoul), while largely a copy of the 1984 measurement, introduced the "painted line" method of course measurement.

Right now, before the next round begins, is a good time to look critically at these past measurements, and figure out which of the various precedents ought to be kept or discarded. At the same time, as IAAF measurement standards and structures are now taking shape, I would like to start a new precedent: Let's have the course measured and "certificated" by a team of IAAF measurers prior to the Games, instead of leaving everything to the host country as has been done for all previous Games.

1984 — Los Angeles

The 1984 Los Angeles measurement was a great measuring "party" that brought together many of the top US measurers at a time when the current TAC certification structure was at a formative stage. It provided many good ideas including use of multiple expert riders and en-route baselines. It is perhaps less well-known that after the 13-cyclist mass ride of April 24, 1983, three of us (Bob Letson, Pete Riegel and myself) spent another seven months analyzing the data collected in that ride.

While the seven months of data analysis may have been excessive, we can probably be forgiven because it was all so new. Nobody had ever done a measurement with 13 riders and 6 en-route baselines before. So we calculated the measured distances numerous ways, with essentially the same answers by every method (although with enough variation that the measurement didn't have a clear "winner;" i.e., no one measurer emerged as having unambiguously ridden the shortest path).

In reality, however, the question that occupied us most during those seven months was deciding how big a "short course prevention factor" to use. And that was where we made our biggest mistake.

A heady feeling results after measuring with so many of TAC's best-known measurers, and with such a higher-than-normal level of effort. You feel certain that the result *must* be far more accurate than any "routine" measurement, so you think it's okay to use less than the standard 0.1% safety factor. For the 1984 Olympic course, at any rate, we were unable to resist that temptation. (And admittedly, I had fun devising various statistical methods to derive a suitable safety factor to use for that measurement.)

(It might also be noted that at the time of that April 1983 measurement, the 1/1000 safety factor had **not** really been firmly established, as it had been introduced only about 6 months earlier.)

To his credit, Pete Riegel argued, for nearly the whole 7 months of deliberations, that we already had a perfectly good layout procedure (including the 0.1% factor) and we should use it. But Pete eventually yielded, particularly after such other luminaries as Bob Hersh and Ted Corbitt weighed in with the opinion that it was okay to use less than the whole 1/1000.

But in retrospect, Pete was right. No individual race course—not even the Olympics—is so important to justify using less than the standard safety factor. The Olympic course should be a standard marathon course. And standard marathon courses are laid out with an extra 42 metres. It makes no sense for the Olympic course (even if measured a bit more accurately than most other courses) to be twenty or so metres *shorter* than all other standard well-measured marathon courses around the world.

It is interesting to note that after all our statistical calculations for the 1984 course, we ended up using *almost* the whole 0.1% anyway! The final course included a safety factor of 28 metres (based on the median measurement). Considering that only about 36 km of that course was measured by bicycle (the remainder being measured by EDM or steel tape), our final 28 m safety factor was about 0.08% of the bicycle-measured distance.

In practical terms, our final 1984 course differed only trivially from what would have obtained using the whole 42 metres. (Difference of only 14 m.) Certainly, it would have been far simpler to just use the standard 1/1000. Unfortunately, we chose to use less than 1/1000, thereby setting a very poor precedent, as would become clear four years later.

1988 — Seoul

Like the Los Angeles measurement, the Seoul measurement was done with bicycles (and 15 riders). But where we applied a safety factor of 28 m to the Los Angeles course, the Koreans used only a 13 m factor for the Seoul course. They determined that 13 m factor using exactly the same sort of statistical calculations as we used for the Los Angeles course. But they got a smaller answer because their measurements were more tightly clustered than ours.

The reason for this tighter clustering of the Korean measurements was a crucial difference in procedure: In Los Angeles, each of the 13 riders was an expert course measurer, and each independently chose what he believed to be the correct path (i.e., "shortest possible route"). But the 15 cyclists in Seoul exercised no independent judgment at all regarding the path to measure. Instead, the Korean riders simply followed a line painted on the road!

This painted-line method was certainly a reasonable choice, given that the Koreans had no measurers skilled and experienced in using the calibrated bicycle method. Lacking "expert measurers" to ride their bicycles, they chose the next best thing: *expert cyclists* (members of a University Cycling Team). But clearly, these cyclists could not be expected to judge the SPR while riding; therefore, a line was painted for them to follow.

Unfortunately, this painted-line method violated the assumptions behind the safety factor calculations we performed for the 1984 course. In Los Angeles, there were 13 independent determinations of the SPR. But the Koreans made only **one** determination of the SPR (when painting their line). Clearly, the entire Korean measurement stands or falls according to the accuracy of that painted line. (Unfortunately, the report of the 1988 measurement contained virtually no detail on how that line was laid out.)

The premise behind all our statistical safety factor calculations for the 1984 course was to make the course safe against being found short in a remeasurement. Possibly, the Koreans didn't fully understand that premise, as it was based entirely on the concept of validation remeasurement which, until very recently, existed only in TAC rules—not IAAF rules. (Only in the past year has IAAF accepted the notion of validation remeasurement.)

Actually, the Seoul course (with its safety factor of only 13 m) probably *was* safe against being found short on remeasurement—**if** the remeasurer agreed to follow the same painted line as used by the original measurers. But this course was **not** safe against remeasurement by a skilled measurer using his own judgment to determine the riding path. This became clear in December 1986, when an IAAF measuring seminar was held in Seoul.

The Seoul Olympic course had already been finalized in July 1986, but during the December 1986 seminar, several international measurers were allowed to check about 11 km of the Olympic course. Although instructed to follow the painted line, the experienced measurers ignored that instruction, and judged the SPR themselves. These measurers generally found themselves riding to the inside of the painted line when turning corners. Not surprisingly, they found that 11 km stretch of the course to be shorter than advertised. The international measurers were **not** given a chance to check the complete marathon course—which might have proved embarrassing to their Korean hosts.

1992 and Beyond

I propose that future Olympic marathon courses be measured in a two-step procedure: First, the host country should lay out the course (preferably a *complete* marathon course, i.e., the whole 42.195 km). Then (still before the actual Games) an IAAF team should remeasure and certificate the course. This team must have the authority to adjust the course as needed, to make sure it is correct.

In the first step, the host country may use any method of measurement they like. For example, if they choose to use bicycles, but don't have many people skilled at judging the SPR while riding a bike, they might use the painted-line method pioneered by the Koreans. They should be sure their course has room for adjustment, in case it is needed by the IAAF team. Clearly, the measurers from the host country should **not** waste a lot of time choosing a safety factor, since the IAAF team will make the final course determination.

In the second step, the IAAF measurers should use standard procedures for a pre-race layout measurement. Thus they should use the entire standard 1/1000 safety factor. If measurers from the host country have painted a line on the road, the IAAF measurers will ignore that line; i.e., each member of the IAAF team will make his or her own determination of the correct path.

If the IAAF team consists of five or more experienced measurers, it may be a bit of overkill to use the "best" (i.e., tightest) of all measurements together with the 1/1000 factor. In this case, I would consider it acceptable to use the *median* measurement with a 1/1000 factor. (The median is a more "robust" statistic than the mean, as it is less sensitive to deviant high or low values.)

It is surely not necessary to calculate the measured distances by all the different methods employed in the reports of the Los Angeles and Seoul measurements. If multiple baselines are used, it would probably be adequate to use the method referred to as "TVC" in the Los Angeles report, or as the "two baseline" method in the Seoul report. If multiple baselines are *not* used, I suggest the larger constant method, which is generally safest in the absence of detailed data on calibration behavior between pre-cal and post-cal.

Politically, it may be difficult to institute the sort of IAAF measurement I am describing, as all site preparation for Olympic Games has traditionally been handled entirely by the host country. Our task will be considerably easier if world road records have been established by 1992. In that case we can point out that unless the course has been certificated by IAAF prior to the Games, then records set in the Olympic marathons will not be assured of acceptance, but will require post-race remeasurement by IAAF, and will be rejected if such remeasurement finds the course to have been short.

If these proposals are accepted, then we can be confident that Olympic marathon courses will satisfy consistent standards of accuracy, no matter where they are held. As an added benefit, it would provide a nice opportunity for a number of IAAF measurers to gather and measure together every four years.

Bob Baumel

IAAF ROAD COURSE MEASUREMENT

IAAF RDC JAKARTA

MARCH 30 – APRIL 1, 1990

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REPORT OF PROCEEDINGS

The International Amateur Athletic Federation (IAAF) conducted a seminar for road race course measurers in Jakarta, Indonesia, on the weekend of March 30 through April 1, 1990. It was the first such seminar to be conducted in this part of the world.

Local arrangements for the seminar were made by Mr. J. E. W. Gosal, Director of the IAAF Regional Development Centre for Asia, Jakarta. Since traffic conditions in Jakarta are not conducive to safe bicycle measuring conditions, Mr. Gosal made arrangements for the seminar to be held near the town of Cibubur, between Jakarta and Bogor. Graha Wisata Pramuka, the headquarters building of a camping and recreation area, was the place where most of the participants lived and worked during the course of instruction.

IAAF instructors were John Disley of Great Britain and Peter Riegel of USA, the co-editors of the new IAAF manual **THE MEASUREMENT OF ROAD RACE COURSES**. Participants are listed at the end of this report.

After greetings by Mr. Gosal, the course of instruction began with students laying out a 30 metre calibration course, and using it to calibrate their pacing. Then they paced out the length of a figure-8 course in the parking lot, of about 135-140 metres in length. Mr. Riegel then demonstrated the use of the Jones counter, calibrated the bike once, and used it to measure the same course more accurately. Several of the participants repeated this exercise. With the principle established, all went inside to be shown the calculation to determine course length.

After more instruction, students went outside to lay out three 150 metre calibration courses on a nearby roadway. John Disley demonstrated the use of fixed nails, to keep the calibration course from becoming lost when the paint wears away.

Temperature correction of steel taping was briefly discussed, and the students were referred to the book for further knowledge. Since all attendees reside in tropical countries, they were advised not to worry about temperature correction. Their tapes will never be shorter than standard (at 20 C).

Students were given Jones Counters, which they affixed to six bicycles. These were shared by all students. They calibrated the bicycles, four rides each, using the three calibration courses. Mr. Riegel led successive groups of riders around a practice course of about 880 metres, demonstrating the way the Shortest Possible Route (SPR) is ridden. Taking turns, the students then each measured the length of the circuit. Thirteen estimates of length ranged from 876 metres (by a highly-experienced measurer) to 891 metres (by an inexperienced measurer who had not ridden a bike for 30 years).

After recalibrating their bicycles, the students came indoors again for more instruction in calculating the average constant, and determining the length of the course. They were shown how to pre-calculate a desired split, and how to apply the Short Course Prevention Factor (SCPF).

After lunch, students were asked to begin at a fixed point, and to lay out a 550 metre halfway point, and a 1.1 km "finish line." By this time the students were beginning to understand better what was going on, and they began to behave in a competitive manner. As each rider came in to lay out his split, he would be greeted with cheers or jeers, depending on where his split fell. Those with points far from the average scratched their heads in perplexity, while we tried to find out what went wrong.

With the riding done, we discussed the reasons for measurement differences. Small variation was due to difference in riding skill, while large variation was due to a corner of the course which invited short-cutting. Some of the measurers elected to cut this corner, since they were sure that runners would do so. In addition, the practice course had many more turns than would a typical road course, which promotes differences.

Copies of the IAAF draft **THE MEASUREMENT OF ROAD RACE COURSES** were given to all participants. Also passed out were copies of the TAC/USA book **COURSE MEASUREMENT PROCEDURES**. This latter work was introduced to Indonesia by Bob Thurston of the USA, and was translated into Indonesian by Mr. Suyono Danusayogo, one of the participants. This translation was passed out as well. All this distribution gave participants much material for study. This concluded the activity of March 31.

Next morning Mr. Varghese announced that it was his birthday, and was treated to a rendition of "Happy Birthday to You" by the assembly. He then announced "April Fool", which got the day started properly with a good laugh.

This day the students were asked to lay out three 200 metre calibration courses, and to use them to lay out a course of 500 metres. This they did with little supervision, the instructors being present for advice only. Once again the students demonstrated a competitive drive, anxiously awaiting the arrival of the next rider to see where his mark would be. The measurement spread on this second day was far less than on the previous day. This indicated that the students had gotten better at riding and calculating.

On the second day some students noticed they were getting a very different riding constant. This was traced to one Jones Counter that records 26 counts per revolution, rather than the 20 that is standard. There are very few of these, but they do exist, and they are totally satisfactory.

At the conclusion it was apparent that the students had grasped the basic principles of measurement. Each group was reminded that they are now the experts in their countries, and urged to do whatever they can to promote accurate course measurement within their home federations.

Certificates were presented to all attendees, concluding the seminar.

Thanks are extended to Mr. Gosal and his staff, and to the members of PASI, the Indonesian Amateur Athletic federation. They worked hard to make this seminar a success.

Pete Riegel

Peter S. Riegel - IAAF Measurement Instructor
3354 Kirkham Road
Columbus, OH 43221
USA

April 4, 1990

THE ZOO RUN PUZZLE

Dave Poppers earned the $20 consultation fee on this one. Readers of the January MN will recall that I sought the best way to fit a 5 mile course into 3 miles of roadway. Bob Baumel suggested changing the distance to 5 km. Eric Smith's solution was nearly the same as Dave's, but came in later. Tadeusz Dziekonski had some extra loops near the start area, as did Wayne Nicoll. Bernie Conway had 2.5 loops around the main course, as did Mike Renner, which I didn't like because of the lapping problem. Ken Young did some nice analyzing of the lapping problem, and also suggested making it a 5 km race. Rick Recker proposed a 2-looper, with coning plans. He concluded "If you have wheelchairs, throw this plan away."

The key to this layout, which I did not recognize, was to use the portion of the road between the zoo and the golf course. Shortly after you read this I will try out Dave Poppers' course on the Columbus Roadrunners, and we'll see whether they want to use it, or just continue to live with what they have.

In any case, my thanks to all contributors. You showed ingenuity in your various approaches to this problem.

MAP OF THE MONTH

This month's map (by Don Standish) shows what can be done with a pencil and a piece of paper. No fancy xerox reductions, just neatness and attention to detail. If you use cones on your measured routes, look at how Don clearly spelled out exactly where the cone is to be located.

ALWAYS INSIST ON A POLICE ESCORT!

The Athletics Congress of the USA

Road Running Technical Committee
Dave Poppers, Colorado Certifier

5938 S. Franklin St.
Littleton, CO 80121
303/795-9743

Pete Riegel
3354 Kirkham Rd.
Columbus, OH 43221

1/20/90

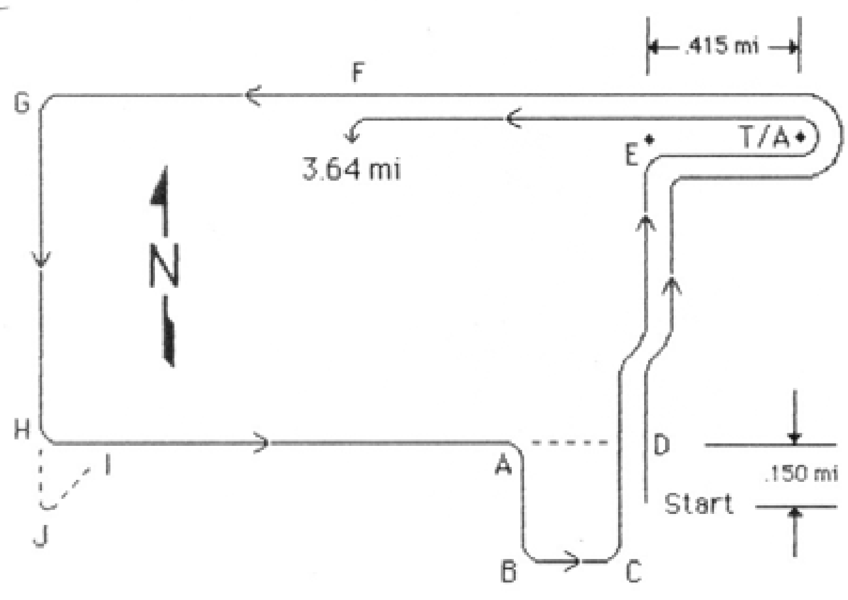
Dear Pete,

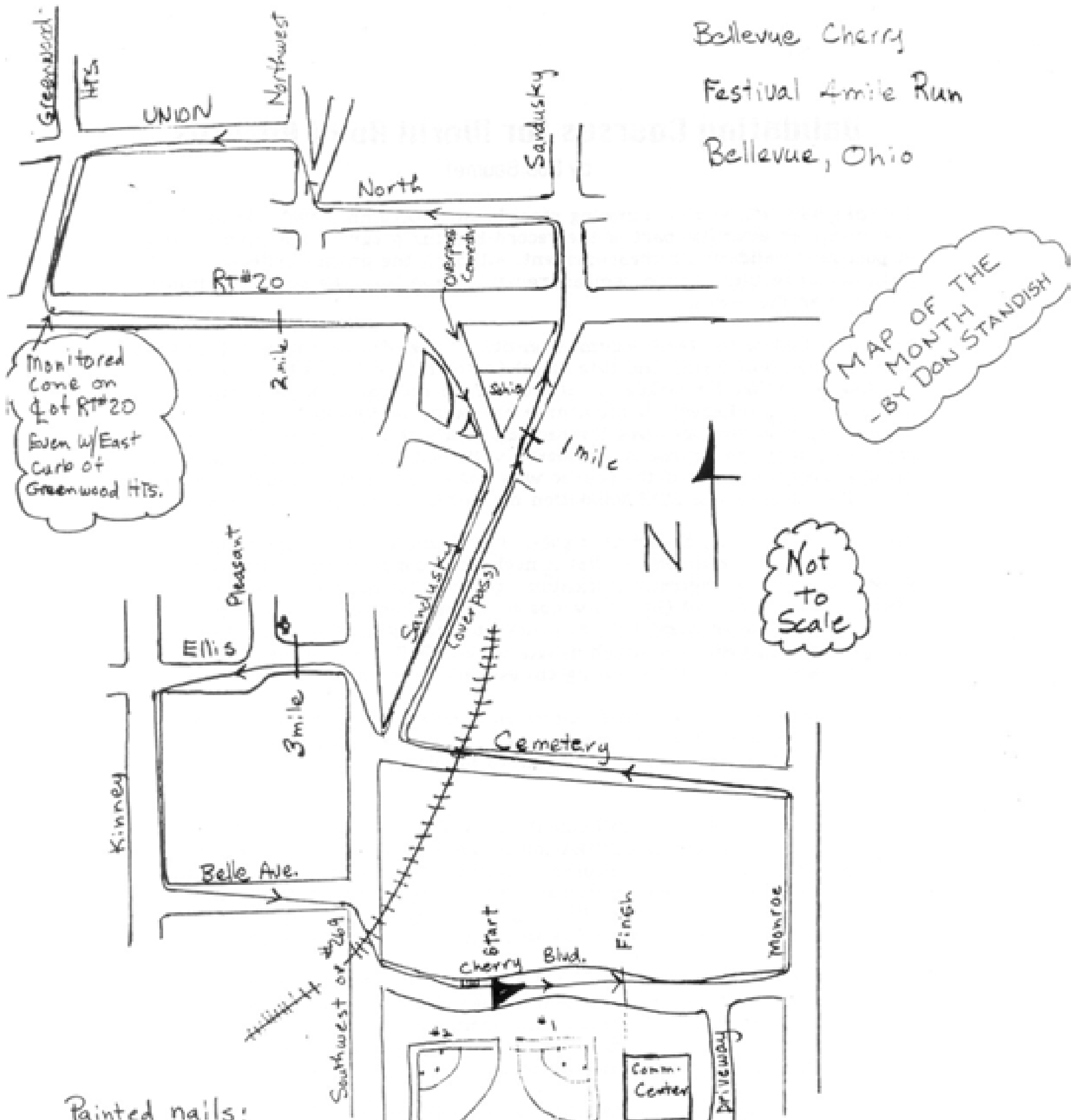
I have a desk that is growing more cluttered than it should due to your Zoo Puzzle challenge, so that I find it necessary to get this out of the way as soon as I can in order to return to a normal clutter level.

Here, in schematic presentation, is my solution. I rotated the map to have north at the top so that I would not go into a catatonic state. It has the advantages of a start without an early turn, enough room behind the start line for all participants to have a straight start, a twice used turn/around to aid in commonality and fewer course marshals, and a pattern that will assure that the slowest runner (within reason) will have passed point F the 1st time when the lead runner passes it for the 2nd time. Additionally, the sponsors will have double visibility when the runners pass through the start area (2.193 miles) the 2nd time and the runners can have the excitement rekindled by the PA and/or band.

I will accept the prize money in small unmarked bills in some dark alley at a later to be agreed upon drop point.

Dave





Painted nails:

Start – 21'8" E. of sewer grate across from 2nd Baseball diamond W/of Comm. Center.

1 mile – 7'2" N. of T/P # 5117C1-55 across from Sohio Station on Sandusky.

2 mile – 1'11" E. of T/P # 5217A4-71 near Hardee's on Rt #20

3 mile – 23'6" E. of Hydrant at Ellis & Pleasant

Finish – In line w/ W. Side of Community Center building on Cherry Blvd.

Validating Courses for World Road Records

by Bob Baumel

TAC has had official road running records since December 1983. From the beginning, an essential part of the record-keeping program has been a system of post-race validation remeasurement, although the precise criteria for judging the results of such remeasurements have been the subject of much debate over the years.

The draft text of the IAAF document entitled "The Measurement of Road Race courses" by John Disley and Pete Riegel (dated March 7, 1990) sets out a possible procedure for validation of world road records. The indicated procedure is two-tiered: If the course has been "certificated" by an IAAF measurer, who also observes the race and verifies that the course is run correctly, then the course is considered validated, and no further measurement is required. But if the course was *not* certificated by IAAF prior to the race, then a post-race IAAF validation measurement must be performed.

This proposal is fine, as far as it goes. But it contains two major omissions: (a) it is too self-contained, in that it neglects to consider any possible role played by *national* course certifications granted by individual member federations of the IAAF, and (b) it is vague as to whether the burden of proof in a validation remeasurement is to demonstrate shortness or longness (which has been the subject of so much debate within TAC). I propose remedying these omissions with the following **three**-tiered procedure:

1) If the course is "certificated" by an IAAF measurer prior to the race, and if this measurer observes the race and verifies that the course was used correctly, then the course is considered validated, and no additional measurements are required.

2) If the course was not "certificated" by IAAF prior to the race, but has been granted a national certification by an IAAF member federation, and if it can be verified that the course so certified was used correctly in the race, then IAAF post-race remeasurement is required. But the mark will be disallowed on the basis of this remeasurement only if it demonstrates that the actual distance was *less than* the nominal race distance.

3) If neither of the criteria (1) or (2) apply, but assuming that the exact route used for the race can be determined, IAAF may, at its discretion, remeasure the course to see if it can qualify for record status. In this case, the course will be considered acceptable only if the remeasurement demonstrates its length to have been *at least* the nominal race distance.

Thus, courses certified by a national athletics governing body, even though not directly "certificated" by IAAF, are given the "benefit of the doubt"; such courses are rejected only when the remeasurement demonstrates shortness (matching the interpretation of validation remeasurement developed in TAC). But courses that have neither been certified by a national governing body nor certificated by IAAF receive no such privilege; these courses are accepted only if the remeasurement demonstrates longness.

The obvious intent of this proposal is to promote the development of national course certification programs. It's fine if we have a strong TAC certification program, and strong AIMS and IAAF programs. But that still leaves a large gap at the grass roots level in most countries outside the United States. To fill that gap, strong certification programs are needed in each country.

Clearly, all such certification programs would need to meet certain minimum standards established by IAAF. Thus, they would need to follow procedures for course measurement and documentation matching those of TAC or IAAF.

To efficiently certify large numbers of courses, these national certification programs would probably do best by following the TAC structure—where *anybody* is allowed to measure a course, so long as he or she submits paperwork acceptable to a "certifier". Nevertheless, certification programs based on the alternative model (where measurers must obtain certain credentials before being allowed to measure) would also be considered acceptable.

This proposal would require a clear understanding at the international level of the difference between course certification and race sanctioning. (Even in the US, this has sometimes been a source of confusion for runners and race directors.) It is likely that some of the marks to be considered for world record status, although set in duly sanctioned competitions, will have been run on courses that haven't been certified in the sense described here.

Course certification is the process of verifying correctness of the course measurement and documentation. Sanctioning concerns numerous other details involved in administering a race. Possibly, one of the main reasons for the health of TAC's certification program has been its "decoupling" of this highly technical measurement aspect from those other administrative aspects. When we judge a course for certification; we consider only its measurement and documentation; we don't worry about whether the race will be sanctioned (or indeed, whether the course will even be used for an actual race!).

I am aware that setting up numerous national course certification programs (and maintaining uniform standards) will make life more difficult than if we had only the IAAF, AIMS and TAC course measurement programs to worry about. But ultimately, the sport will benefit greatly if each country has a strong certification program similar to that of TAC. So it is worthwhile to encourage such programs, and allow for them in the record-keeping rules.

Other Record Considerations: Aided Courses

Credibility of a record-keeping system requires the exclusion of marks that are unfairly aided by factors such as downhill grades or tailwinds. To this end, TAC adopted the highly publicized (and much maligned) amendment to its course eligibility requirement at its December 1989 Convention. According to TAC's new rule, courses are eligible for records only if: (a) the net drop is less than 1 m/km, and (b) either the separation is less than 30%, or if separation exceeds 30%, then wind measurement must demonstrate the absence of a net tailwind.

It is not clear how well part (b) will work out in practice. Thus, before adopting a similar IAAF rule, it might be wise to wait a few months and observe TAC's experience in implementing the wind measurement provision of its new Rule.

This should not, however, prevent IAAF from endorsing part (a) as soon as possible. The 1 m/km drop limit is definitely the right number. It matches the declination limit for tracks (IAAF Rule 161.6). A drop of 1 m/km provides a *substantial* amount of aid (4-5 times as much aid as provided by a course that is *short* by 1 m/km). And this 1 m/km drop limit has already appeared in an IAAF draft document on world records, distributed in 1985.

In the debates at the December 1989 TAC Convention regarding this rule change, our most persuasive argument for the 1 m/km drop limit may have been the claim that IAAF favors this figure. In view of the publicity generated by this rule change, there is little doubt that it will be challenged at the 1990 TAC Convention. However, our position will be buttressed considerably if IAAF has formally endorsed the 1 m/km drop limit by December 1990.

Bob Baumel

ADMINISTRATIVE CHANGES

Basil and Linda Honikman are relocating to California from Florida. As a result of this move, Doug Loeffler will assume the certifier duties for Florida, retaining Mississippi. Tom McBrayer will become the Louisiana certifier, retaining Texas. This will keep everyone's territory closer to where he lives. Basil will retain Final Signatory status.

We wish Basil and Linda well in the move, and hope that the disruption to their lives and to their TACSTATS operation is not too tough.

TACSTATS / USA 7745 S.W. 138 Terrace, Miami, Florida. 33158 USA / Telephone (305) 253-8448

TACSTATS/USA IS MOVING WEST

From May 17 to May 25, 1990 the office of TACSTATS (the National Center for Long Distance Running and Race Walking Records and Research) will be closed while our moving van races along an uncertified point to point course from Miami to Santa Barbara, California. All mail should be forwarded but to be safe, race results and corresondence should not be sent to the Miami address after May 10 (or to Santa Barbara before May 20). We will send confirmations of all results received during May June and July. The new address will be:

TACSTATS/USA
915 Randolph
Santa Barbara, CA 93111

The new telephone number will be:

(805) 683-0408 as of May 25

provided the phone company has no trouble with that line. In that event new numbers for both TACSTATS and Basil Honikman should be available from directory assistance.

The May/June TACTIMES containing the Largest Races of 1989 will be mailed on May 12. The latest Road Running Records and Rankings booklets and binder including more that 11,000 national class performances of 1989 will be mailed in June and can be ordered now for $30.00 ($35.00 after May 12) or $5 for each booklet of one distance.

In spite of water shortages and earthquakes we are looking forward to joining family and friends on the west coast. Please help us inform the running public of this change so that any interruption to record keeping and information service functions can be kept to a minimum.

Sincerely,

Linda and Basil Honikman

Linda and Basil Honikman

The National Center for Long Distance Running & Race Walking Records & Research

MUSCAT MARATHON

Report on the organisation of the Muscat Marathon

1) Introduction

This event held on the 26th. January 1990 was the second marathon held in the Sultanate of Oman. The event being organised by the Oman Athletic Association in conjunction with ex-patriot members of the local running clubs. The organising committee would like the event to receive international recognition and be included in future I.A.A.F. road race fixtures. As a result I was invited to measure the course in accordance with A.I.M.S. / I.A.A.F. procedures and comment on the standard of the event.

2) Course Configuration

The course was a one-way or point to point route starting at a somewhat remote point some 50m above sea level with the first kilometre being very steeply downhill. The undulating nature of the course continued to approximately 8 kilometres with two severe hills having to be negotiated. Thereafter the the route was almost flat with only one fairly steep ascent and descent to be surmounted in the final two kilometres of the race, the finish being located outside the Sultan Qaboos Sports Complex.

3) Course Measurement

The original course measurement was carried out by Race Director Mr. William Norgrove using a digital odometer fitted to a bicycle. The official measurement using a Jones Counter and riding the "Shortest Possible Route" revealed an error of (-)160m. There was however some confusion concerning the numbering of the kilometre measure marks, with a miss-counting error being evident. Full details of the actual course measurement procedures are shown in the accompanying course measurement report.

4) Distance & Time Markers

There were no static time display point on the course or on the lead vehicle, but officials did record 5k split times with hand held stop watches. Every 1 kilometre was marked on the roadside, but only clearly displayed every 3k to coincide with the drinks stations. As mentioned previously there was some confusion as to which were the official measure marks. Problems were compounded by over zealous road sweepers who cleaned up the marks as quickly as they were laid down. The 42k distance marker being placed at a point where the runners still had another 1200m to go, which produced quite a protest from the leading runners.

5) Traffic Control

The race route was open to traffic through the duration of the marathon. A police escort was provided for the lead runners, but the volume of traffic was such that the runners path was obstructed on a few occasions. Dangerous roundabouts and road junctions were adequately policed and the traffic well regulated. The main problems being caused by the ignorance of local drivers unaccustomed to the spectacle of a marathon race through their city.

6) Health & Safety

Adequate medical facilities were provided throughout the marathon route, with doctors and ambulances in close attendance at all times. The radio communications network was provided by the Sultans Special Forces, and all emergencies were quickly covered.
All the local Filling Stations along the marathon route had agreed to allow the runners to use their toilet facilities, these were spasmodic

however, and no such facilities were present at the start or finish locations.
Water / Sponge stations were well administered, placed at 3k intervals throughout the course. Advance warning of the presence of each station being given by high visibility signs.

7) Course Monitoring & Definition
At least one of the lead runners strayed from the designated course due to poor marshalling. Each of the marshalls wore an official "T" shirt, but they were not easily identified by the runners. Each turn and intersection was marked with directional arrows, but these were sparse and not particularly of high visibility. There were police officers strategically placed throughout the course, but there principle role was to control traffic, with no obvious attempt being made to give any direction to the runners.

8) Finish Line Arrangements
Due to the field of runners being so small (only 121 registered) the finish arrangements were acceptable. There was a small "run-in" of approximately 30m on an unsuitable soft surface, which should be avoided for future events. Of the sixty-five recorded finishers, eighteen were subsequently disqualified for not passing through all the secretly placed check points on the route.

9) Conclusions & Recommendations
The 1989 Muscat Marathon was a "low key" affair when compared to other big city marathons included in the IAAF road race fixtures, with only sixty-five runners completing the course. It was a cosmopolitan event with runners of twelve nationalities participating, but no athlete officially represented their country.

Inadequate traffic control was the major critism of this years event, if the race is to receive international recognition it must be traffic free. A "loop" or "out & back" course may help some of the operational & traffic problems, with the start and finish being located in the Baushar Stadium which would add great prestige to the race.

Attempts must also be made to attract a greater number of entries particularly some quality athletes, through greater worldwide publicity and perhaps some attractive awards for the winners.

Improvements could be made to the organisational structure of the race, there seemed to be little delegation of responsibility. Some of the key officials were multi-functional carrying out many duties. Whilst this may be possible with only one-hundred runners, if the status of the event is to be improved this will not be acceptable in the future.

The event does have potential, and from these modest beginnings a quality road race could be developed if greater interest were engendered.

Paul A Hodgson
IAAF / AIMS Approved Course Measurer.
5th February 1990

Copies to :-
J. B. Holt - General Secretary, IAAF.
Barkat Al-Sharji - Oman Athletic Association.
William Norgrove - Race Director.
John Disley - IAAF Measurement Coordinator.
Ted Paulin - AIMS Technical Committee.
Peter Riegel - AIMS Course Registrar.

VALIDATING A COURSE AND ADJUSTING IT FOR THE NEXT RACE

You may be called on to validate an international race course. In this procedure, you measure what is already there, and arrive at a measured length. You will generally stop at already-established split points rather than lay down your own. When you are done you can use your data to correct deficiencies in the course. Consider the following example of a 5 km course:

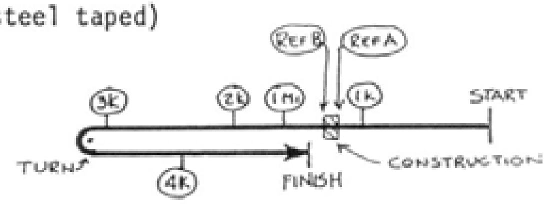
You find that there is an impassable construction area between 1 km and 2 km, and must measure across it with steel tape, and combine the distance with those obtained with your bicycle.

<u>Calibration</u> - using a 1 km calibration course you obtain:

```
   precal = 9262, 9263, 9262, 9261   avg = 9262.0
  postcal = 9266, 9267, 9265, 9266   avg = 9266.0
day's avg = 9264.0 counts/km      (without 1.001)
```

<u>Measurement data</u> - You obtain the following measurements for all the intervals, and after recalibration, immediately convert all the measured distances into metres. From now on "counts" will not be used. Note also that we are using "real" metres, without any 1.001 SCPF tacked on. This means that taped and bicycled distances may be combined without correction.

	RECORDED COUNT	INTERVAL COUNT	INTERVAL METRES	
START	00490			
1K	09828	9338	1008.0	
Ref A	11572	1744	188.3	
Ref A				
Ref B			39.6	(steel taped)
Ref B	11600			
1M	14946	3346	361.2	
2K	18786	3840	414.5	
3K	28073	9287	1002.5	
TURN	30117	2044	220.6	
4K	37244	7127	769.3	
FINISH	46659	9415	1016.3	
MEASURED DISTANCE			5020.3	(reported distance for a validation measurement)



Since 5020.3 metres exceeds 5 km, the course was OK for yesterday's race, although a bit oversize.

For tomorrow's race, the desired length of the course is 5005 metres, including SCPF. The existing cumulative distance from start to finish is 5020.3 meters.

Thus, you may remove 15.3 meters from the course. The race director would like to make the adjustment at the turnaround.

With the adjustment, the overall length of the course becomes correct. However, some of the splits are misplaced. This has no effect on the validity of the overall course, but it is desirable to have them right.

Construct a table like the following, and use it to figure out where all the splits will lie <u>after</u> adjusting the turnaround, and how much they should be moved:

INTERVAL	(1) METRES ORIGINAL LENGTH	(2) METRES ADJUST-MENT	(3) METRES AFTER ADJUST	(4) METRES CUM LENGTH	(5) METRES DESIRED LENGTH	(6) METRES NEEDED TO ADD
START				0.0	0.0	0.0
1 km	1008.0		1008.0	1008.0	1001.0	-7.0
REF A	188.3		188.3	1196.2		
REF B	39.6		39.6	1235.9		
1 Mile	361.2		361.2	1597.0	1611.0	13.9
2 km	414.5		414.5	2011.6	2002.0	-9.6
3 km	1002.5		1002.5	3014.0	3003.0	-11.0
TURN	220.6	-7.7	213.0	3227.0		
4 km	769.3	-7.7	761.7	3988.7	4004.0	15.3
FINISH	1016.3		1016.3	5005.0	5005.0	0.0

(1) This column is the same as the "INTERVAL METRES" column on the previous page.

(2) This column reflects any adjustments made. It shows that 7.65 metres was removed from the course between 3 km and TURN, and 7.65 between TURN and 4 km.

(3) This column is the sum of columns (1) and (2). It reflects locations of splits after adjustment to TURN is made.

(4) This column shows the <u>actual</u> distance of each split point from the start, after the 15.3 metre adjustment to the TURN is made.

(5) This column shows the <u>desired</u> distance of each split point from the start. Here is where we apply the 1.001 SCPF. Note that each km split is exactly 1.001 times its nominal value. Also, 1 mile (1 mi = 1609.344 m) has been increased to 1609.344 X 1.001 = 1611.0 metres.

(6) This column shows the adjustments that must be made to make the splits come out right. It is simply column (5) minus column (4).

Actions to be taken on the roadway:

Move 1 km split 7 metres TS (toward start along runners' path)
Move 1 mile split 13.9 metres TF (toward finish)
Move 2 km split 9.6 m TS
Move 3 km split 11.0 m TS
Move TURN 7.65 m to shorten course by 15.3 m
Move 4 km split 15.3 m TF

With the above actions taken, the course is correct. It will be 5005 actual meters long, and every split will be proportionally larger by 0.1 percent.

There are other ways to do this, but this is one way that works. All the way through you are working in actual, true metres, so don't forget to include the SCPF in the "METRES DESIRED LENGTH" column.

1990 ADT LONDON MARATHON

The ADT London Marathon follows the pre-race validation procedure mandated by AIMS, of which it is a member. This requires that the course be measured by a local measurer, and then checked by an approved foreign measurer. The foreign measurer also views the race from the lead car to assure that the measured course was the one raced.

Continuing construction in the Docklands has meant that the middle of the course is slightly different each year. This requires John Disley, the local measurer, to search out roadway combinations that will not require radical alterations of the start or finish lines. This year he made six alterations, two removing distance and four adding it, that made the course come out right. This required many midnight rides, with no protection, to rough things out.

Measurements in 1987 through 1989 established accurate, documented reference points at 10k, 15k and the Tower of London exit, leaving about 21 kilometres in the middle to be accurately remeasured. After John got his rough figures right, he did one final ride of the mid-portion of the course, again riding unprotected, in which he laid out split points.

With this done, he invited me to London to check his course. Because we had the time, at John's suggestion I elected to remeasure from our 10k reference point to the entrance of the Tower, picking up John's splits enroute and adjusting them after we had established a tentative course length.

Race Director Chris Brasher and AAA measurer Mike Tomlins accompanied me on the measurement, with John leading the way to each successive split mark. Order of riding was Mike, Pete, Chris. We calibrated on 500 m in Greenwich, rode the distance, stopping at all John's splits, and recalibrated on the same calibration course, which I had checked the previous year.

When we were done we had a marathon course which was 42256 metres long, or 19 metres longer than the 42137 (42195 + 42.2) metres it is supposed to be. In other words, quite acceptable. Part of this difference was due to John's unprotected riding, and part due to a typographic error in data I had sent him after last year's ride. The errors almost offset one another. In any case, to satisfy the desire for as much perfection as we could get, we had to remove 19 metres from the course, which we did at the start, and adjust the splits to more accurate locations.

Since split relocations ranged from 19 to 68 metres, and since absolute accuracy was not required, we adjusted them by pacing the distances. In this way we believed each split was no more than a few metres off.

Each 5k split had a line across the road to mark it, and a clock tower nearby. The mile splits were marked with smaller marks, and timing towers erected as near to the actual marks as space constraints permitted. Thus the runners and lead car observers may have misjudged the exact locations of the mile splits.

Few measurements are perfect, and this one was no exception. For example, John reported a count of 88247 at 13M. In calculating I assumed he transposed, and gave it 88427. This brought his 13M split in accordance with the rest of us. It had been 21 m off. However, the required adjustment of the 13M split was 21 m less than the required adjustment of the adjacent splits, suggesting that we may not have stopped at the same mark that John used on his ride. Marks from previous races were present, and it is possible we got this one wrong.

John's measurement of the 19M to 20M split interval exceeded ours by 10 metres. I have no explanation for this. His data everywhere else was much closer than that. Stopping at a wrong mark is unlikely, since this would have affected two split intervals, not just one.

German measurer Helge Ibert, age 55, ran the race (2:57!), and had a fancy new stopwatch on which he was able to record every mile split. After a slow start, because of the crowd of 35000, Helge settled into a regular pace. He questioned his 12M and 13M splits because they were irregular. The elite leaders, observed from the lead car, showed no similar irregularity.

The 5k splits reflect the pace of the race. After an hour of heavy rain, it started in a downpour, at a temperature of about 10C (50F). The rain quit between 2M and 3M. A sizeable lead pack ran at 15:18 for the first 5k and 15:10 for the next. Nick Rose, Bill Reifsnyder and Allister Hutton began to break free, covering the next 5k in 15:01. Halfway through, Rose dropped out, his pacemaking chores done, and Reifsnyder and Hutton continued to lead. By 25k their lead was 1:30, near which point Reifsnyder, not fully recovered from a previously-injured ankle, had to retire, leaving Hutton alone in the lead. Although the pack narrowed the gap, Hutton hung on to finish in 2:10:10, 30 seconds ahead of Bettiol.

Next year I'd suggest a different color scheme for the marks. There are enough now in place that more similar ones will add confusion. The first and last segments remain OK, but the middle needs attention. The only technical error I believe we made was in the placement of the 13M split, and I'd guess it was off by 20 metres, probably because we confused the marks.

One of the high points of the trip for this measurer was the chance to meet with John Jewell, the man who gave Ted Corbitt early guidance in the measurement of road courses. In the early 1960's John realized the need for accurate course measurement, and pioneered work with the Veeder-Root counter, which, with use of spoke-counting, gave accuracy comparable with the Jones counter. It was a warm experience to meet him, and to let him know of the esteem in which we hold him.

Pete Riegel

Peter S. Riegel
April 26, 1990

MEASUREMENTS OF 1990 ADT LONDON MARATHON COURSE

All calculations use average constant without additional 1.001.

	JOHN	PETE	CHRIS	MIKE	
	PRECAL				
	8 Apr 9 AM 800 m 11.5 C	15 Apr 6:30 AM 500 m 6 C	15 Apr 6:30 AM 500 m 6 C	15 Apr 6:30 AM 500 m 6 C	
	7405.5	4625	4636	4718.5	
	7405.5	4626.5	4636	4718	
	7405.5	4627	4635	4718	
	7405.5	4628	4636	4718	
		4627			Used Pete's
		4626.5			last 4 rides
pre avg	7405.5	4627.125	4635.75	4718.125	
ct/km	9256.875	9254.25	9271.5	9436.25	
	POSTCAL				
	8 Apr 2 PM 800 m 12.9 C	15 Apr 10 AM 500 m 11 C	15 Apr 10 AM 500 m 11 C	15 Apr 10 AM 500 m 11 C	
	7405	4628.5	4635	4713.5	
	7405	4628	4636	4713	
	7404	4629	4635	4713	
	7406	4628.5	4636	4712.5	
post avg	7405	4628.5	4635.5	4713	
ct/km	9256.25	9257	9271	9426	
Day avg Cts/km	9256.562	9255.625	9271.25	9431.125	

Measurement data - counts obtained

	JOHN	PETE	CHRIS	MIKE	
10k		44254	45000	18000	
7M		56010	56795	29997	
8M		70864	71676	45139	
9M	28603	85741	86597	60319	
15k	33384	90528	91391	65202	
10M	43514	100647	101532	75519	
11M	58425	115527	116461	90683	
12M	73336	130435	131405	105880	
20k	79711.5	136806	137787	112369	
13M	88427	145543	146544	121277	John reported 88247 at 13M.
HMar	89878	146949	147945	122706	88427 is assumed here.
14M	103158	160200	161229	136205	Subsequent riders may have
15M	118069	175082	176135	151357	stopped at a different mark.
25k	126039	183026	184096	159451	
16M	132980	189980	191064	166544	
17M	147891	204885	206001	181729	
18M	162802	219790	220939	196912	
30k	172366.5	229358	230531	206662	
19M	177713	234701	235884	212102	
20M	192624	249505	250722	227186	
21M	207535	264405	265656	242368	
35k	218694	275553	276830	253710	
22M	222446	279300	280584	257522	
Tower	225722	282543	283863	260848	

AT GREENWICH CALIBRATION COURSE. - NOTE SIGN -

PETE MIKE JOHN CHRIS

MEASURED INTERVALS EXPRESSED IN METRES

	JOHN	PETE	CHRIS	MIKE	LOWEST OF LAST 3	
10k						
7M		1270.1	1272.2	1272.1	1270.1	
8M		1604.9	1605.1	1605.5	1604.9	
9M		1607.3	1609.4	1609.6	1607.3	
15k	516.5	517.2	517.1	517.8	517.1	
10M	1094.4	1093.3	1093.8	1093.9	1093.3	
11M	1610.9	1607.7	1610.2	1607.9	1607.7	
12M	1610.9	1610.7	1611.9	1611.4	1610.7	
20k	688.8	688.3	688.4	688.0	688.0	
13M	941.5	944.0	944.5	944.5	944.0	Based on assumed
HMar	156.8	151.9	151.1	151.5	151.1	transposition
14M	1434.7	1431.7	1432.8	1431.3	1431.3	
15M	1610.9	1607.9	1607.8	1606.6	1606.6	
25k	861.0	858.3	858.7	858.2	858.2	
16M	749.8	751.3	751.6	752.1	751.3	
17M	1610.9	1610.4	1611.1	1610.1	1610.1	
18M	1610.9	1610.4	1611.2	1609.9	1609.9	
30k	1033.3	1033.7	1034.6	1033.8	1033.7	
19M	577.6	577.3	577.4	576.8	576.8	
20M	1610.9	1599.5	1600.4	1599.4	1599.4	???? John ????
21M	1610.9	1609.8	1610.8	1609.8	1609.8	
35k	1205.5	1204.5	1205.2	1202.6	1202.6	
22M	405.3	404.8	404.9	404.2	404.2	
Tower	353.9	350.4	353.7	352.7	350.4	
Sum 10k +		25745.3	25763.8	25749.6	25738.6	
Sum 9M +	21295.1	21263.0	21277.2	21262.5		

OVERALL LENGTH CALCULATION

The distance from the start to the 10k reference point was determined to be 9996.0 metres last year. That portion of the course did not change. It is 389.0 metres across Tower Wharf, determined in 1987. It is an additional 6125.5 metres from the west end of the Tower to the finish, determined in 1989. No changes occurred here this year.

Using Pete's measurement of 10k-to-Tower as official we get:

Start to 10k	9996.0
10k to Tower E	25745.3
Tower E to Tower W	389.0
Tower W to Finish	6125.5
Length of course:	42255.8
Desired length:	42237.2
Amount to remove:	18.6

In accordance with the above, the course was shortened by 18.6 metres at the start.

ADJUSTMENTS TO SPLITS

The splits from the new start to 10k were each moved 19 metres TF (toward finish, in the direction of running). The splits from the Tower to the finish needed no adjustment. The splits in the middle were adjusted as follows:

	Pete's distance	Distance from old start	Distance from new start	Desired distance	Distance to move split TF
10k		9996.0	9977.4	10010.0	32.6
7M	1270.1	11266.1	11247.5	11276.7	29.1
8M	1604.9	12871.0	12852.4	12887.6	35.2
9M	1607.3	14478.4	14459.8	14498.6	38.8
15k	517.2	14995.6	14977.0	15015.0	38.0
10M	1093.3	16088.8	16070.2	16109.5	39.3
11M	1607.7	17696.5	17677.9	17720.5	42.6
12M	1610.7	19307.2	19288.6	19331.4	42.8
20k	688.3	19995.5	19976.9	20020.0	43.1
13M	944.0	20939.5	20920.9	20942.4	21.5
HMar	151.9	21091.4	21072.8	21118.6	45.8
14M	1431.7	22523.1	22504.5	22553.3	48.9
15M	1607.9	24131.0	24112.4	24164.3	51.9
25k	858.3	24989.3	24970.7	25025.0	54.3
16M	751.3	25740.6	25722.0	25775.3	53.3
17M	1610.4	27351.0	27332.4	27386.2	53.8
18M	1610.4	28961.3	28942.7	28997.2	54.4
30k	1033.7	29995.1	29976.5	30030.0	53.5
19M	577.3	30572.4	30553.8	30608.1	54.4
20M	1599.5	32171.8	32153.2	32219.1	65.9
21M	1609.8	33781.6	33763.0	33830.0	67.0
35k	1204.5	34986.1	34967.5	35035.0	67.5
22M	404.8	35390.9	35372.3	35441.0	68.6