

The Profiling and Preparation of an Elite Junior Miler



Scott Christensen
December 2010

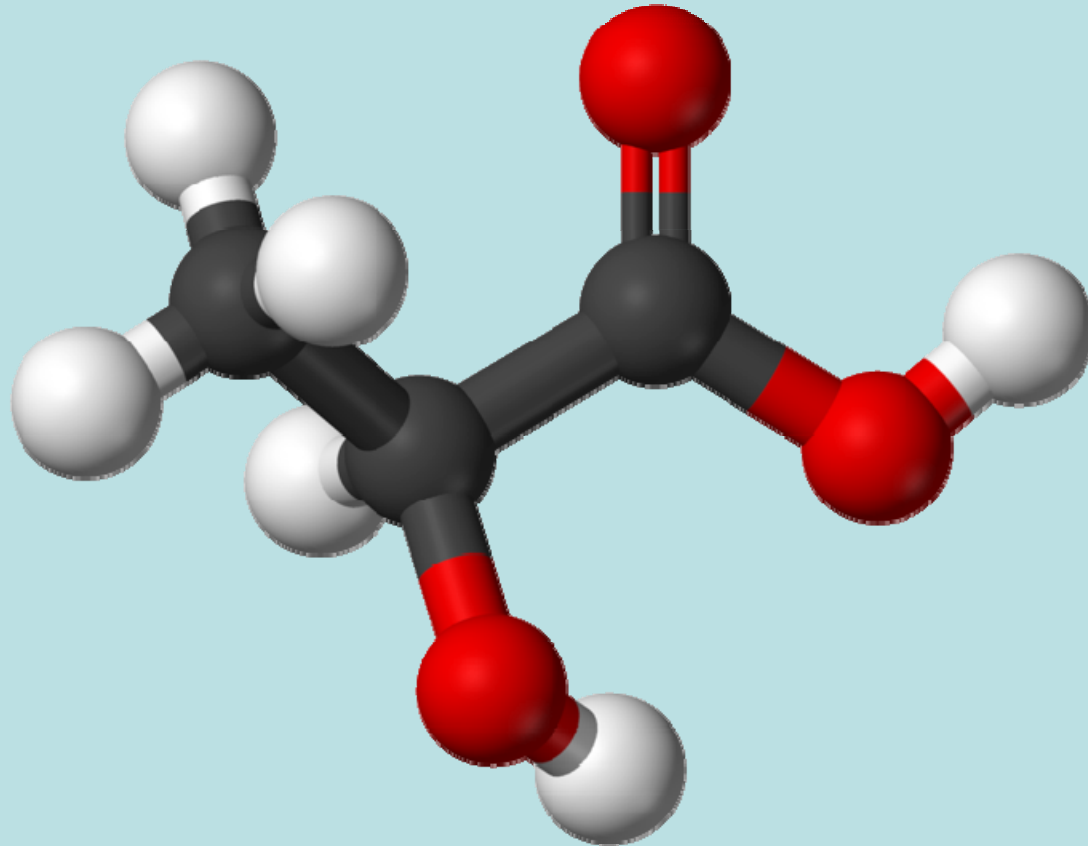
“The 800 and 1500 meter events are physiologically very close, but very distant psychologically” Peter Coe.



Successful racing in the fast end of
the combined zone (800 and 1500)
relies on managing oxygen
and.....



The toleration of disassociated Lactic Acid ($\text{C}_3\text{H}_5\text{O}_3^- + \text{H}^+$)



Anaerobic and Aerobic Energy Contributions

<u>Event</u>	<u>Aerobic</u>	<u>Anaerobic Glycolytic</u>	<u>Anaerobic Alactic</u>
• 800 meters	40%	55%	5%
• 1500 meters	50%	48%	2%
• 3200 meters	70%	30%	<1%
• 5000 meters	80%	20%	<1%

Wilmore and Costill 1985

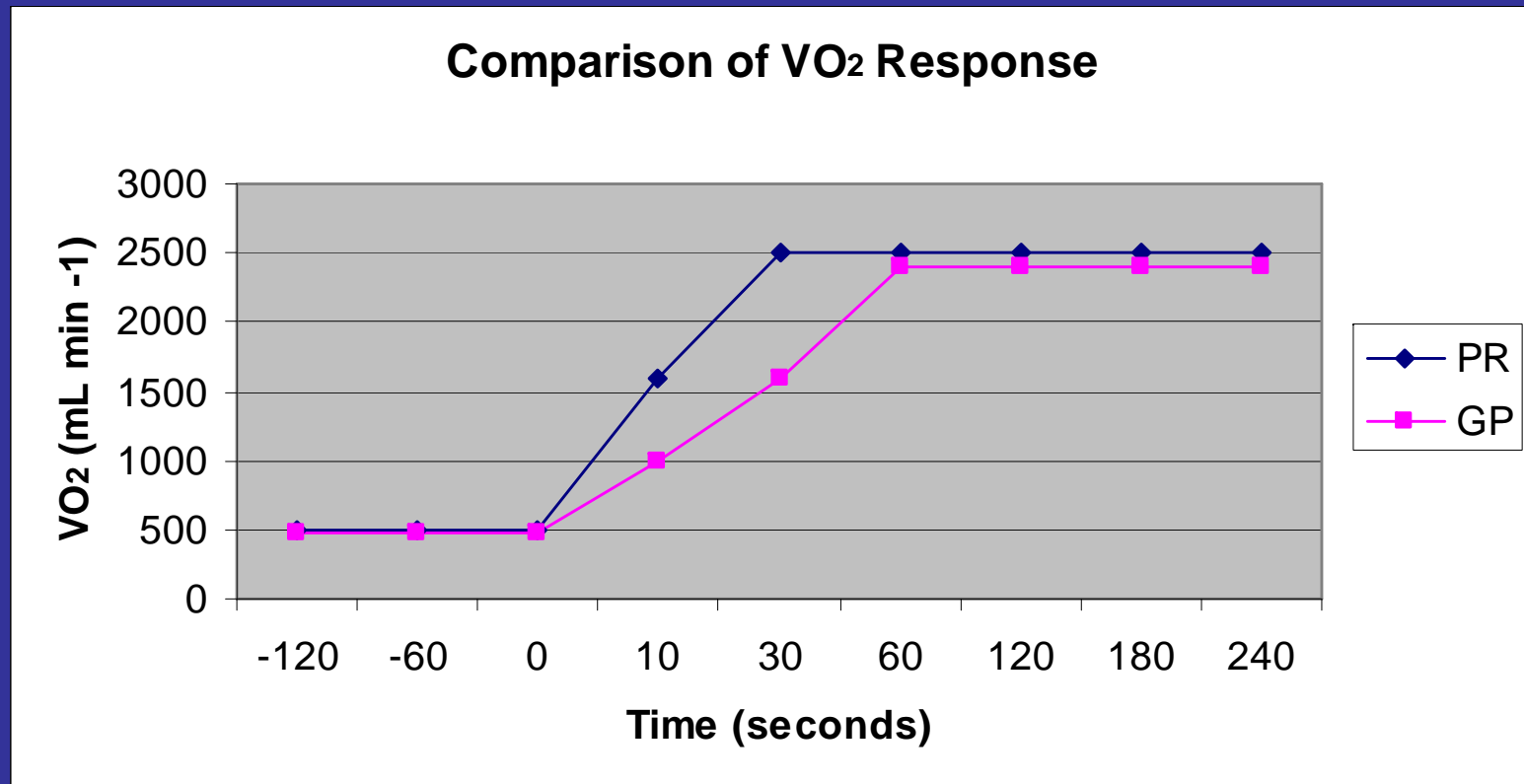
Physiological Definition of “Elite” in Endurance Events

- A genetic/trained physiological shift in an athlete to a greater contribution by the aerobic energy system at a combined zone race distance.
- **Example: 3000 meter race.**
 - *General Population* = 70% aerobic/30% anaerobic
 - *Paula Ratcliffe* = 85% aerobic/15% anaerobic

VO₂ Kinetics to Steady State

@ 16 km/hour

Jones and Berger 2008



It Is All About Preparation

“ If given 8 hours to cut down an oak tree, I would spend the first 6 hours sharpening my axe.”

Abraham Lincoln

Preparation Considerations for the Training Periods of the Elite Miler

- Determining goals, objectives, and physiological parameters.
- $v\dot{V}O_2$ max pace [date]
- vAT pace [date]
- vLT pace [date]
- Psychological needs of the athlete are prioritized.



Goals and Objectives

	800 Meters	1600 Meters	vVO ₂	5000 Meters
December	2:05.30	4:27.00	4:56.00	15:37.00
January	2:04.05	4:25.00	4:53.00	15:31.00
February	2:02.81	4:23.00	4:51.00	15:24.00
March	2:01.58	4:21.00	4:48.50	15:11.50
April	1:57.34	4:14.00	4:42.30	14:51.35
May	1:54.87	4:09.78	4:34.50	14:37.50
State Meet	1:53.52	4:06.23	4:31.80	14:26.32
Junior Nats	1:51.78	4:04.36	4:28.30	14:23.30

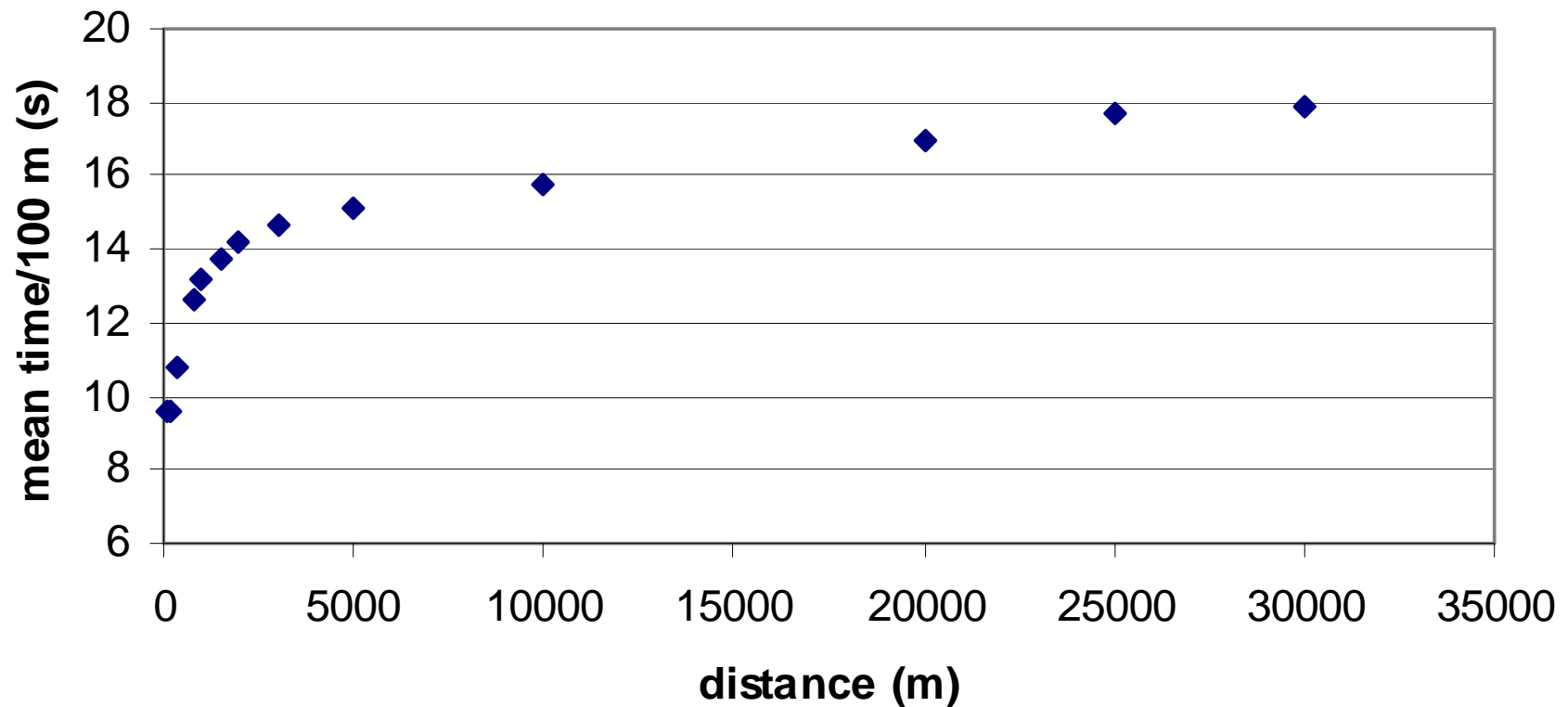
Physiological Parameters

	200-400	400-600	600-800	1000-1600	20-40 Min.
	120% VO ₂	114% VO ₂	105% VO ₂	100% VO ₂	LT 85% VO ₂
Dec	62.65	67.69	4:51.00	4:56.95	5:44.00
Jan	62.02	66.78	4:49.00	4:53.98	5:42.20
Feb	61.41	65.66	4:47.00	4:51.04	5:40.23
March	60.79	64.83	4:43.50	4:48.13	5:36.30
April	58.36	63.00	4:37.30	4:42.63	5:28.30
May	57.85	62.02	4:30.50	4:34.30	5:23.89
State	57.21	61.20	4:28.80	4:31.20	5:18.32
Junior Nat	55.93	61.08	4:25.30	4:28.33	5:15.10

Training Sprinters vs. Distance Runners

[Rate vs. Economy]

WR Mean Time per 100 m vs. Distance



*Designing the elements of the 1500
macrocycle so that the best
performances are at the end of the
season » should be the number one
objective.*



Specific Periods Within the 1500 Meter Macrocycle

- The **Preparation Period** focuses on the athlete as an endurance runner.
- The **Competition Period** focuses on the athlete as a miler.
- The **Transition Period** allows the athlete to prepare for the next stage of development.

Training Modalities for Middle Distance Runners

- The Long Run **IMPORTANT**
- Tempo Run **IMPORTANT**
- Strength Run **IMPORTANT**

- Recovery/Base Run **CRITICAL**
- $VO_{2\max}$ Run **CRITICAL**
- Interval Run **CRITICAL**
- Repetition Run **CRITICAL**

The Multi-Paced Training Scheme

- Based on a 12 day microcycle.
- The long run, tempo run, strength run, recovery run, and races are included within the 12 days.
- The 12 day cycle also includes one day each of five distinctively varied paces that predominantly deliver ATP through the anaerobic energy system.

The 5 Paces of the Multi-Paced Training Scheme for the 800/1500.

- $\text{VO}_2 \text{ max}$ Run (800-3200 meters)
- Special Endurance 2 (500-600 meters)
- Special Endurance 1 (300-500 meters)
- Speed Endurance (150 meters)
- Speed (30-60 meters)

Frank Horwill, Peter Coe, and Sebastian Coe

VO₂ max Field Tests

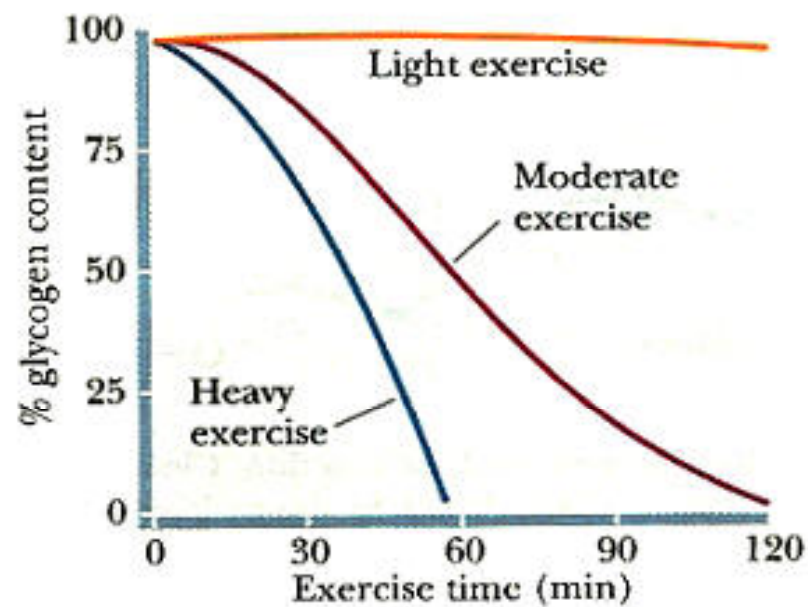
- *Buchfuhr* protocol: 10 min to exhaustion. (d)
- *Astrand* protocol: 2 miles at exhaustive pace. (t)
- *Taylor* protocol: 65% of date pace exhaustive 400 meters. (p)

Long Run

- Outer reach of fitness level is the goal
- Fatty acid rather than carbohydrate is the primary energy source
- Done at the **aerobic threshold**, 70% $\dot{V}O_2$ max pace
- Pace consideration when done in a group
- Extent is 20% of weekly mileage throughout the macrocycle

Fuel Depletions and Limits

Glycogen Utilization in Working Muscle



Biochemistry, 3rd ed, Garrett and Grisham, 2004, p. 772

Tempo Run

- Extent of work is beyond 1500 race distance to 15 K.
- Intensity is done closer to the **lactate threshold**
- Duration dictates pace:
- 6K-7K at 92% of VO_2 max.
- 8K-9K at 90% of VO_2 max.

FINAL EDITION **London Herald** FINAL EDITION
 No. 31201 FRIDAY 7th MAY 1954

BANNISTER BREAKS FOUR MINUTE MILE

Greatest Record in Sport Falls



Miracle Mile for British Medical Student
 By Tom Phillips

The greatest human exploit ever recorded, the four-minute mile, was broken today by Roger Bannister, a 27-year-old medical student, in a race which has been hailed as the greatest feat in the history of sport.

Bannister, a 27-year-old medical student, broke the four-minute mile today, a feat which has been hailed as the greatest feat in the history of sport. He did this in a race which was watched by a large number of spectators, and which was broadcast on the radio.

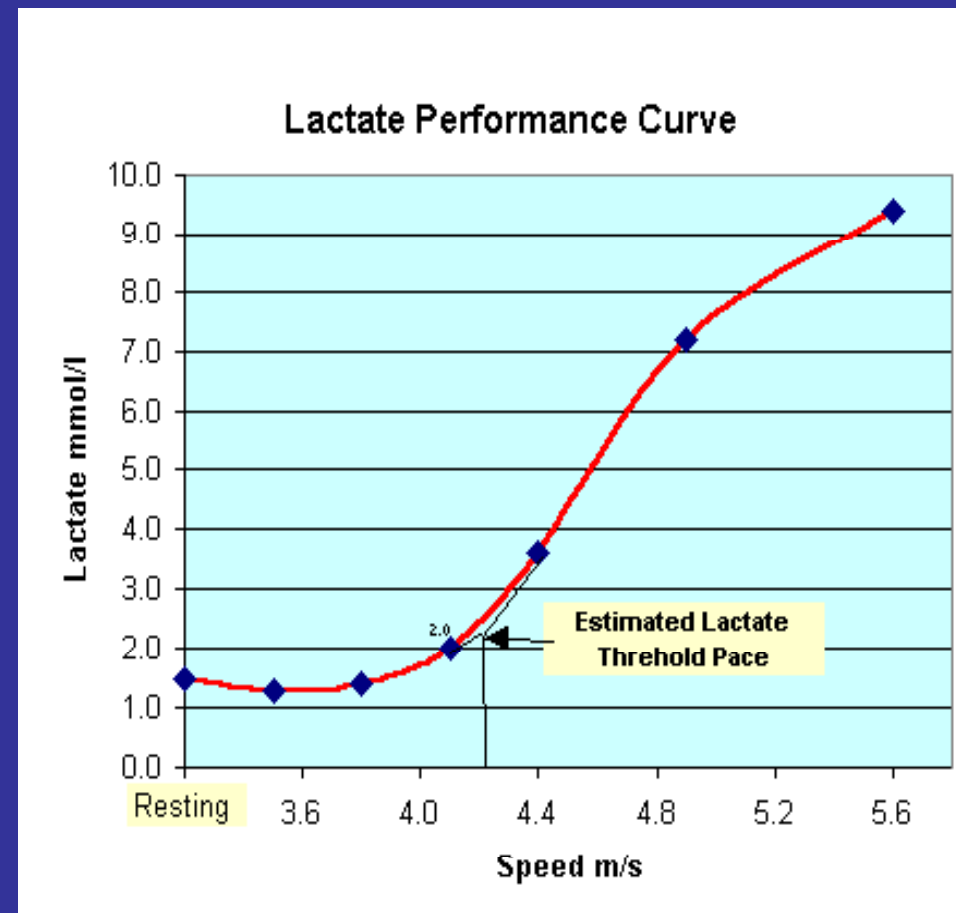
The feat was achieved by Bannister, a 27-year-old medical student, in a race which has been hailed as the greatest feat in the history of sport. He did this in a race which was watched by a large number of spectators, and which was broadcast on the radio.

OTHER NEWS

... (The rest of the page content is too small to transcribe accurately, but it contains various news snippets.)

Anaerobic/Lactate Threshold

- The speed at which H^+ ions begin accumulating.
- Measured by lactate concentrations.
- About 15K pace (4.2 m/s) is the training mark, or 85% of $VO_{2\text{ max}}$ **velocity**.
- **Tempo runs** are done as a percentage of $VO_{2\text{ max}}$ **velocity**.



Strength Run

- Greater applied force against resistance is the goal.
- Any running is strength work.
- Hills are the main target workout.
- Hills are done in 4 microcycle blocks of time.
- 35-45 second bouts of work.
- 4 minute jog of incomplete recovery.
- Sets of 6-8.

Recovery Run

- Recovery has many aspects and may simply be adding base mileage at the aerobic threshold pace. **Shorter in distance than the long run.**
- Energy system recovery and muscle repair are the biggest concerns.
- **20 min run at minimum.**

A Critical Understanding of $\text{VO}_2 \text{ max}$ is Necessary for the 800/1500

- Aerobic power improves due to cardiovascular development.
- Cardiac Output (Q) = HR x SV
- $\text{VO}_2 \text{ max} = \text{HR} \times \text{SV} \times \text{A-vO}_2 \text{ diff}$
- $\text{HR}_{\text{max}} = 207 - 0.7 \times \text{age}$
- $\text{VO}_2 \text{ max}$ pace HR is ~88% of HR_{max}



Percentage of $\text{VO}_2 \text{ max}$ as a Function of Race Velocity

<u>Event</u>	<u>% of $\text{VO}_2 \text{ max}$</u>
• 800 Meters	120-125%
• 1500-1600 Meters	112-114%
• 3000-3200 Meters	102-100%
• 5000 Meters	97%

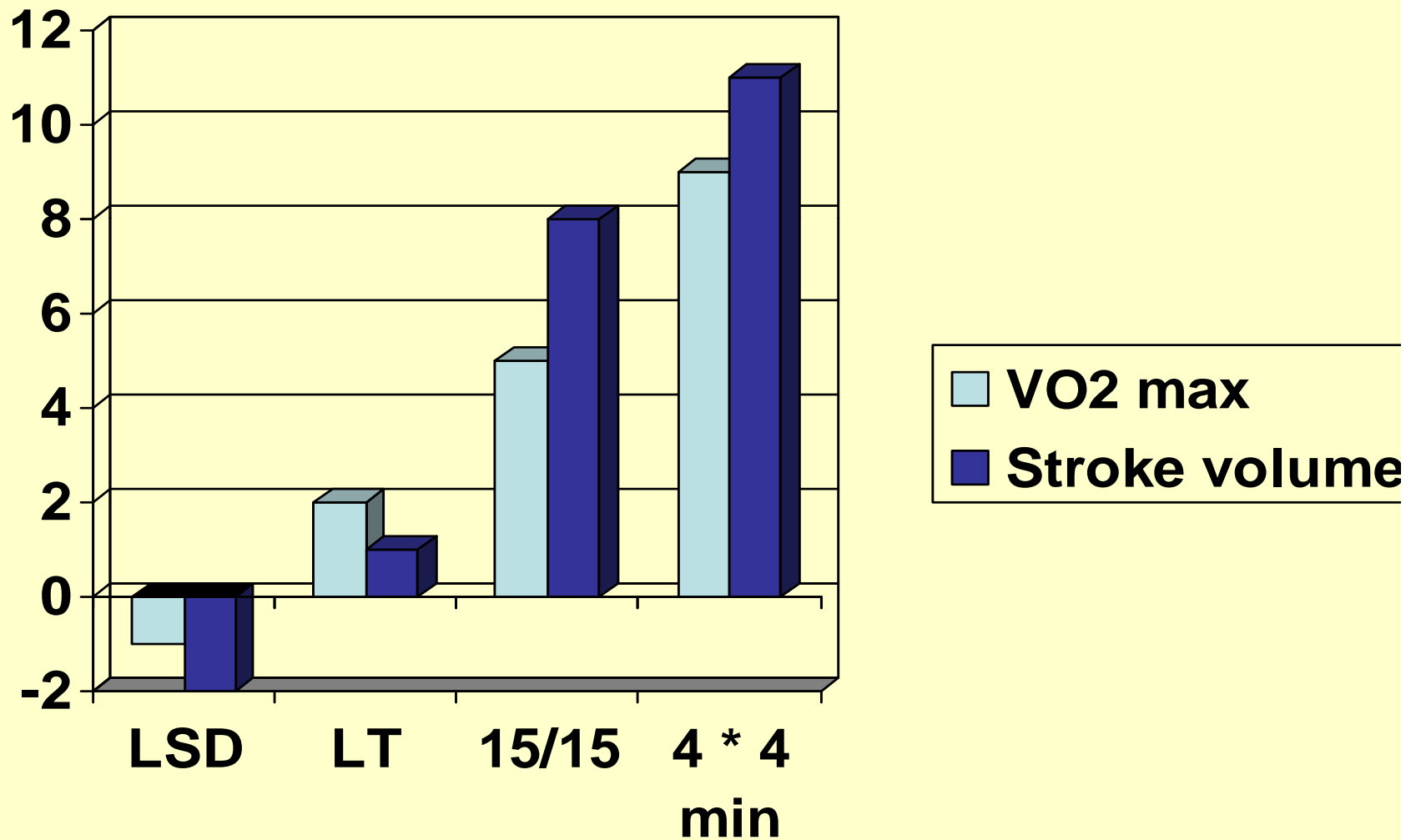
VO₂ max Training Study
12 week Training Period
(Helgerud et al, 2007)

- LSD: CR for 45 min @70% VO₂ max
 - LT: CR for 25 min @85% VO₂ max
- 15/15: 47 reps @90% HR max, 15 s rest
 - 4*4 min: 4 min repeats @ VO₂ max

Workout repeated twice per week, 40 mile weeks.

% Change VO₂ max & Stroke Volume (12 Weeks)

Helgerud et al, 2007, MSSE



Pre/Post Physiological Changes

	Pre LSD	Post LSD	Pre LT	Post LT	Pre 15/15	Post 15/15	Pre 4*4	Post 4*4
VO₂ max	55.8	53.8	59.6	60.8	60.5	64.4	55.5	61.4
V_E O₂	150.6	153.3	148.8	153.6	147.5	160.3	150.7	164.8

Deena Kastor's $v\dot{V}O_2$ _{max} Development

- Tested $\dot{V}O_2$ _{max} :
 - Age 22 (1995) $\dot{V}O_2$ _{max}: 77.5 ml/kg/min
 - Age 27 (2000) $\dot{V}O_2$ _{max}: 80.5 ml/kg/min
 - Age 32 (2005) $\dot{V}O_2$ _{max}: 81.1 ml/kg/min
- Tested $\dot{V}O_2$ _{uptake} at Lactate Threshold:
 - Age 22 (1995) : 61.8 ml/kg/min (79%)
 - Age 27 (2000) : 62.2 ml/kg/min (79%)
 - Age 32 (2005) : 67.3 ml/kg/min (82%)

VO₂ max Run

- A lab value and a field value.
- Each bout of work is 400-3200 meters.
- Total volume is 3200-8000 meters.
- Done as an interval style workout.
- *Pace is date specific.*
- *Rest equal to work.*



Interval and Repetition Runs

- Used mainly for glycolytic and VO_2 _{max} development.
- 30 meters to race distance.
- Barefoot grass runs.
- Rest dictates training effect.
- Efficiency early.
- Capacity late.

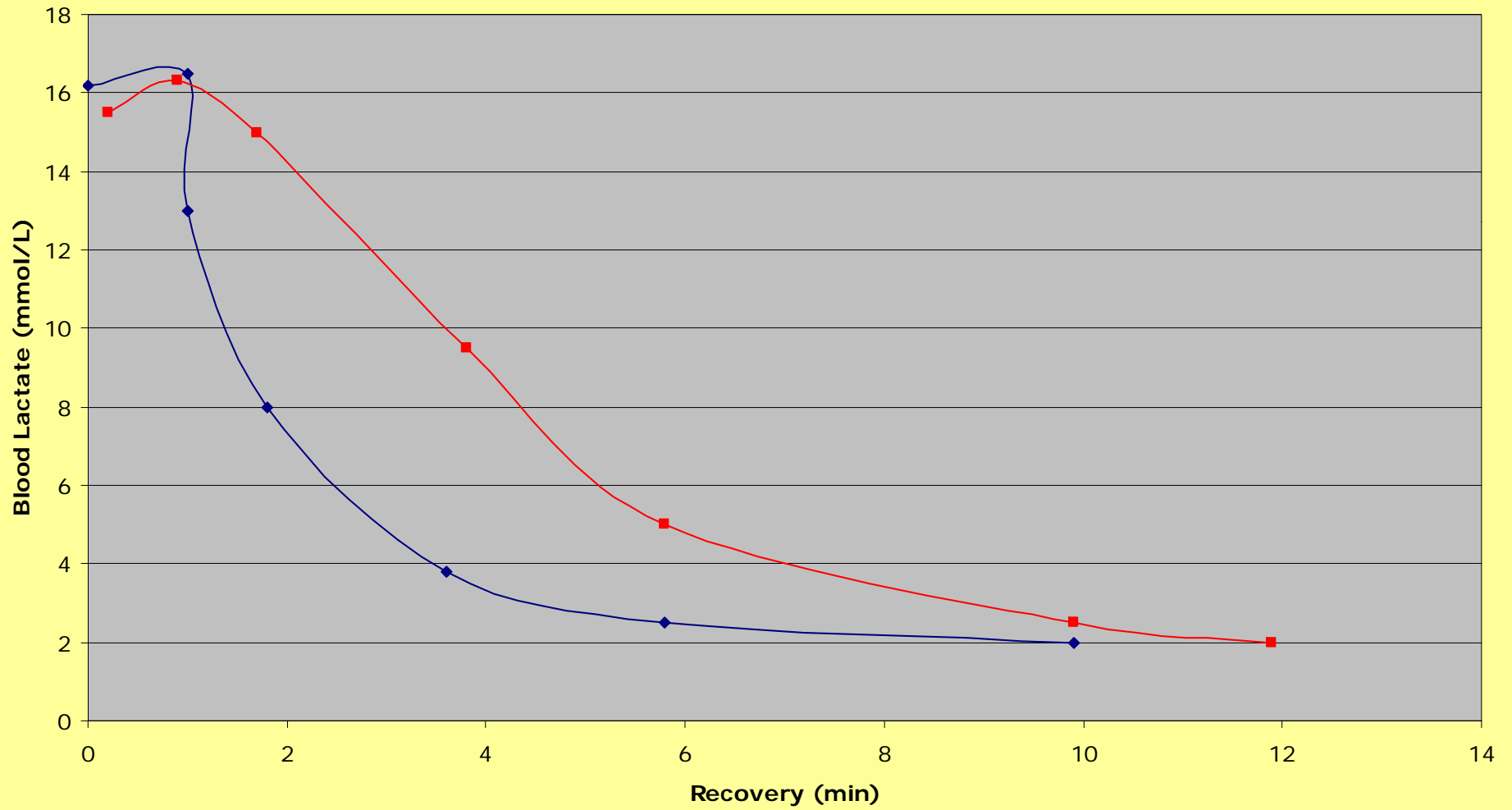
Glycolytic Training Parameters

- **Efficiency** work done first 2/3 of season.
- **Capacity** work done last 1/3 of season.
- **Efficiency** work done as interval runs.
- **Capacity** work done as repetition runs.



Recovery And Blood Lactate Levels

◆ Active Recovery ■ Passive Recovery



The Multi-Paced Training Scheme

- Based on a 12 day microcycle.
- The long run, tempo run, strength run, recovery run, and races are included within the 12 days.
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The 5 Paces of the Multi-Paced Training Scheme for the 800/1600.

- VO_2 max Run (800-3200 meters)
- Special Endurance 2 (500-600 meters)
- Special Endurance 1 (300-500 meters)
- Speed Endurance (150 meters)
- Speed (30-60 meters)
- *Adapted from: Frank Horwill, Peter Coe, and Sebastian Coe*

Improvements in Ground Contact Time

“If a distance runner can lessen their ground contact time by .02 seconds per stride, with all else being equal, there should be a ~5 second improvement in 1600 meter performance. This can be accomplished by strengthening the muscles of the foot.”

Ralph Mann Ph.D.

Special Endurance 2 Work *Done on the Grass*

- Used on a regular basis it will strengthen the muscles of the foot.
- Athletic fields or grassy parks can be set up with cones to provide a 500-600 meter course.



12 Day Multi-Paced Microcycle

- Day 1: VO_2 max
- Day 2: Hills
- Day 3: Long Run
- Day 4: Special 1
- Day 5: Recovery Run
- Day 6: Race
- Day 7: Special 2
- Day 8: Tempo Run
- Day 9: Recovery Run
- Day 10: Speed Endur.
- Day 11: Recovery Run
- Day 12: Speed

Cornerstone Workouts

- 4 * 1 mi @ VO_2 max pace
- 7 * 800 @ VO_2 max pace
- 8 * 90 sec runs on grass
- 8 * 400 with 3 min rest
- 6 * 150 with 4 min rest
- 8 * 400 with 45 sec rest
- 15 * flying 30 meters
- 4 * 500 with 15 min rest
- 8 * 200 with 8 min rest
- 2 * 3 * 300 with 3 min rest
- VO_2 max
- VO_2 max
- Special Endurance 2
- Special Endurance 2
- Speed Endurance
- Special Endurance 2
- Speed
- Special Endurance 2
- Special Endurance 1
- Special Endurance 1

VO_2 max Workout #1

- Active 3 mile warm-up run.
- Extent is 4 * 1 mile.
- Pace is *PRESENT DAY* 3200 max effort.
- Use a conversion table or a \dot{V}_{dot} (Jack Daniels) value to determine work effort from another race value.
- Rest is equal to work.
- 2 mile jog.

VO_2 max Workout #2

- Active 3 mile warm-up run.
- Extent is 7 * 800 meters.
- Pace is *PRESENT DAY* 3200 max effort.
- Use a conversion table or a \dot{V}_{dot} (Jack Daniels) value to determine work effort from another race mark.
- *Rest is equal to work.*
- 2 mile jog.

Special Endurance 2 Workout #1

- 2 mile active warm-up.
- Using 5 cones set up a 500-600 meter course on the grass of several side by side soccer fields or a park.
- Have the runners barefoot during the repeats.
- Extent of run is 8 * 600 with near max effort.
- Vary the rest so that the athletes run all 8 at about the same time. Start with 3 minutes rest and gradually move to 4-5 minutes rest between.
- 2 mile jog.

Special Endurance 2 Workout #2

- 2 mile active warm-up.
- Several very fast strides.
- Extent of work is 8 * 400 meters at near max effort on the track.
- Rest is 3 minutes.
- Time goal is ~5 seconds faster than *PRESENT DAY* 1600 pace.
- 2 mile jog.

Speed Endurance Workout

- *With a measuring wheel and can of spray paint, mark a dot on the track exactly 150 meters from the finish line.*
- 2 mile very active warm-up.
- Extent of work is 6 * 150 meters on the track at max effort. Use a starting device.
- Rest is 4 minutes.
- Time goal is their *PRESENT DAY* 400 meter time multiplied by .35.
- 3 mile easy run.

Speed Workout

- 2 mile active warm-up.
- Several active strides.
- Flying 30 meter repeats on the track.
- Work is max effort.
- 4 minutes jog rest between repeats.
- Do up to 12 reps.
- 4 mile easy run.



Special Endurance 2 Workout #4

- *Capacity work done as repetition running.*
- 2 mile active warm-up.
- Several active strides.
- Extent of work is 4 * 500 at max effort.
- Rest is near complete at 15 minutes.
- Time goal is *PRESENT DAY* 800 pace multiplied by .59.
- 1 mile jog.

Special Endurance 1 Workout #1

- 2 mile active warm-up.
- Several very active strides.
- Extent of work is 8 * 200 at near max effort on the track.
- Rest is extensive at 8 minutes between repeats.
- Time goal is *PRESENT DAY* 400 meter pace multiplied by .47.
- 2 mile jog.

Special Endurance 1 Workout #2

- 2 mile active warm-up.
- Several very active strides.
- Extent of work is 2 sets of 3 repeats of 300 meters on the track.
- Rest is incomplete at 3 min between repeats and 5 minutes between the sets.
- Time goal is **seasonal 800 goal pace** multiplied by .35.
- 2 mile jog.

▪

Regeneration Timeframe

24 hours

- Normal long runs, strength runs, recovery runs, moderate tempo runs, alactic runs

48 hours

- Races, long runs plus, lactate threshold runs, basic glycolytic, strong tempo runs, $\dot{V}O_2$ max

72 hours

- Long races, very strong glycolytic, very strong or long tempo runs

Training Effects

- Some physiological effects after 24 hours.
- Full physiological effects after 20 days.
- Periodize and sequence your workouts so they fit the race schedule.
- The body is very resilient when at a high fitness level.
- Watch for muscle trauma caused by too much testosterone.

*More Endurance Information
Available in the Following Book:*

*The Complete Guide to Track and
Field Conditioning for Endurance
Events.*

By Scott Christensen



Athletesacceleration.com/trackandfieldendurance.html