Lance Armstrong's Physiological Maturation

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Professor
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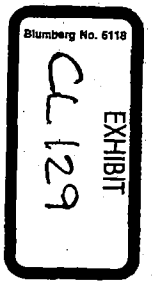
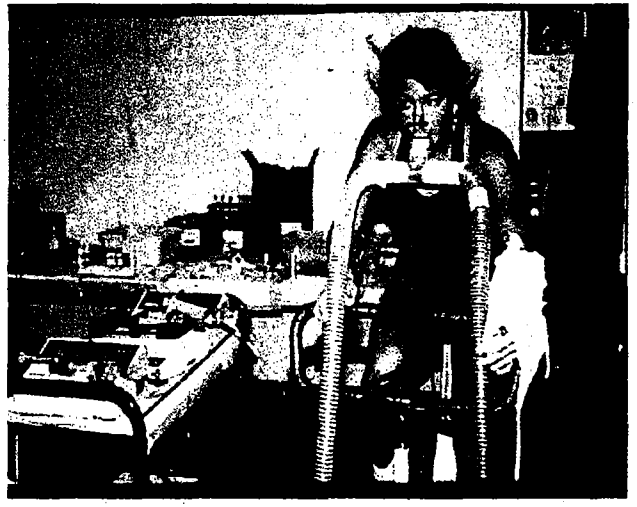
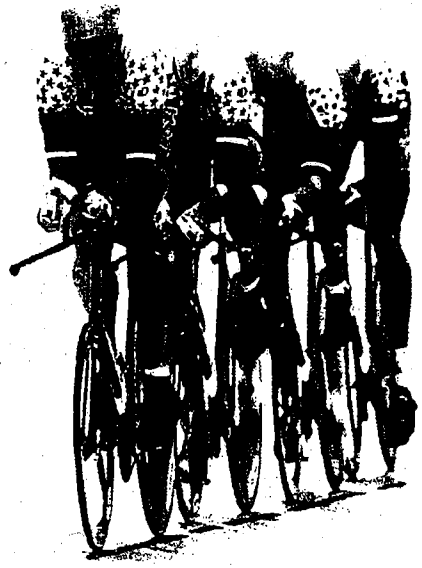
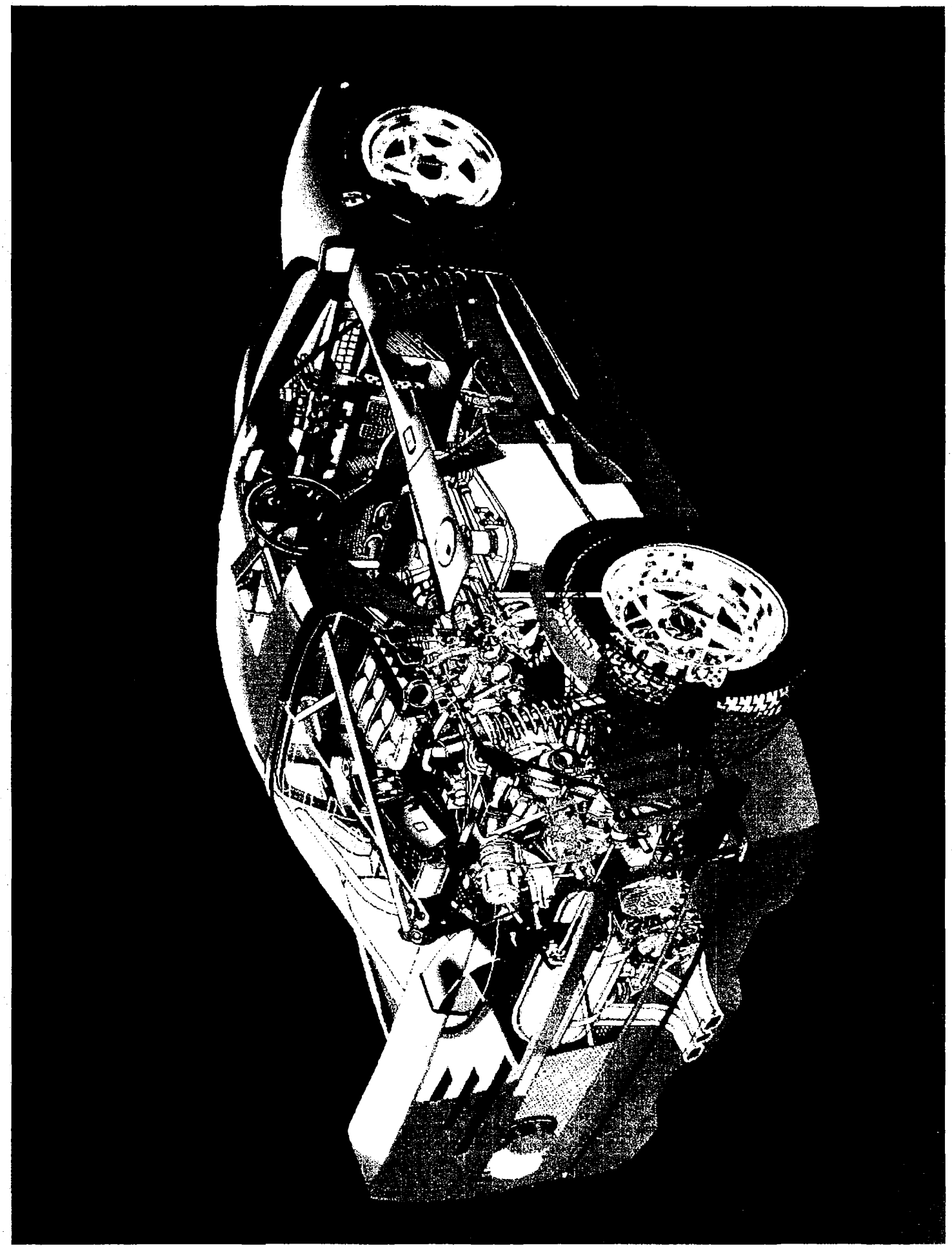


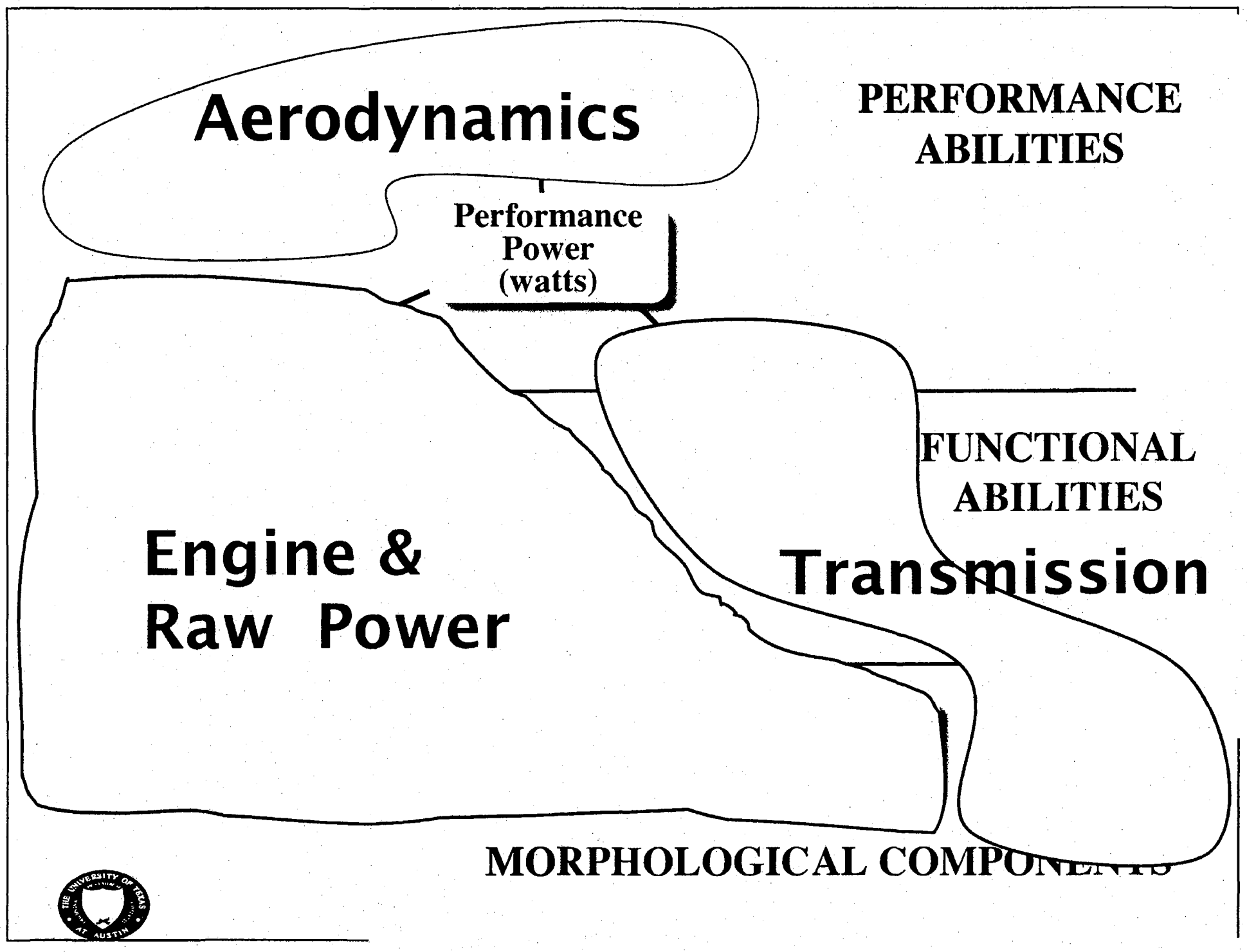
Human Performance Laboratory



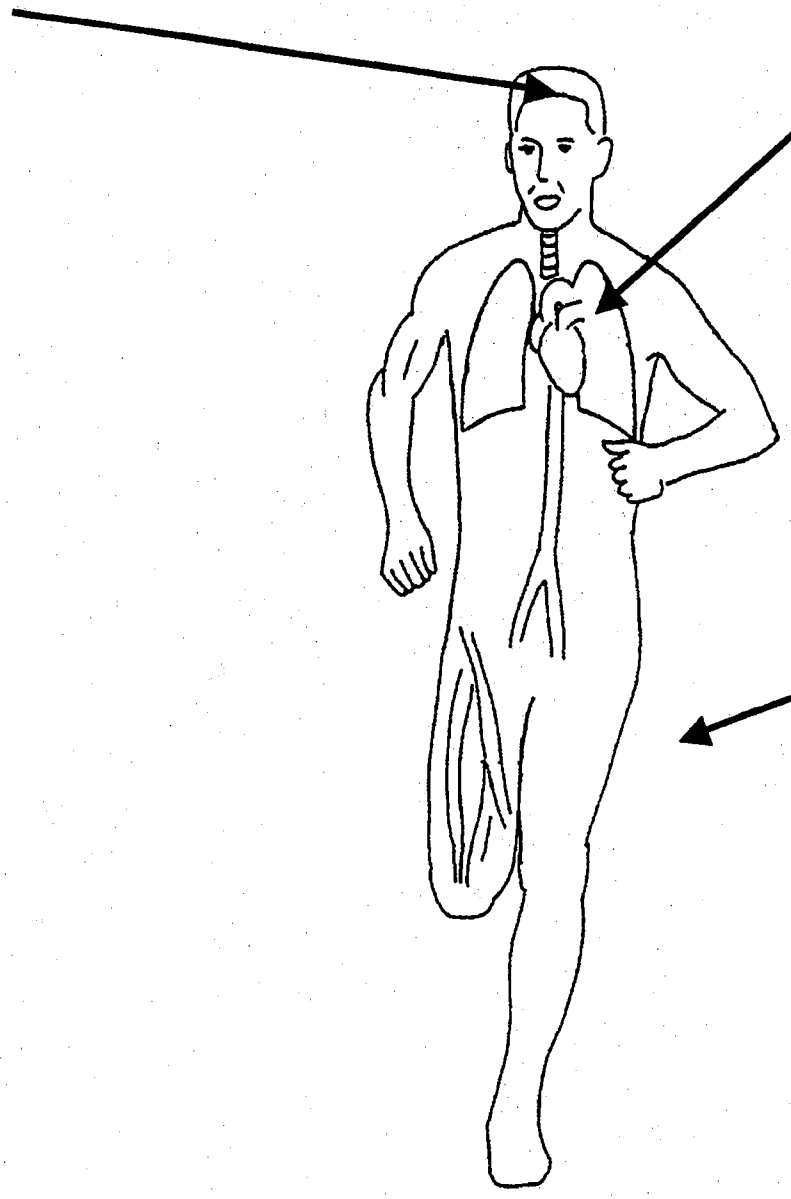
Aerobic Endurance Primary in Competitive Events Lasting 3 min to Several Hours





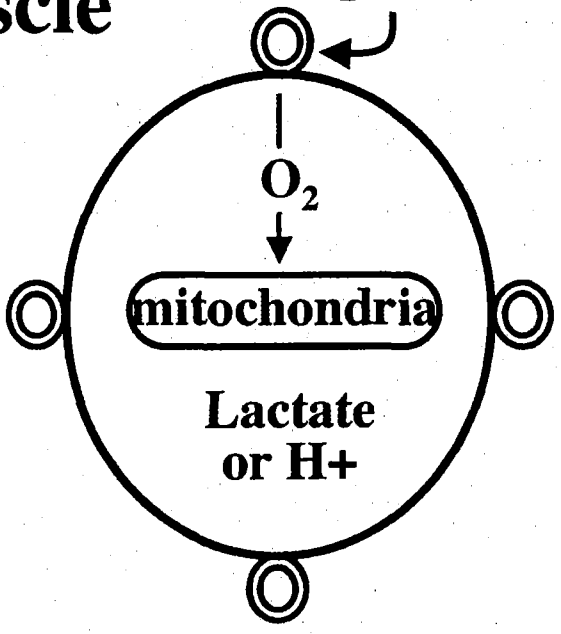

Aerodynamics
PERFORMANCE ABILITIES
Performance Power (watts)
FUNCTIONAL ABILITIES
Engine & Raw Power
Transmission
MORPHOLOGICAL COMPONENTS

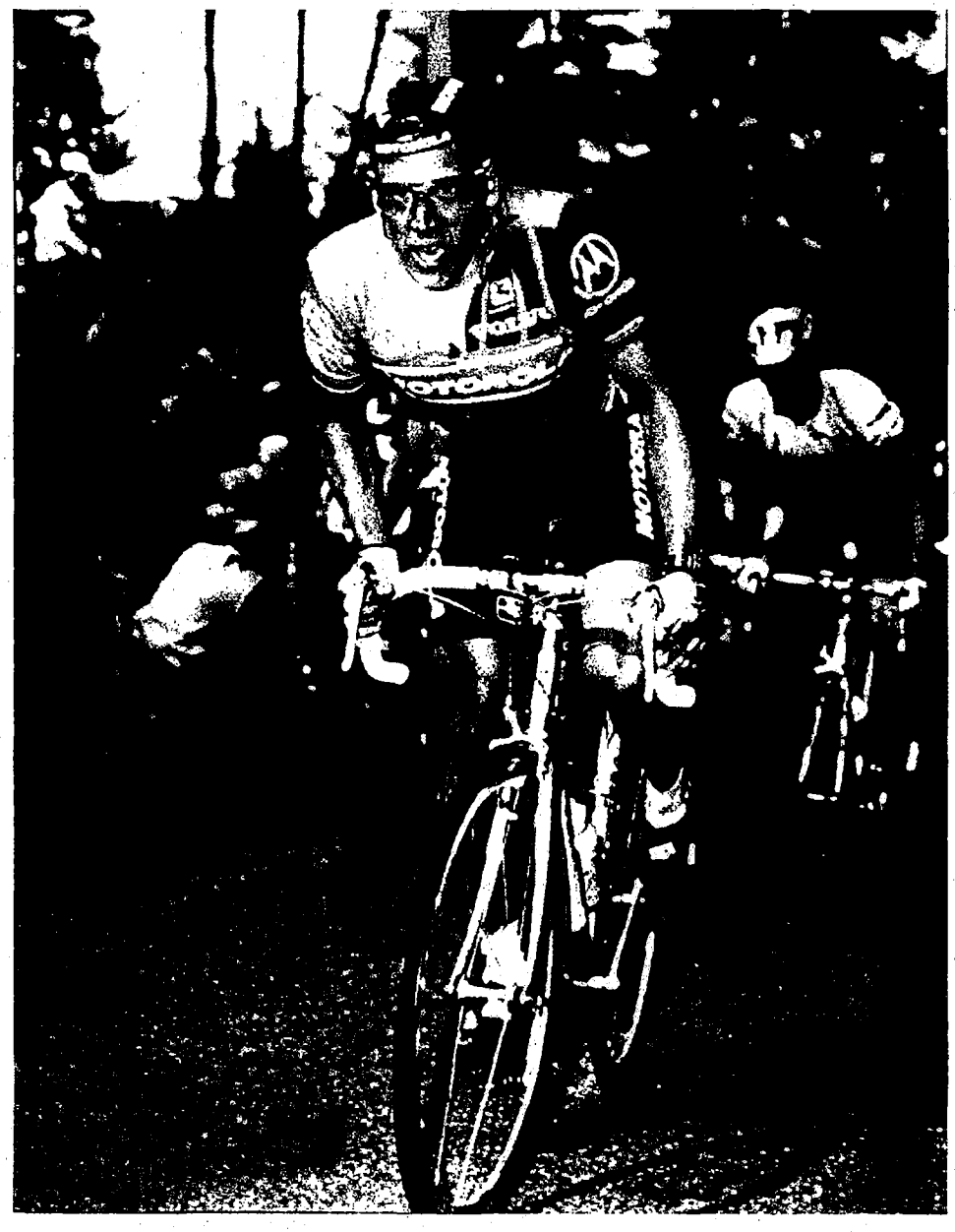
Heart
or
Vessels



Muscle

capillary





Lance Armstrong

1999, 2000, 2001, 2002, 2003, 2004, 2005…

Grand-Champion 'Tour de France'

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CIEDIT
LYONNAIS


AVIA
64
NIKE

Highlights of the bicycling racing history and medical history of the subject.

Year	Age	Event	
1991	19 y	U.S.A. National Amateur Champion	
1992	20 y	14th place in Olympic Road Race; Barcelona	
1993	21 y	1st place in World Championships, Road Racing; Oslo Winner, one stage in Tour de France	
1995	23 y	Winner of one stage in Tour de France	
1996	24-25 y	12th place in Olympic Road Race; Barcelona 6th place in Olympic Individual Time-trial; Barcelona Diagnosed with testicular cancer; chemotherapy ; brain surgery in October 1996. Last chemotherapy treatment December 1996.	
1998	26 y	4st place in World Championships, Road Racing 4st place in World Championships, Time-trial	
1999	27 y	1st place - Tour de France Grand Champion	
2000	28 y	1st place - Tour de France Grand Champion 13th place in Olympic Road Race; Sydney 3th place in Olympic Individual Time-trial; Sydney	
2001	29 y	1st place - Tour de France Grand Champion	
2002	30 y	1st place - Tour de France Grand Champion	
2003	31 y	1st place - Tour de France Grand Champion and	
2004	32 y	1st place - Tour de France Grand Champion	

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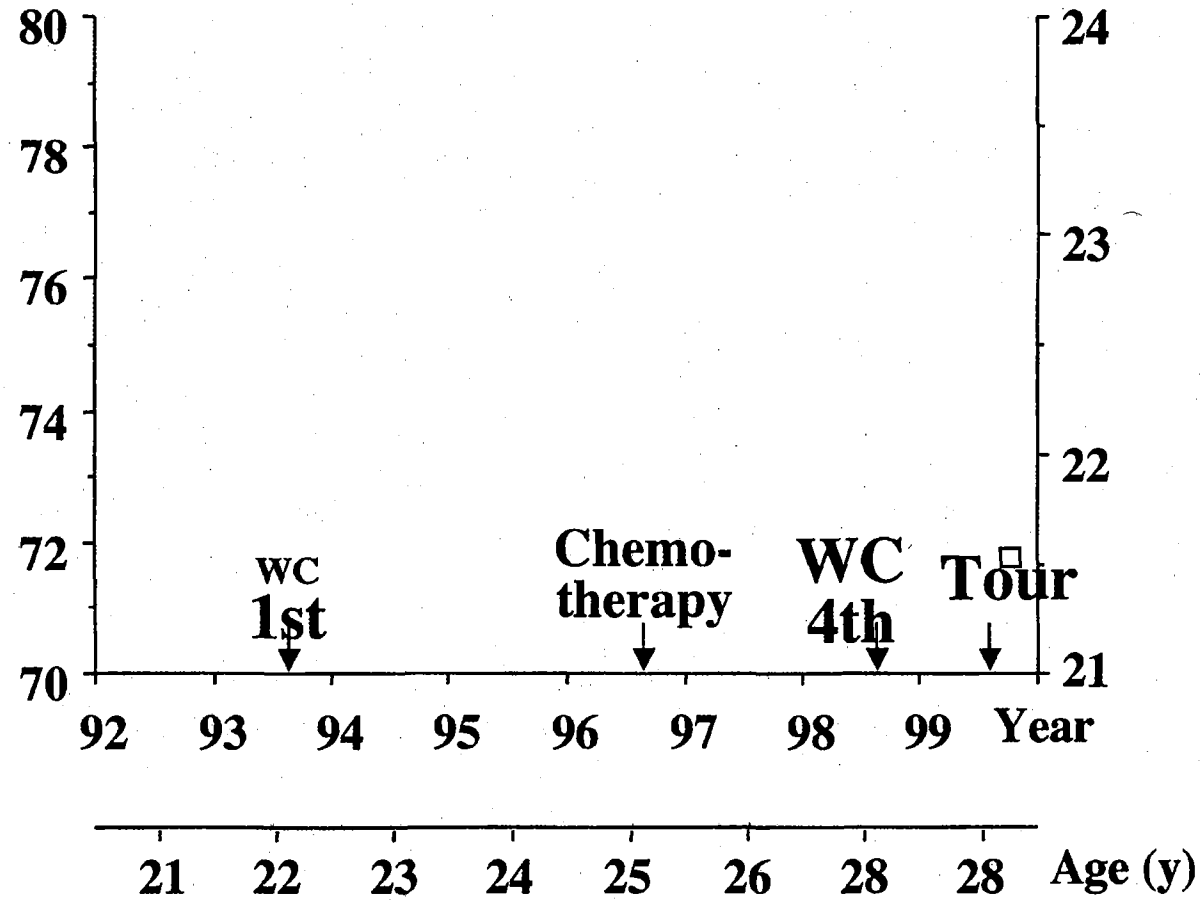
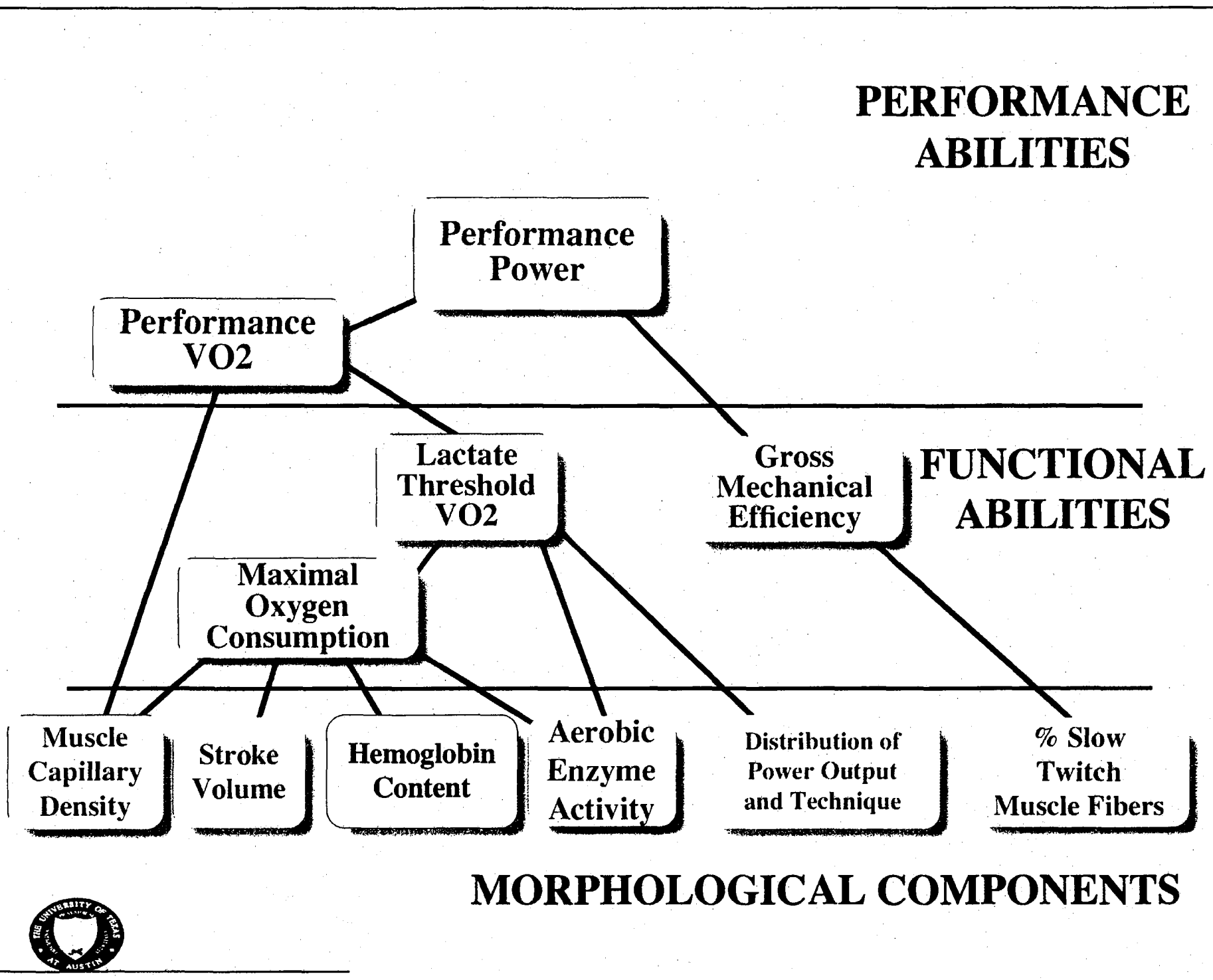

80
78
76
74
72
70
24
23
22
21
WC
1st
Chemo-
therapy
WC
4th
Tour
92
93
94
95
96
97
98
99
Year
21
22
23
24
25
26
28
28
Age (y)

Over Age 21-28 y
Lance Armstrong Showed
Little to Moderate Variation In:

VO_2max	= 5.8 - 6.0 łmin
	= 76-83 młkg/min
HRmax	= 206 - 200 bts/min
$\%VO_2max$ @ LT	= 78 - 82%
Lean Body Weight	= 68 - 70 kg

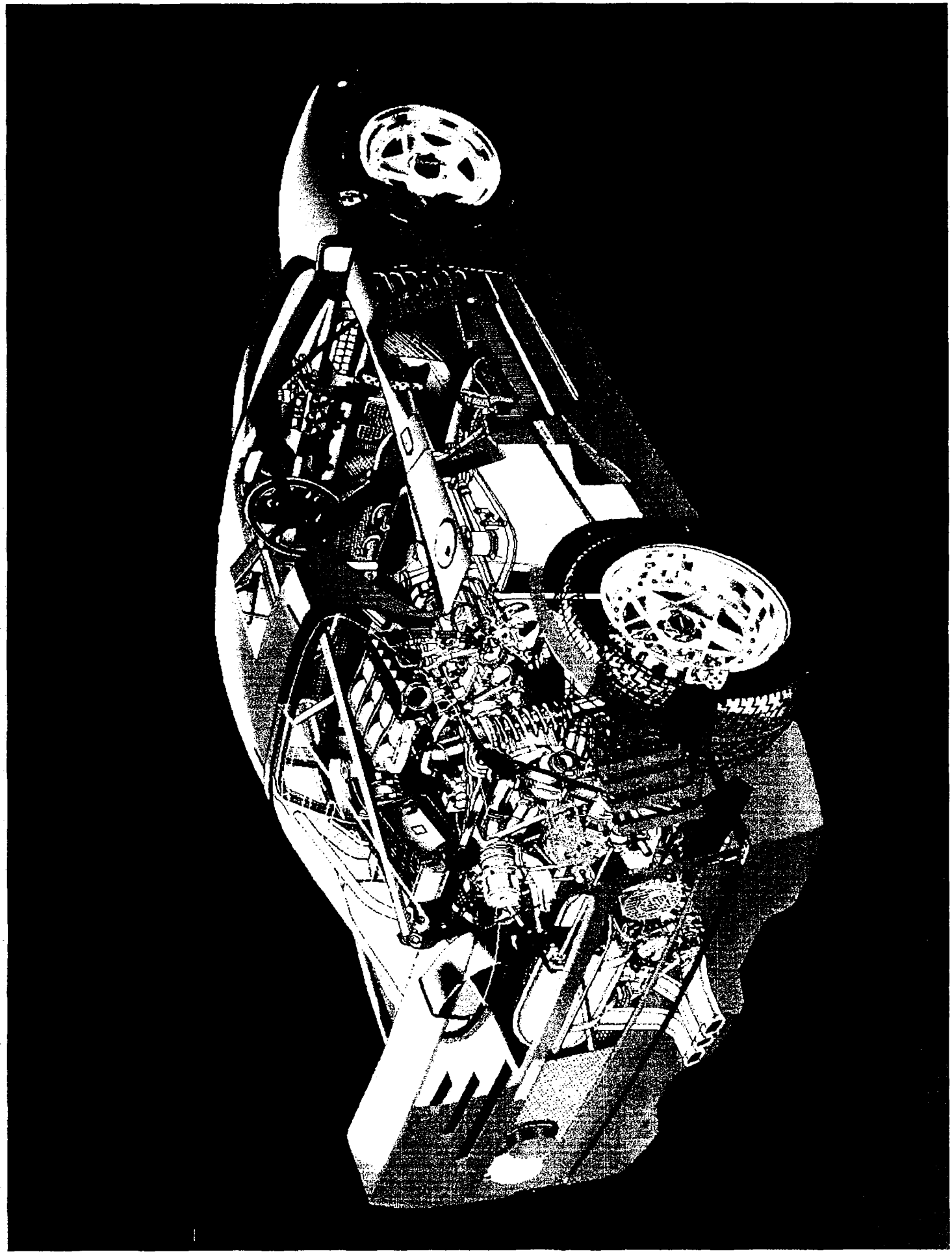
Age; y	**21.1 y**	**21.4 y**	**22.0 y**	**25.9 y**	**28.2 y**
Date; Month-	Nov.	Jan.	Sept.	Aug.	Nov.
Year	1992	1993	1993	1997	1999
Training Stage	pre-season	pre-season	racing	reduced	pre-season
Maximal AerobicAbility					
Maximal O_2 Uptake; L/min	5.56	5.82	6.10	5.29	5.7
Maximal O_2 Uptake; ml/kg/min	70.5	76.1	81.2	66.6	71.5
Maximal Heart Rate; bts/min	207	206	202	200	200
Maximal Blood Lactic Acid; mM	7.5	6.3	6.5	9.2	


don't
with
cats

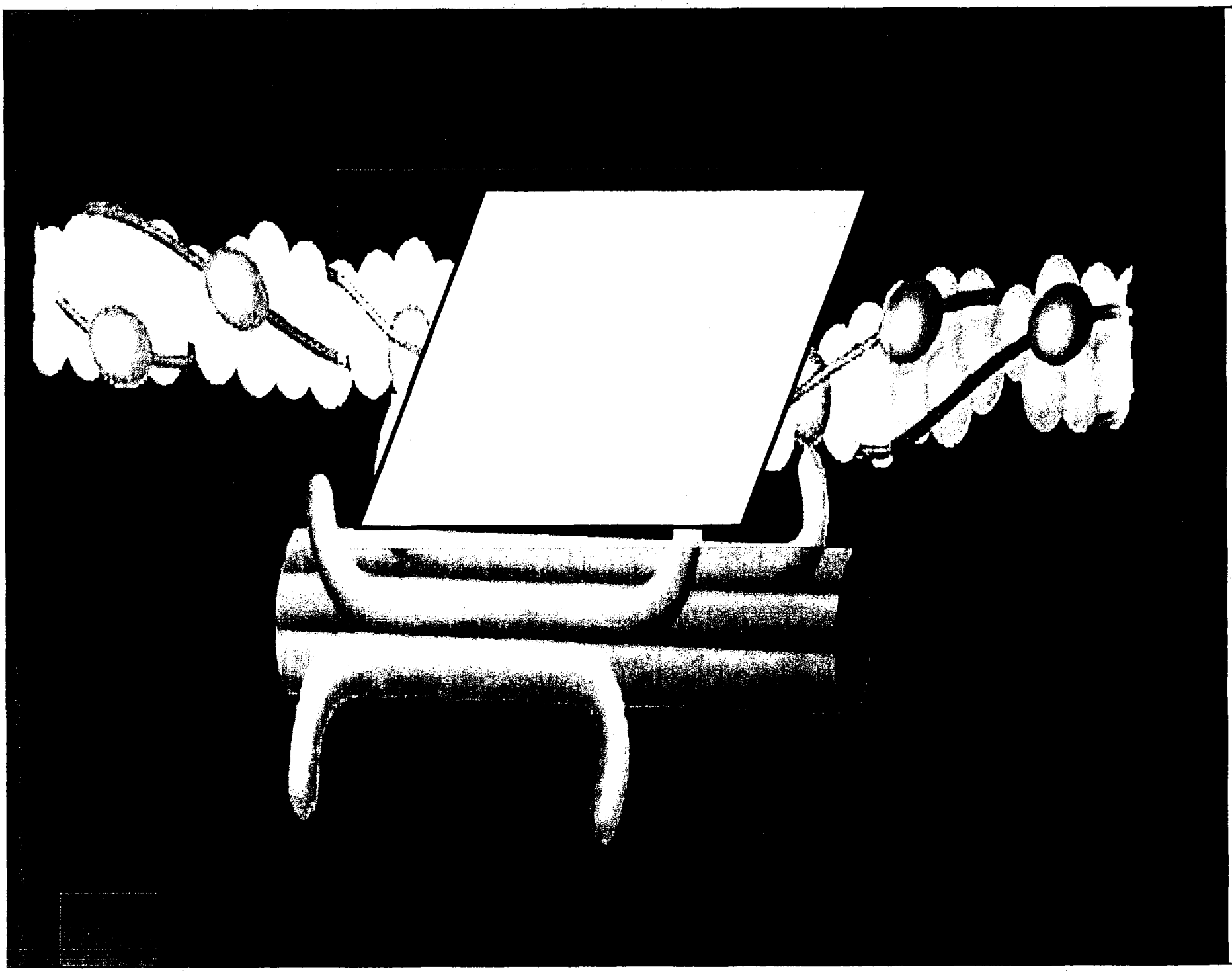

PERFORMANCE ABILITIES
Performance Power
Performance VO2
Lactate Threshold VO2
Gross Mechanical Efficiency
FUNCTIONAL ABILITIES
Maximal Oxygen Consumption
Muscle Capillary Density
Stroke Volume
Hemoglobin Content
Aerobic Enzyme Activity
Distribution of Power Output and Technique
% Slow Twitch Muscle Fibers
MORPHOLOGICAL COMPONENTS

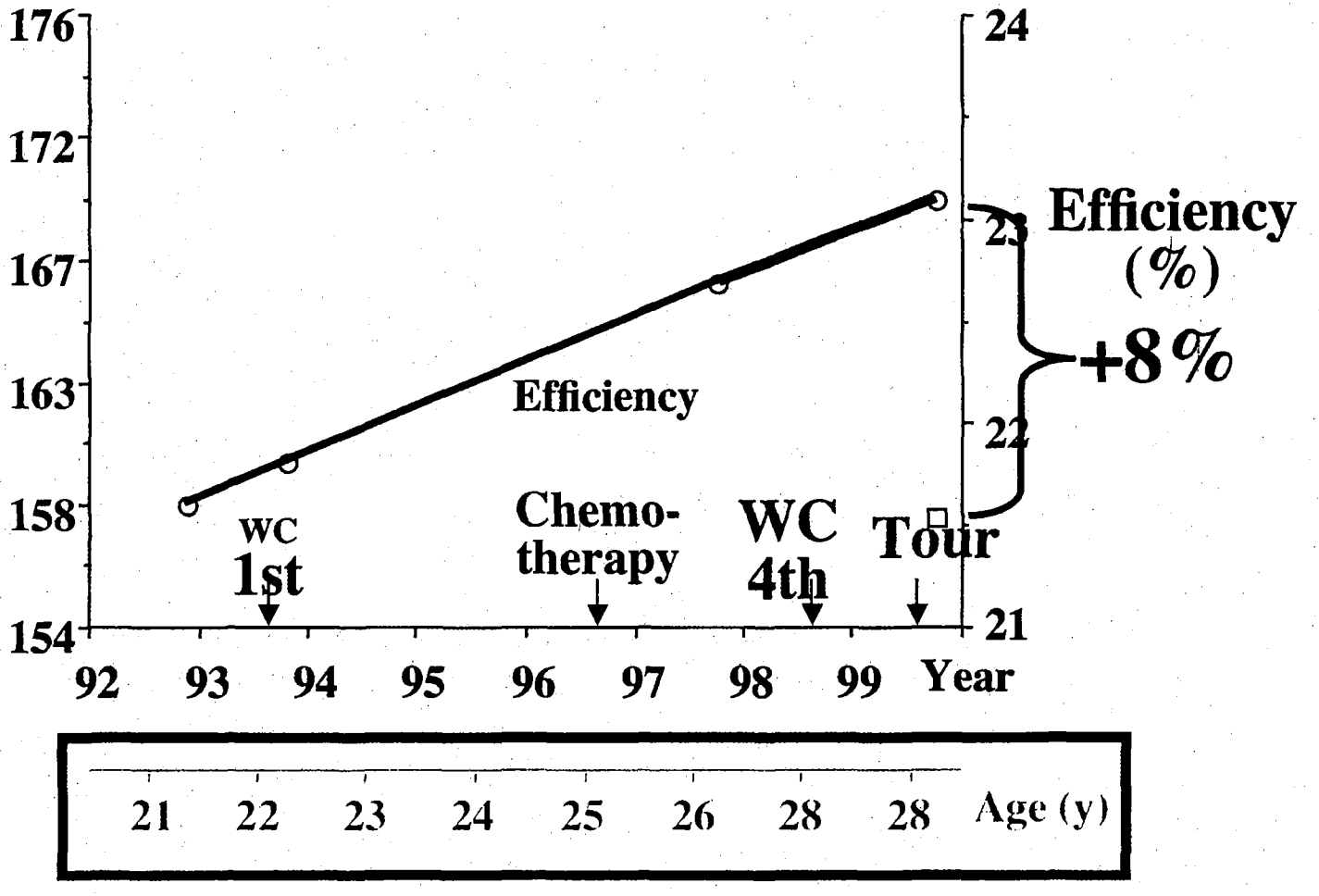
Mechanical Efficiency

Age; y	**21.1 y**	**21.4 y**	**22.0 y**	**25.9 y**	**28.2 y**
Date; Month-	Nov.	Jan.	Sept.	Aug.	Nov.
Year	1992	1993	1993	1997	1999
Training Stage	pre-season	pre-season	racing	reduced	pre-season
Gross Efficiency; %	21.18	21.61		22.66	23.05
Delta Efficiency; %	21.37	21.75		22.69	23.12



Muscular Efficiency




176
172
167
163
158
154
24
23
22
21
Efficiency
(%)
+8%
Efficiency
WC
1st
Chemo-
therapy
WC
4th
Tour
92
93
94
95
96
97
98
99
Year
21
22
23
24
25
26
28
28
Age (y)

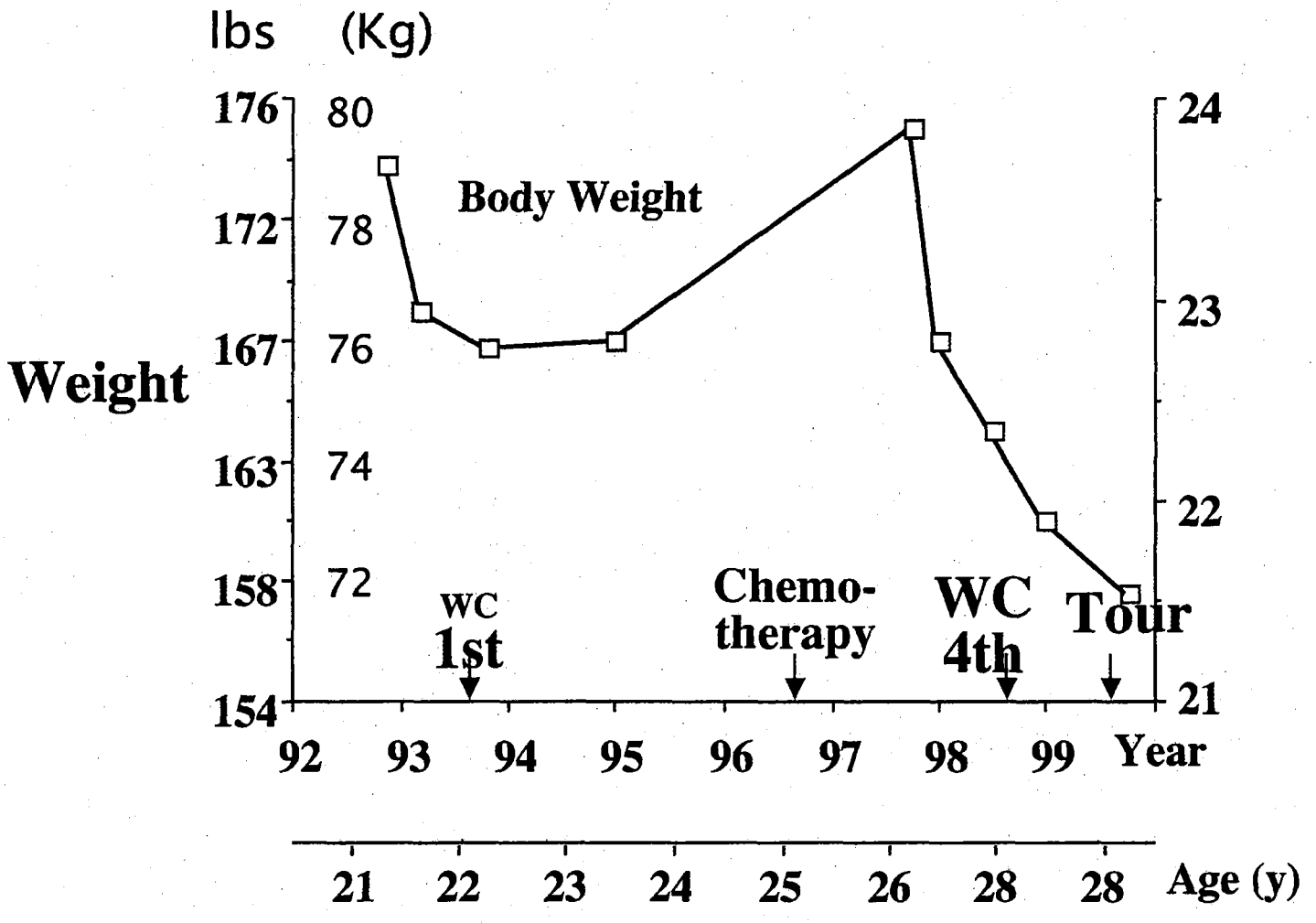
Increased Power Due to Mechanical Efficiency

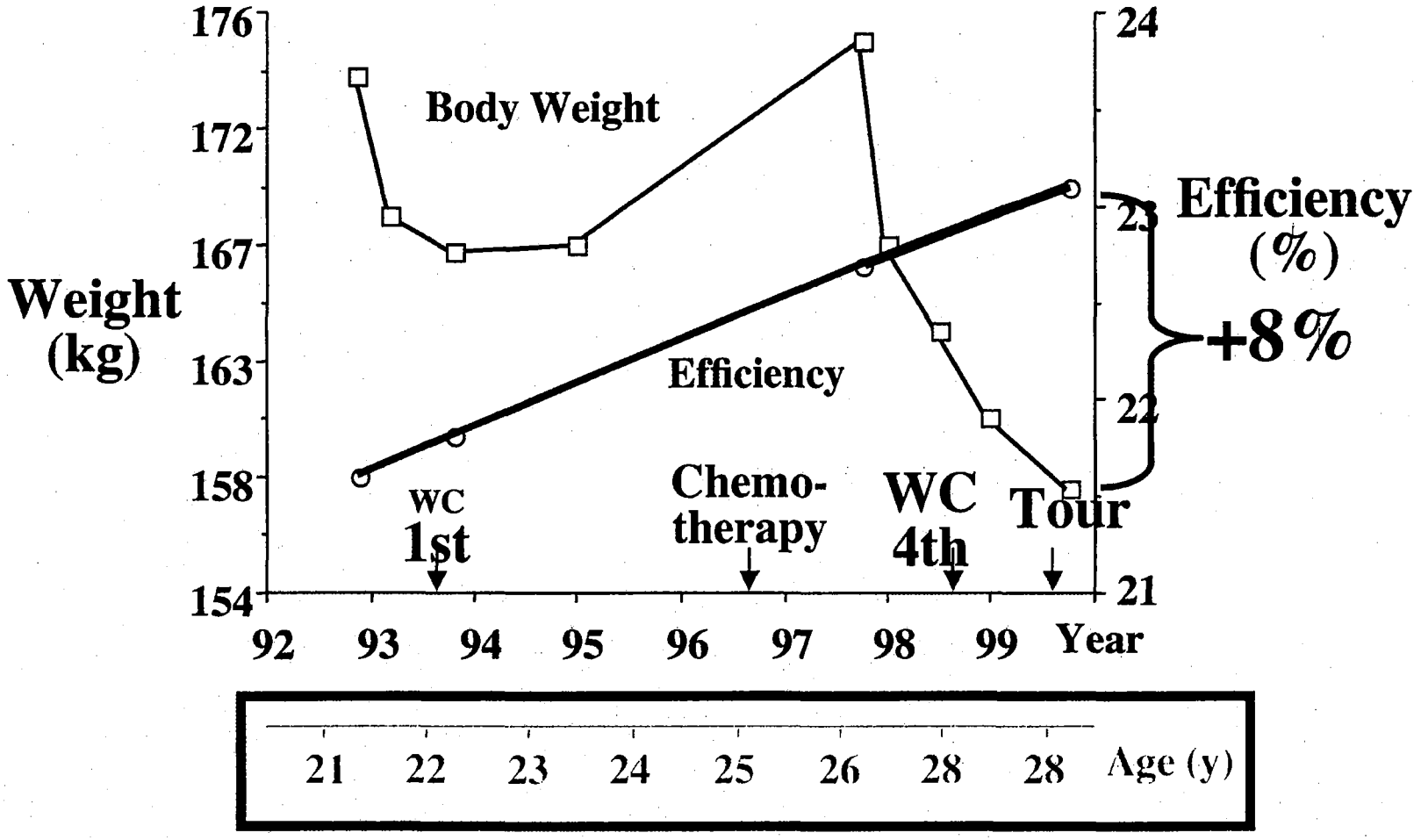
Age; y	**21.1 y**	**21.4 y**	**22.0 y**	**25.9 y**	**28.2 y**	
Date; Month-	Nov.	Jan.	Sept.	Aug.	Nov.	
Year	1992	1993	1993	1997	1999	
Training Stage	pre-season	pre-season	racing	reduced	pre-season	
Power at VO_2 of 5.0 L/min	83% of maximum					
Watts	374	382		399	404	}+8%

In 20 Elite Cyclist

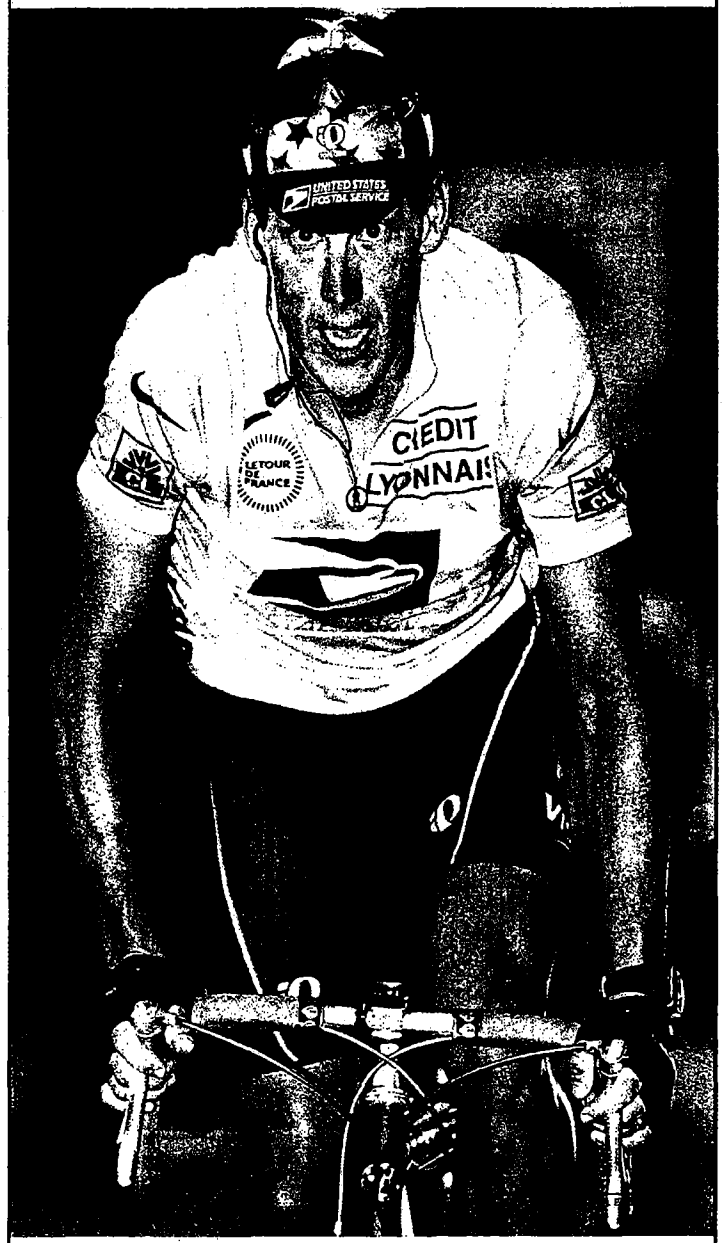
% ST	VO2 (Łmin)	Power (Watts)
75%	4.48 =	342 **+9%**
48%	4.46	315

	Age, yr				
	21.1	21.4	22.0	25.9	28.2
Date: Month-Year	Nov 1992	Jan 1993	Sept 1993	Aug 1997	Nov 1999
Training stage	Preseason	Preseason	Racing	Reduced	Preseason
		Anthropometry			
Body weight, kg	78.9	76.5	75.1	79.5	79.7



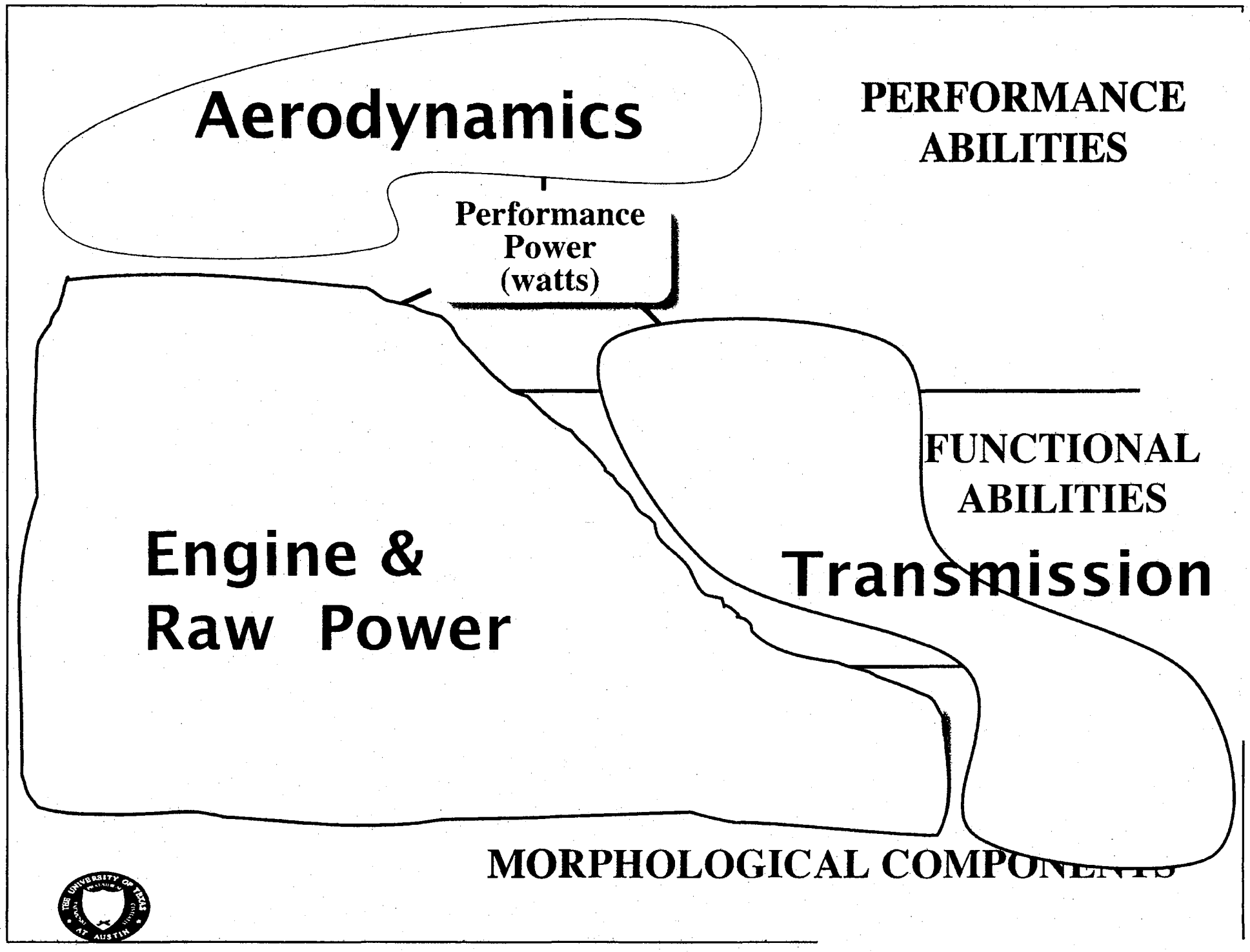

Weight (kg)
176
172
167
163
158
154
Body Weight
Efficiency
WC 1st
Chemo-therapy
WC 4th
Tour
24
23
22
21
Efficiency (%)
+8%
92
93
94
95
96
97
98
99
Year
21
22
23
24
25
26
28
28
Age (y)


VISA
TR

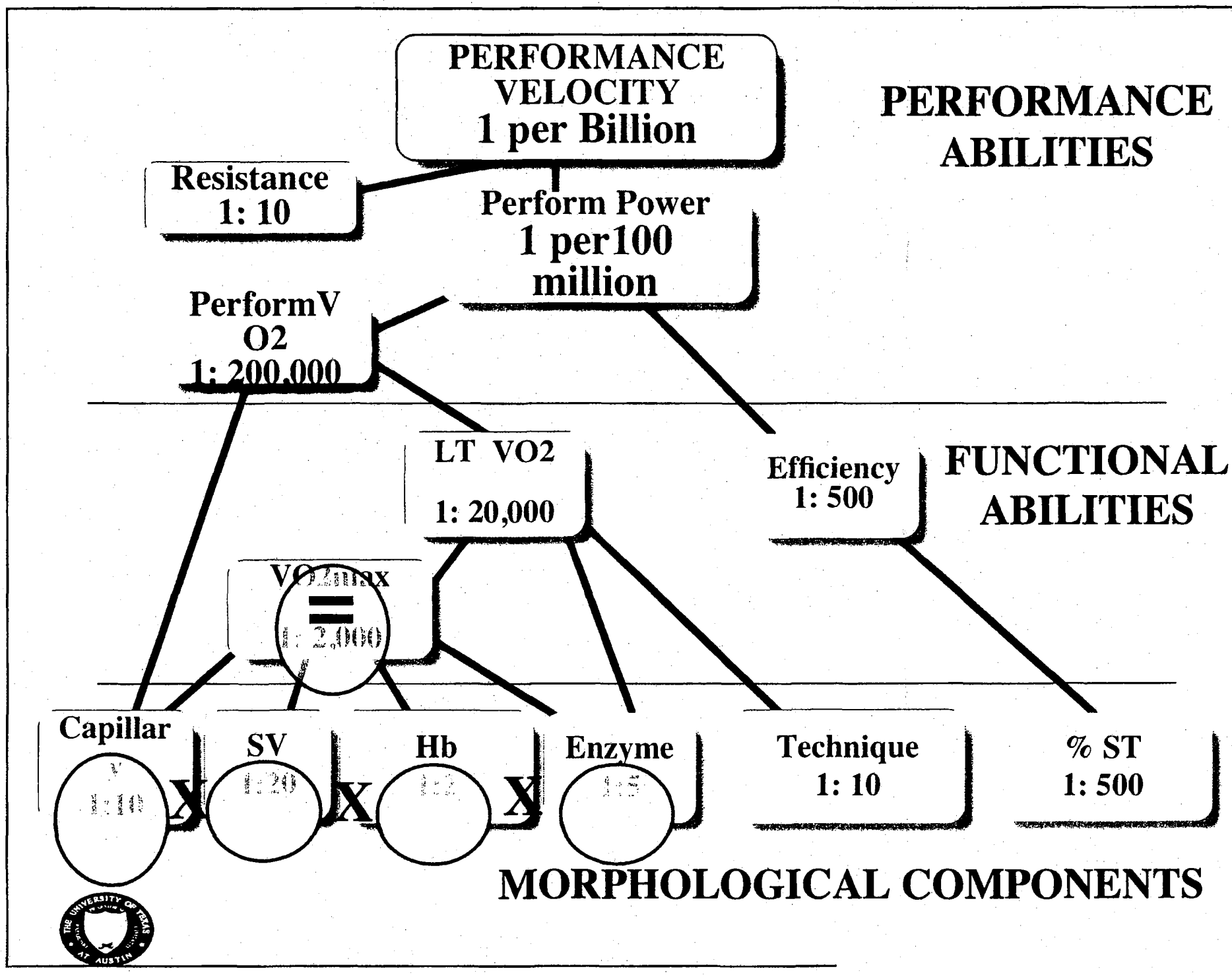

UNITED STATES POSTAL SERVICE
CREDIT LYONNAIS
LE TOUR DE FRANCE

$$\frac{\text{Watts}}{\text{Kg}} = +18\%$$

$$\frac{\text{Power}}{\text{Kg}} = \frac{500\ \text{Watts}}{71\ \text{kg}} = > 7\ \frac{\text{Watts}}{\text{kg}}$$


Aerodynamics
PERFORMANCE ABILITIES
Performance Power (watts)
FUNCTIONAL ABILITIES
Engine & Raw Power
Transmission
MORPHOLOGICAL COMPONENTS


Blessed are the genetic freaks.


PERFORMANCE VELOCITY 1 per Billion
PERFORMANCE ABILITIES
Resistance 1: 10
Perform Power 1 per100 million
PerformV O2 1: 200,000
LT VO2 1: 20,000
Efficiency 1: 500
FUNCTIONAL ABILITIES
VO2max
Capillar
SV
Hb
Enzyme
Technique 1: 10
% ST 1: 500
X
X
X
MORPHOLOGICAL COMPONENTS

UNTRAINED

NOVICE

GOOD

ELITE

$\dot{V}O_2max$

Muscle Oxidative Capacity

Capillaries

Improve Lactate Threshold

a) Spread Work to Large Muscle Mas

b) Muscle Oxidative Capacity

Maximize Power

a) Improve Muscle Efficiency