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Time analysis of the sprint hurdle events at the II World Champioships in Athletics

The 1987 International Athletic Foundation - IAAF Scientific Report

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"The authors illustrate the biomechanical study of the sprint hurdle events carried out during the II World Championships in Athletics. The last part of this article is a practical interpretation of the results of the biomechanical study, written by the BAAB National Coach, Malcolm Arnold."

This report is taken from the 1987 International Athletic Foundation/IAAF Scientific Project Report. The full report and accompanying 3-hour video is available from the IAAF Bureau.

1. Introduction

The Men's 110 meters Hurdles event has been dominated by athletes from the USA for dozens of years. Four American athletes claim the major share of the world's 25 all-time best performances. Among the top ten athletes, ranked by best times, there are only two non-Americans. The Women's 100 metres Hurdles, on the other hand, is a much more open affair. The yearly and all-time world lists indicate a greater distribution of top performances to athletes from a number of countries.

The curve of the best performances in any year will be extremely uneven as it can be markedly influenced by exceptional performances of athletes like Nehemiah (USA) in 1979-81. A more telling indication of changes in world performance levels is a curve of the mean best performances of the world's best athletes in a given event. The trend of improvement in the 110m and 100m hurdle events is shown in Figs. 1 and 2. The solid line shows the course

of each year's top performance while the other two lines indicate the course of the mean of the maximum performances of the top three and top ten athletes respectively.

Ignoring the exceptional year 1960, the improvement in performance by the men was 0.30s in the period 1961-1971 and another 0.29s in the period 1972-1987. In the women's event the improvement amounted to 0.70s in the period 1963-1971 (1963 was the first year statistics were kept for the event), and to a further 0.53s from 1971-1987. The greatest improvement was recorded in 1969, the year the event was officially introduced, and in 1970. Fully automatic electronic timing was introduced in 1972 and that point is indicated on the graph by a vertical line.

The rise in performance levels has been the result of improved training methods, the application of new knowledge provided by a variety of scientific disciplines, improved technical equipment, etc.

The final results of the sprint hurdle events at the II World Championships

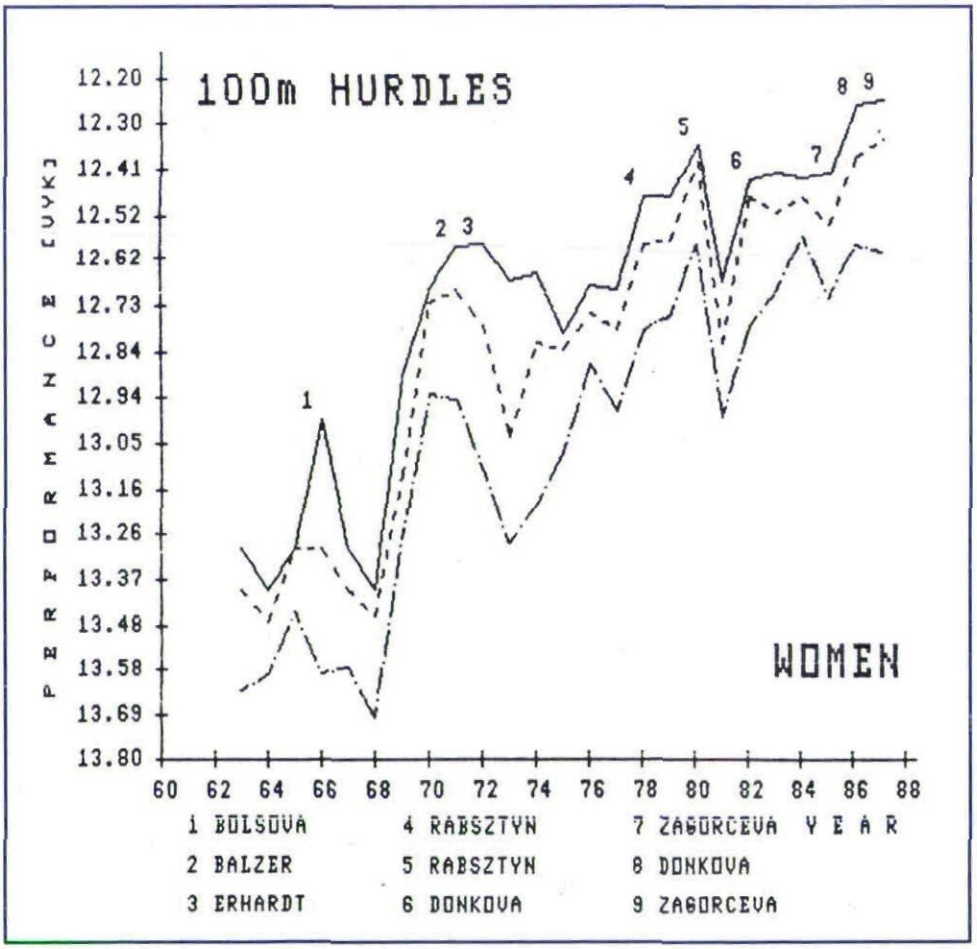


 Fig. 1

in Athletics are shown in Table 1 (see page 54). Complete individual time analysis for the medalists in each event are given in Section 4 of this report. Individual time analyses for all finalists and semi-finalists are available in the International Athletic Foundation Scientific Project Report on the Championships.

2. Methods and Procedures

2.1 Cameras and Siting

The 100m and 110m hurdle events at the II World Championships in Athletics were analyzed by means of three Sony video cameras and two Photosonics 500 high-speed cameras. The video cameras were used for time analyses of all the races concerned. Two of these cameras recorded the entire race, including the smoke from the starter's gun. The third camera recorded the athletes from the start to the landing after the first hurdle. The siting of the video cameras is shown in Fig. 3. Information and findings from the video recordings were published as "Fast Information" Reports and were

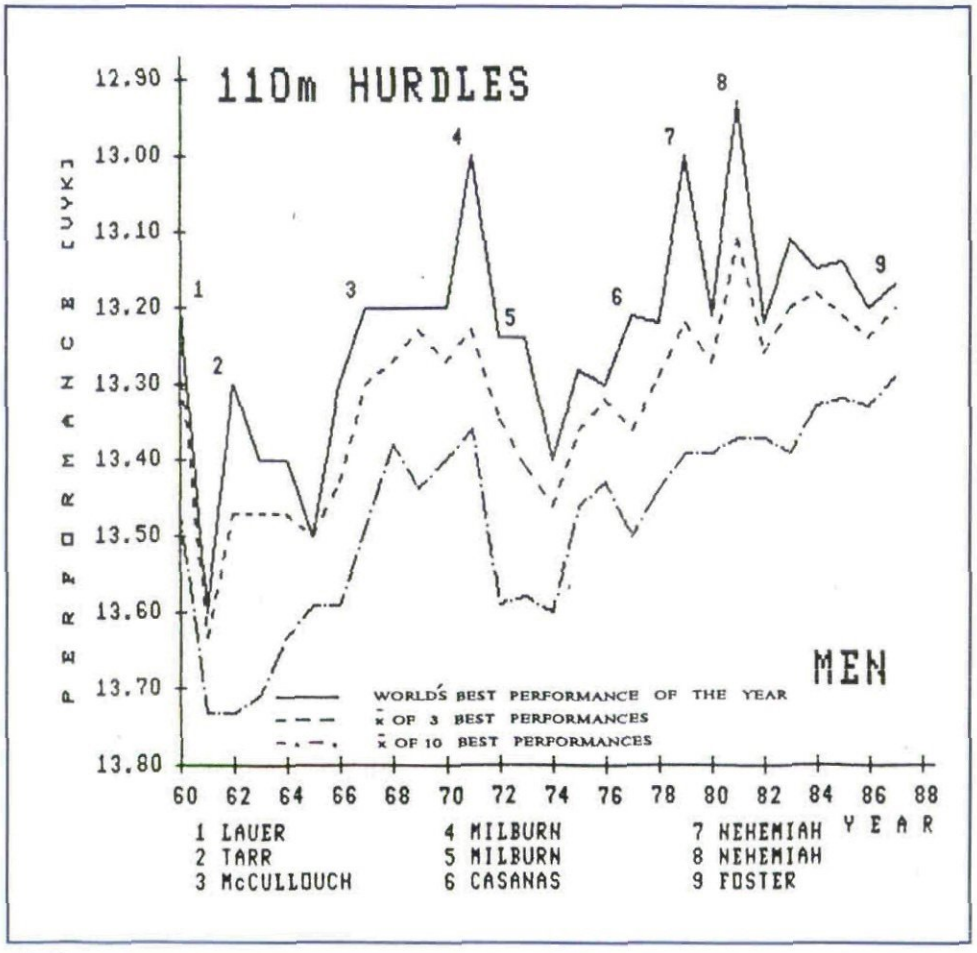


Fig. 2

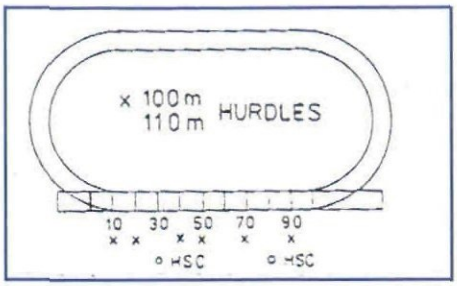


Fig. 3

available to the press and in the Athletes Village in Rome. Each round's recordings were shown the following day as a part of a video presentation given to the athletes in the Village.

The synchronized Photosonics 500 high-speed cameras were placed (see Fig. 4) with a view to facilitating 3-D analysis of the athlete's stride, with special emphasis on stride length and frequency. They were positioned by means of a second-theodolite from Carl Zeiss Jena. The cameras worked at a frequency of 200 frames per second. One of the cameras photographed the smoke from the starter's gun. The film from this camera was used for both the visual assessment and comparisons with the official measurements of the athletes' reaction times. The films were also used for comparison with material obtained from the video recordings in the preparation of this final report.

2.2 Model Intermediate Times

The material used for plotting the model intermediate times was provided by time analysis of performances at events such as the Olympic Games (O.G.), World Championships in Athletics (W.C.) and European Champioships (E.C.) between 1980 and 1986. The times for touchdowns after hurdles 1-10 were related to the final performances. The results were regression straight lines whose correlation coefficient has a continuously

Table 1

FINAL		**3/9 - 17.50 (+ 0.50 m/s)**
1. 1034 Foster Greg	58 USA	13.21
2. 448 Ridgeon Jon	67 GBR	13.29
3. 433 Jackson Colin	67 GBR	13.38
4. 1072 Pierce Jack	62 USA	13.41
5. 963 Kazanov Igor	63 URS	13.48
6. 269 Sala Carlos	60 ESP	13.55
7. 154 Mc Koy Mark	61 CAN	13.71
281 Bryggare Arto	58 FIN	DNS

Time 17:52 - Temp.: +27°C
Press.: 1012 mBar - Humidity: 68%

4/9		**18.30 (– 0.56 m/s)**
1. 74 Zagorcheva Ginka	58 BUL	12.34
2. 312 Uibel Gloria	64 GDR	12.44
3. 308 Oschkenat Cornelia	61 GDR	12.46
4. 59 Donkova Yordanka	61 BUL	12.49
5. 210 Piquerau Anne	64 FRA	12.82
6. 199 Elloy Laurence	59 FRA	12.83
7. 247 Zaczkiewicz Claudia	62 FRG	12.98
8. 646 Martin Lavonna	66 USA	13.06

Time 18:32 - Temp.: +21°C
Press.: 1013 mBar - Humidity: 84%

rising tendency. In the relationship between touchdown after the 10th hurdle and the final performance, the correlation approximates 1.

The regression straight lines were subsquently turned according to × to start in the beginning of the coordinate system. The tangents of the straight lines make up a regression parabola which can be used for laying down model intermediate times. A tolerance field has been provided for each intermediate time, taking account of possible errors of measurements. The mathematical procedure is described in more detail in Susanka (1978).

3. Analysis of the sprint hurdle competitions at the II World Championships in Athletics

In the hurdles, performance is the sum of the reaction time (RT), the time of the approach run, the time of the nine rhythmic units (RU), and the time of the run-in.

3.1 *Reaction time*

In real terms, an athlete's reaction time is shorter than that officially measured. The difference is due to the time required for the transmission of the starting signal (sound propagation from the starter's gun to the starting spot), and by mechanical delays inherent in the design of the starting blocks, and the level of the reaction force set on the blocks. The electronic device in the starting blocks stops measuring the reaction time at the moment the pressure on the blocks reaches the preset value (e.g., 250 N).

The results of measurements of reaction time at events such as the EC, WC and OG in the period 1978-87 are shown in Tab. 3. The differences recorded in mean reaction times at the I WJC, the II WC 87 and other events seem to indicate a lack of uniformity in the methods of measuring reaction time. Higher mean RTs were measured at the I WJC and II WC 87 in the sprint hurdles as well as in other events

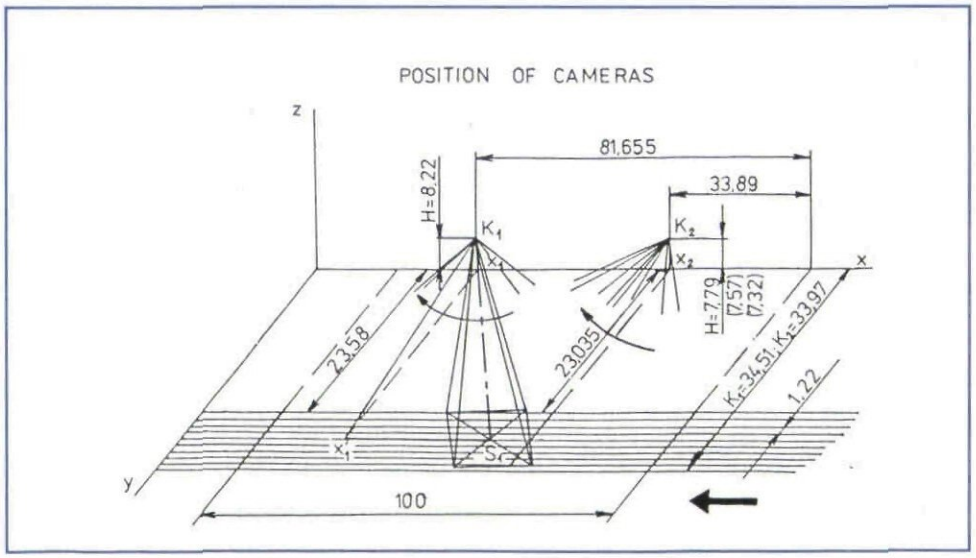


Fig. 4

(the sprints and the 400m Hurdles) although an increase of actual reaction times is extremely unlikely.

The following rule-of thumb scale for evaluating RT has been plotted, in milliseconds, on the basis of RT statistics.

Generally valid	*Men*
Outstanding	< 130
Above average	(130; 150)
Average	(155; 185)
Below average	(185; 210)
Substandard	> 210

Generally valid	*Women*
Outstanding	< 130
Above average	(130; 150)
Average	(155; 185)
Below average	(185; 210)
Substandard	> 210

Owing to the considerable difference in reaction times measured at Rome, the following scale, valid only for the II WC, has been plotted.

	Men
Outstanding	< 130
Above average	(130; 170)
Average	(170; 210)
Below average	(210; 250)
Substandard	> 250

	Women
Outstanding	< 140
Above average	(140; 180)
Average	(180; 220)
Below average	(220; 260)
Substandard	> 260

The following minimum RTs were measured at II WC.

	100m Hurdles	110m Hurdles
Men		133
Women	111	

3.2 Approach Run

Beginning:

(a) from the gun;
(b) from the athlete's first movement, i.e. minus RT (for determining the acceleration level).

End:

Moment of touchdown after the first hurdle.

Objective:

Achieving an optimal (model) intermediate time that would make it possible for the athlete to achieve a personal best; providing the conditions for smooth clearance of the hurdles.

	Men	*Women*
For performances:	13.25/13.50	12.30/12.50
approach run	2.52/ 2.60	2.45/ 2.58
approach run minus RT (for determing acceleration level)	2.27/ 2.45	2.33/ 2.40

3.3 Rhythmic Units

Beginning:

Moment of touchdown after hurdle.

End:

Moment of touchdown after next hurdle.

Objective:

(a) the shortest time possible in a rhythmic unit;

(b) standardization of the above time, with a maximum difference of 3%;
(c) the fastest average time possible over the nine rhythmic units:

	Men	*Women*
RU minimal	0.98/1.30	0.94/0.98
RU average	1.20/1.50	0.97/0.99
Number of RUs with maximal 3% difference	4/6	4/7

3.4 Run - In

Beginning:

Moment of touchdown after 10th hurdle.

End:

Moment of crossing the finishing line.

Objective:

The smooth continuation of the running between the hurdles into the run-in. This can be practised only in actual race situations, not training sessions. A well-trained athlete should make full use of each race for practising this phase of the race. This will not involve any significant losses of energy for a physiologically well-trained athlete.

In the heats of the II WC the results were clear well before the end of each race. However, only a few of the qualifiers (e.g. Zagorcheva) finished the race at flat-out speed. The following figure indicates the fastest and slowest time for the run-in achieved at the II WC.

	Men	*Women*
Run-in	1.30/1.40	1.05/1.10

3.5 Evaluating acceleration and speed endurance

A number of criteria are used for evaluating the above abilities of athletes in coaching practice. For the sake of simplicity, the performances achieved can be used as a basis, without any need for calculations of mean or momentary velocities or acceleration.

Tab. 2 - Reaction times measured at different athletic competitions (European, World Championships, World Junior Championships and Olympic Games)

Men	*110m Hurdles*			*Women*	*100m Hurdles*		
	n	$\bar{x}$	SD		n	$\bar{x}$	SD
EC 78	43	157	29		19	149	22
OG 80	46	151	14		43	157	21
EC 82	44	160	19		24	153	25
WC 83	50	178	37		90	162	24
OG 84							
WJC 86	34	191	38		35	187	20
EC 86							
WC 87	65	192	39		45	201	40
AVERAGE	282	172	30		257	170	26

Acceleration:

The ability to achieve maximum speed (or a speed amounting to 97% of the athlete's maximum speed) over the shortest possible section of the track.

Time used as indices:

Approach-run times minus RT, and the times in the 1st and 2nd RUs (or their sum).

Fastest and slowest times achieved at II WC:

	Men	*Women*
(a) approach-run minus RT	2.27/2.45	2.33/2.40
(b) (approach-run - RT) + 1st RU	3.38/3.53	3.36/3.50
(c))approach-run RT) + 1st RU + 2nd RU	4.41/4.57	4.34/4.50

The difference between (b) and (c) shows clearly that, in practice, watching any one of the indices will do.

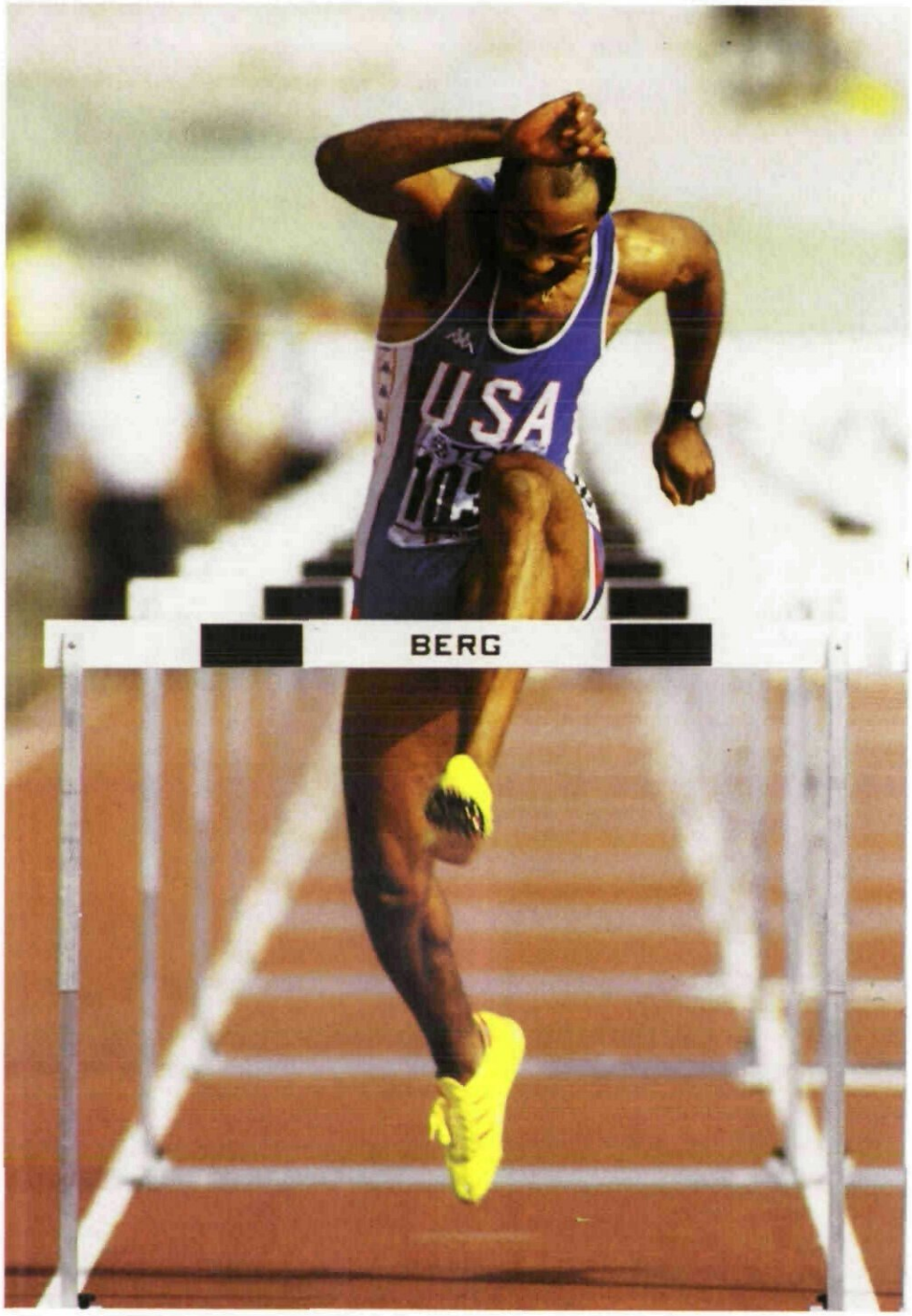
Speed endurance is manifested in the athlete's ability to achieve the best intermediate times even in the final stages of the race.

	Men	*Women*
(a) Run-in	1.30/1.40	1.05/1.10
(b) Run-in + 9th RU	2.36/2.71	2.03/2.22
(c) Run-in + 8th RU + 9th RU	3.41/3.83	3.00/3.26

The athlete's level of acceleration and speed endurance can be judged on the basis of his or her closeness to the extremes of the above variation ranges - but only in the races run flat out, i.e. with maximum effort.

Allsport/Tony Duffy

58 **Ginka Zagorcheva (BUL)**



Allsport/Bob Martin

Greg Foster (USA)

4. Evaluation of individuals at the II World Championships in Athletics

INDIVIDUAL EVALUATION

RT in the heat substandard, in successive rounds poor. Mean time of approach, after substracting RT, the best of all finalists, the fastest in the heat. Acceleration section shortened progressively. Maximum specific speed in heat, in the 5th RU (0.98s); in the final, in the second RU (1.00s). Relative stabilization

110 m. HURDLES -1A- 2ndWORLD ATHLETICS CHAMPIONSHIPS 29.8. - 6.9 ROME 87

TIME ANALYSIS FOSTER GREG 58 USA

PLACING 1. 1. 1st RUN RESULT 13.20

	HURDLES: 1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	FINISH
A.	2.60	3.63	4.64	5.64	6.64	7.62	8.63	9.67	10.72	11.79	13.20
B.	2.48	3.50	4.52	5.54	6.56	7.58	8.61	9.66	10.71	11.79	13.20
C.		1.03	1.01	1	1	0.98	1.01	1.04	1.05	1.07	1.41
D.		1.03	1.02	1.02	1.02	1.02	1.03	1.04	1.06	1.08	1.41
E.	-0.07	-0.08	-0.07	-0.05	-0.03	---	---	---	---	---	

PLACING 2. 1. SEMIFINAL RESULT 13.41

	HURDLES: 1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	FINISH
A.	2.60	3.65	4.68	5.70	6.72	7.76	8.79	9.85	10.93	11.99	13.41
B.	2.51	3.56	4.60	5.63	6.67	7.70	8.75	9.81	10.88	11.98	13.41
C.		1.05	1.03	1.02	1.02	1.04	1.03	1.06	1.08	1.06	1.42
D.		1.04	1.04	1.03	1.04	1.04	1.05	1.06	1.07	1.09	1.43
E.	-0.04	-0.04	-0.03	-0.02	---	-0.01	---	---	-0.01	---	

PLACING 1. FINAL RESULT 13.21

	HURDLES: 1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	FINISH
A.	2.60	3.64	4.64	5.64	6.64	7.65	8.67	9.72	10.76	11.81	13.21
B.	2.48	3.51	4.53	5.55	6.57	7.59	8.62	9.66	10.72	11.80	13.21
C.		1.04	1	1	1	1.01	1.02	1.05	1.04	1.05	1.40
D.		1.03	1.02	1.02	1.02	1.02	1.03	1.04	1.06	1.08	1.41
E.	-0.07	-0.08	-0.06	-0.04	-0.02	-0.01	---	-0.01	---	---	

HURDLES:	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
TOLERANCE:	±0.05	±0.05	±0.05	±0.05	±0.05	±0.05	±0.05	±0.05	±0.04	±0.04

A. REAL TOUCHDOWNS

B. MODEL TOUCHDOWNS

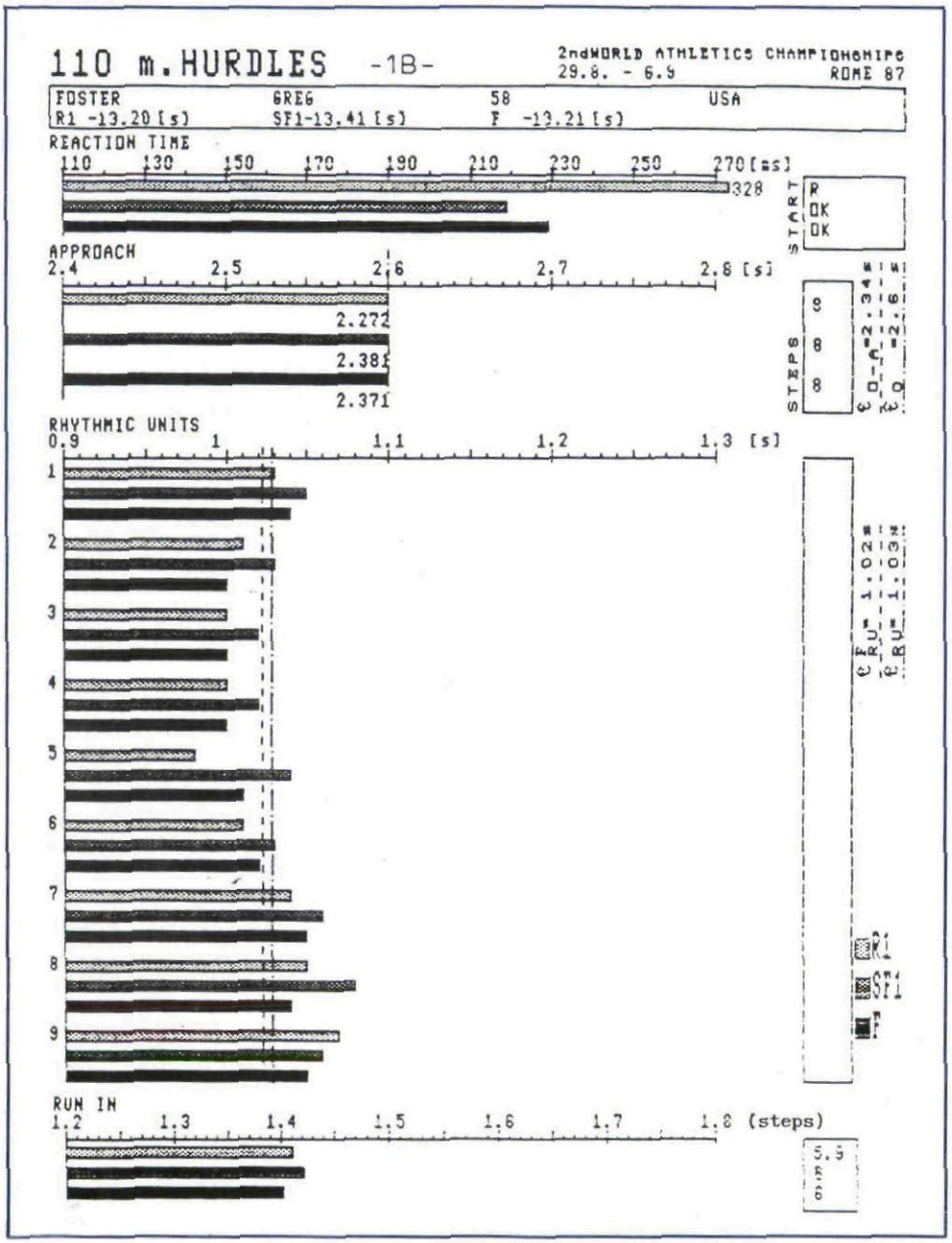
C. REAL RHYTHMIC UNIT

D. MODEL RHYTHMIC UNITS

E. DEVIATIONS FROM THE MODEL TOUCHDOWNS

of specific speed ends with the 6th RU. Specific speed reduction occurred last 3 RU in all rounds. Time of run-in stable. All rounds run without colliding with hurdles. Advantages: explosive strength and maximum specific running speed; shortcomings: reaction time and specific endurance.

* DATA MEASURED
R RESTART
N WARNING



INDIVIDUAL EVALUATION

RT in the heat substandard, in successive rounds average. Mean of approach times, without RT, slowest among the finalists. Acceleration over 2 RUs/in semifinal and final had an unsteady speed curve. Fasted specific speed in the 3rd RU in the semifinal (0.01s). In the relative stabilization of specific speed in each round, at least one RU featured a pronounced drop of speed (the 2nd RU in the final). In the final, speed increased over the last two RUs. The fastest man on the run-in. In all rounds, the run-in run with full effort: average of run-in times 1.33s (0.08s faster than the 2nd runner). Advantage: very well trained in

110 m. HURDLES -2A- 2nd WORLD ATHLETICS CHAMPIONSHIPS 29.8. - 6.9 ROME 87

TIME ANALYSIS RIDGEON JON 67 GBR

PLACING 1. 3. 1st RUN RESULT 13.46

	HURDLES: 1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	FINISH
A.	2.72	3.77	4.81	5.85	6.88	7.94	8.98	10.02	11.06	12.15	13.46
B.	2.52	3.57	4.61	5.65	6.69	7.73	8.78	9.85	10.92	12.02	13.46
C.		1.05	1.04	1.04	1.03	1.06	1.04	1.04	1.04	1.09	1.31
D.		1.05	1.04	1.04	1.04	1.04	1.05	1.06	1.08	1.10	1.44
E.	-0.15	-0.15	-0.15	-0.15	-0.14	-0.16	-0.15	-0.12	-0.10	-0.09	

PLACING 1. 1. SEMIFINAL RESULT 13.34

	HURDLES: 1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	FINISH
A.	2.60	3.65	4.72	5.73	6.75	7.78	8.85	9.89	10.93	11.98	13.34
B.	2.50	3.54	4.57	5.60	6.63	7.66	8.71	9.76	10.83	11.91	13.34
C.		1.05	1.07	1.01	1.02	1.03	1.07	1.04	1.04	1.05	1.36
D.		1.04	1.03	1.03	1.03	1.03	1.04	1.05	1.07	1.09	1.43
E.	-0.05	-0.06	-0.10	-0.08	-0.07	-0.07	-0.09	-0.08	-0.06	-0.03	

PLACING 2. FINAL RESULT 13.29

	HURDLES: 1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	FINISH
A.	2.60	3.64	4.70	5.72	6.76	7.79	8.82	9.88	10.93	11.96	13.29
B.	2.48	3.53	4.55	5.58	6.61	7.64	8.67	9.72	10.79	11.87	13.29
C.		1.04	1.06	1.02	1.04	1.03	1.03	1.06	1.05	1.03	1.33
D.		1.03	1.03	1.03	1.03	1.03	1.04	1.05	1.06	1.08	1.42
E.	-0.06	-0.06	-0.10	-0.09	-0.10	-0.10	-0.10	-0.11	-0.10	-0.05	

HURDLES:	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
TOLERANCE:	±0.05	±0.05	±0.05	±0.05	±0.05	±0.05	±0.05	±0.05	±0.04	±0.04

A. REAL TOUCHDOWNS

B. MODEL TOUCHDOWNS

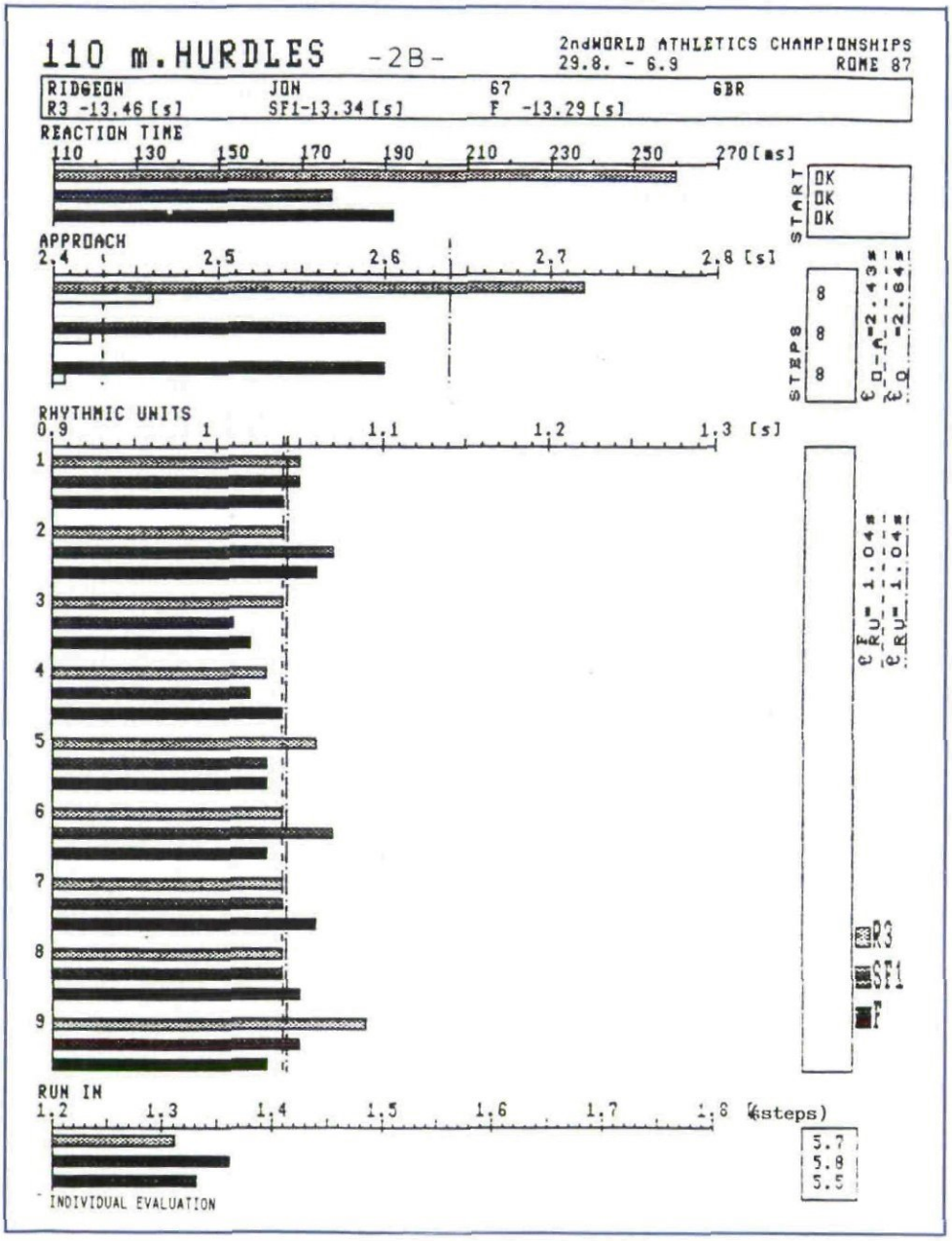
C. REAL RHYTHMIC UNIT

D. MODEL RHYTHMIC UNITS

E. DEVIATIONS FROM THE MODEL TOUCHDOWNS

specific endurance, including run-in; shortcomings: reaction speed, explosive strength and ability to keep up specific speed (unbalanced curve of running speed).

* DATA NOT MEASURED
R RESTART
N WARNING



INDIVIDUAL EVALUATION

RT about average and outstanding in the final, the best of all. Mean of approach times, without RT, 4th of the finalists. Acceleration gradually shortening in successive rounds. Highest specific speed achieved in 6th and 7th RUs in the heat and the final (0.96s). Relative stabilization of specific speed the longest of all in the final-from 2nd to 9th RU. The average time of all RUs in the final (0.97s), without any reduction of running speed. Times of running clearly show special preparation. Although the speed in the last RU of

100m HURDLES -1A- 2ndWORLD ATHLETICS CHAMPIONSHIPS 29.8. - 6.9 ROME 87

TIME ANALYSIS ZAGORCHEVA GINKA 58 BUL

PLACING 1. 1. 1st RUN RESULT 12.51

	HURDLES: 1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	FINISH
A.	2.56	3.57	4.57	5.57	6.54	7.53	8.49	9.46	10.45	11.45	12.51
B.	2.48	3.48	4.47	5.45	6.42	7.40	8.38	9.37	10.38	11.41	12.51
C.		1.01	1	1	0.97	0.99	0.96	0.97	0.99	1	1.06
D.		1.00	0.99	0.98	0.98	0.98	0.98	0.99	1.01	1.03	1.10
E.	-0.03	-0.04	-0.05	-0.07	-0.07	-0.08	-0.06	-0.04	-0.03	---	

PLACING 2. 1. SEMIFINAL RESULT 12.75

	HURDLES: 1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	FINISH
A.	2.60	3.63	4.65	5.66	6.66	7.64	8.62	9.62	10.62	11.69	12.75
B.	2.53	3.55	4.55	5.55	6.55	7.54	8.54	9.55	10.58	11.63	12.75
C.		1.03	1.02	1.01	1	0.98	0.98	1	1	1.07	1.06
D.		1.02	1.01	1.00	0.99	1.00	1.00	1.01	1.03	1.05	1.12
E.	-0.02	-0.03	-0.05	-0.06	-0.06	-0.05	-0.03	-0.02	---	-0.02	

PLACING 1. FINAL RESULT 12.34

	HURDLES: 1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	FINISH
A.	2.51	3.52	4.49	5.46	6.44	7.41	8.38	9.34	10.31	11.28	12.34
B.	2.45	3.43	4.41	5.37	6.34	7.30	8.27	9.25	10.24	11.25	12.34
C.		1.01	0.97	0.97	0.98	0.97	0.97	0.98	0.97	0.97	1.06
D.		0.99	0.97	0.97	0.96	0.96	0.97	0.98	0.99	1.01	1.09
E.	-0.01	-0.04	-0.03	-0.04	-0.05	-0.06	-0.06	-0.04	-0.05	---	

HURDLES:	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
TOLERANCE:	±0.05	±0.05	±0.05	±0.05	±0.05	±0.05	±0.05	±0.05	±0.04	±0.04

A. REAL TOUCHDOWNS
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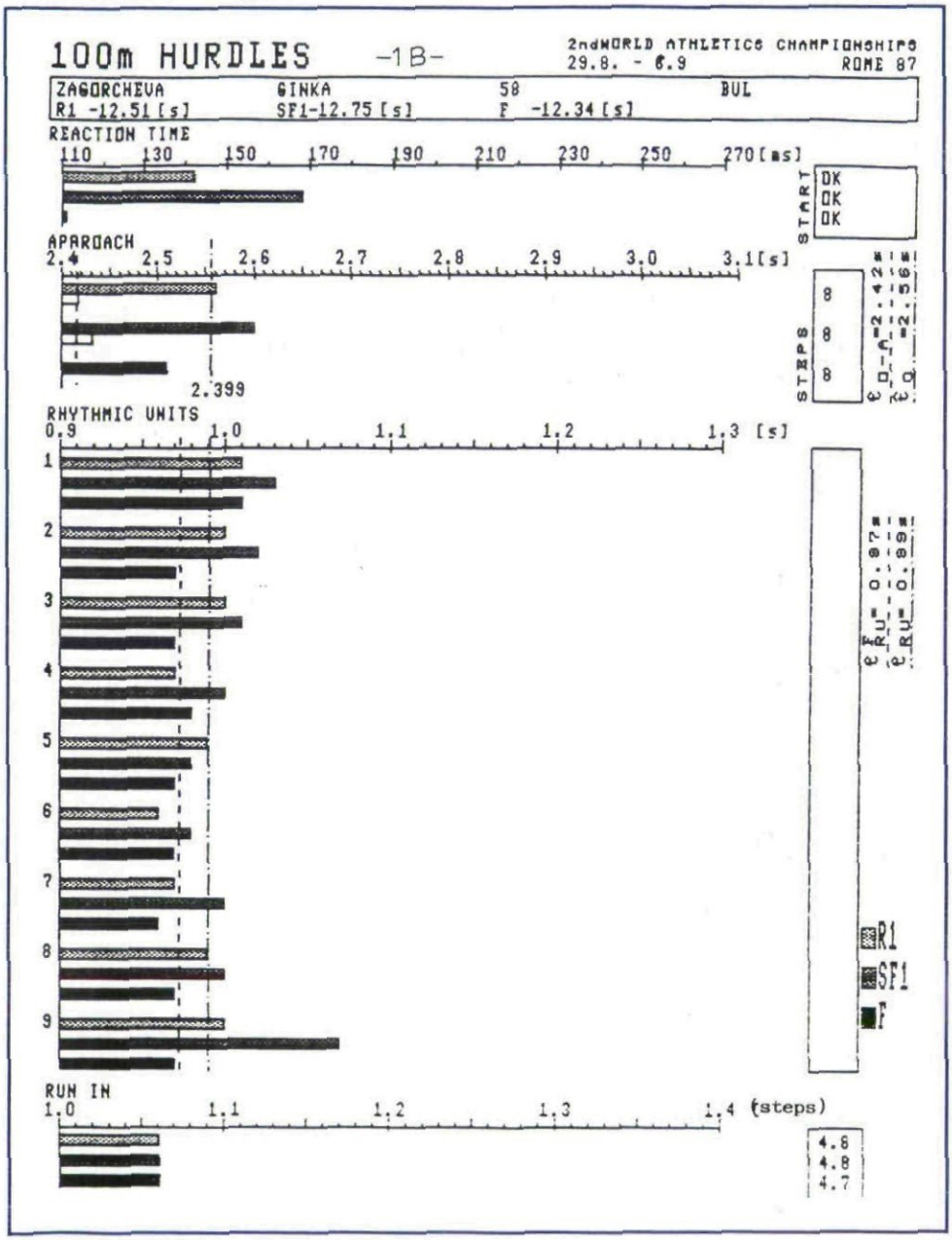
C. REAL RHYTHMIC UNIT
D. MODEL RHYTHMIC UNITS
E. DEVIATIONS FROM THE MODEL TOUCHDOWNS

the semifinal was reduced, the run-in was completed with full effort; run-in times in all rounds identical (1.06s). Advantages: reaction speed and high level of specific endurance including the run-in, shortcomings: explosive strength.

* DATA NOT MEASURED
R RESTART
N WARNING



INDIVIDUAL EVALUATION

RT below average, in semifinal substandard. Approach times without RT, and the times of the first RU, are evidence of a fairly good level of explosive strength. Acceleration over 1-2 RUs; the highest specific speed of all hurdlers in the final (0.94s). The optimum curve of running speed demonstrated in the semi-final. In the final, irregular curve of running speed during stabilization. Speed reduced usually in the last RU. Average times of all RUs and run-in times gradually improved in successive rounds. Advantages:

100m HURDLES -2A- 2ndWORLD ATHLETICS CHAMPIONSHIPS 29.8. - 6.9 ROME 87

TIME ANALYSIS UIBEL GLORIA 64 GDR

PLACING 1. 4. 1st RUN RESULT 12.81

	HURDLES: 1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	FINISH
A.	2.61	3.63	4.60	5.59	6.58	7.58	8.57	9.59	10.60	11.67	12.81
B.	2.54	3.56	4.57	5.58	6.58	7.58	8.58	9.60	10.63	11.68	12.81
C.		1.02	0.97	0.99	0.99	1	0.99	1.02	1.01	1.07	1.14
D.		1.02	1.01	1.00	1.00	1.00	1.01	1.02	1.03	1.05	1.13
E.	•	-0.02	---	---	---	---	---	---	---	---	

PLACING 1. 2. SEMIFINAL RESULT 12.68

	HURDLES: 1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	FINISH
A.	2.65	3.66	4.65	5.63	6.60	7.57	8.54	9.53	10.54	11.55	12.68
B.	2.51	3.53	4.53	5.52	6.51	7.50	8.50	9.50	10.52	11.56	12.68
C.		1.01	0.99	0.98	0.97	0.97	0.97	0.99	1.01	1.01	1.13
D.		1.01	1.00	0.99	0.99	0.99	1.00	1.01	1.02	1.04	1.12
E.	-0.09	-0.08	-0.07	-0.06	-0.04	-0.02	---	---	---	---	

PLACING 2. FINAL RESULT 12.44

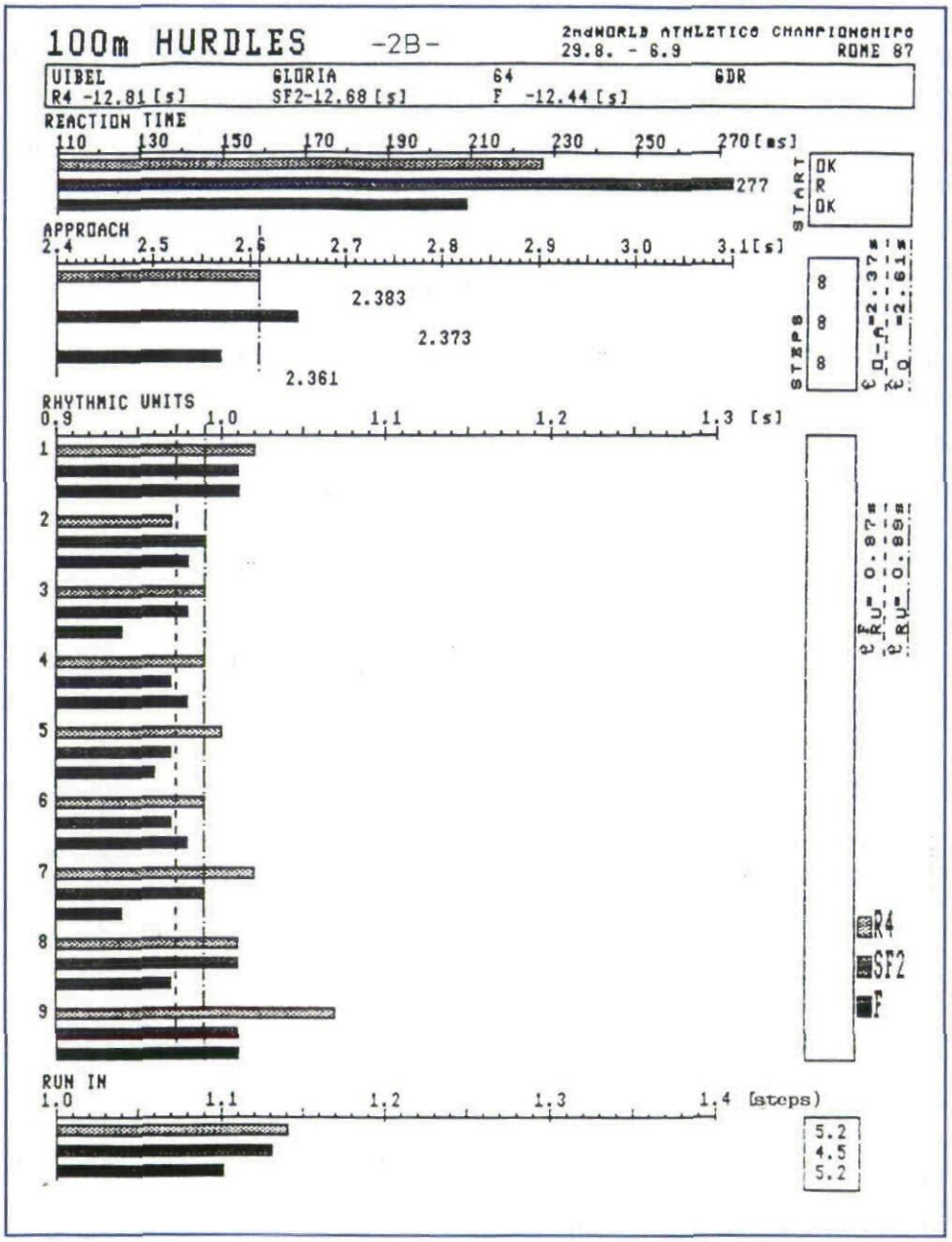
	HURDLES: 1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	FINISH
A.	2.57	3.58	4.56	5.50	6.48	7.44	8.42	9.36	10.33	11.34	12.44
B.	2.47	3.46	4.44	5.42	6.39	7.36	8.33	9.32	10.32	11.34	12.44
C.		1.01	0.98	0.94	0.98	0.96	0.98	0.94	0.97	1.01	1.10
D.		1.00	0.98	0.97	0.97	0.97	0.98	0.99	1.00	1.02	1.10
E.	-0.05	-0.07	-0.07	-0.03	-0.04	-0.03	-0.04	---	---	---	

HURDLES:	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
TOLERANCE:	±0.05	±0.05	±0.05	±0.05	±0.05	±0.05	±0.05	±0.05	±0.04	±0.04

A. REAL TOUCHDOWNS
B. MODEL TOUCHDOWNS
C. REAL RHYTHMIC UNIT
D. MODEL RHYTHMIC UNITS
E. DEVIATIONS FROM THE MODEL TOUCHDOWNS

level of explosive strength, maximum specific speed and specific endurance; high shortcomings: reaction speed, ability to maintain specific speed in the run-in.

* DATA NOT MEASURED
R RESTART
N WARNING



INDIVIDUAL EVALUATION

RT in the heat substandard, in the following rounds excellent. The best in the approach time, after subtracting the RT. Length of acceleration irregular. Highest specific speed in the final from 2nd to 8th RUs.

100m HURDLES -3A- 2ndWORLD ATHLETICS CHAMPIONSHIPS 29.8. - 6.9 ROME 87

TIME ANALYSIS OSCHKENAT CORNELIA 61 GDR

PLACING 1. 3. 1st RUN RESULT 12.83

	HURDLES: 1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	FINISH
A.	2.62	3.66	4.66	5.63	6.62	7.62	8.61	9.62	10.62	11.66	12.83
B.	2.54	3.57	4.58	5.59	6.59	7.59	8.60	9.61	10.65	11.70	12.83
C.		1.04	1	0.97	0.99	1	0.99	1.01	1	1.04	1.17
D.		1.03	1.01	1.00	1.00	1.00	1.01	1.02	1.03	1.05	1.13
E.	-0.03	-0.04	-0.03	---	---	---	---	---	---	---	

PLACING 1. 1. SEMIFINAL RESULT 12.65

	HURDLES: 1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	FINISH
A.	2.47	3.54	4.56	5.56	6.52	7.51	8.50	9.49	10.49	11.53	12.65
B.	2.51	3.52	4.52	5.51	6.49	7.48	8.48	9.48	10.50	11.54	12.65
C.		1.07	1.02	1	0.96	0.99	0.99	0.99	1	1.04	1.12
D.		1.01	1.00	0.99	0.99	0.99	0.99	1.00	1.02	1.04	1.11
E.	---	---	---	---	---	---	---	---	---	---	

PLACING 3. FINAL RESULT 12.46

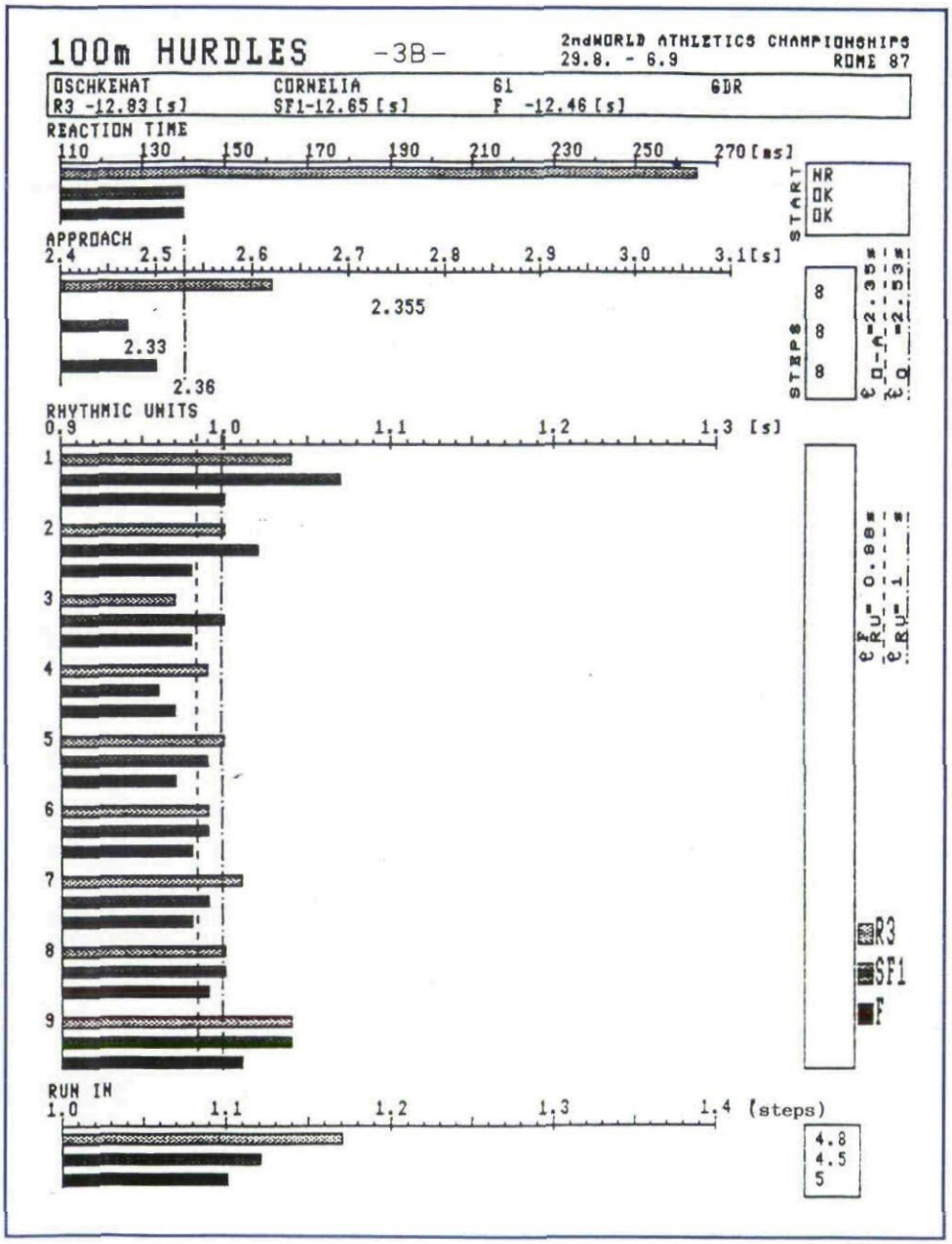
	HURDLES: 1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	FINISH
A.	2.50	3.50	4.48	5.46	6.43	7.40	8.38	9.36	10.35	11.36	12.46
B.	2.47	3.47	4.45	5.43	6.40	7.37	8.35	9.34	10.34	11.36	12.46
C.		1	0.98	0.98	0.97	0.97	0.98	0.98	0.99	1.01	1.10
D.		1.00	0.98	0.98	0.97	0.97	0.98	0.99	1.00	1.02	1.10
E.	---	---	---	---	---	---	---	---	---	---	

HURDLES:	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
TOLERANCE:	±0.05	±0.05	±0.05	±0.05	±0.05	±0.05	±0.05	±0.05	±0.04	±0.04

A. REAL TOUCHDOWNS
B. MODEL TOUCHDOWNS
C. REAL RHYTHMIC UNIT
D. MODEL RHYTHMIC UNITS
E. DEVIATIONS FROM THE MODEL TOUCHDOWNS

Notable speed reduction in the last RU. Run-in times gradually improved in successive rounds. Advantages: reaction speed and explosive strength; shortcomings: maximum specific speed and run-in speed.

* DATA NOT MEASURED
R RESTART
N WARNING



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5. Interpretation from the point of view of training practice

Malcolm Arnold, BAAB National Coach, Wales

In the past, scientific research into track and field events has sometimes been divorced from practical, trackside coaching. Coaches and scientists often use a very different language, sometimes so different that there has been a total lack of communication in very important areas of development.

Nowadays that gulf is being bridged, with scientists and coaches being able to understand each other to a greater degree.

The analyses undertaken in the sprint hurdles by the team in Rome add significant information to that which we already possess and is commended to all who coach hurdling. The very useful section on the history and development of performance puts present day hurdling standards into correct context.

When seeing results of the research from previous major championships, one often wonders how the information is obtained to such a high degree of accuracy. The researchers' notes on methods and procedures are very reassuring and should give any coach confidence in their final findings.

The figures obtained are explained well, in terms which the practising coach can understand. Each race is broken down into the following parts:

1. Reaction time of the athlete on the starting blocks. When reading the report, coaches should also compare the hurdlers reaction times with those of the 100 metres sprinters.

2. *The Approach Run,* where two figures are given. The first figure is minus the reaction time and the second figure includes the reaction time. The approach run without the reaction time is determined as significant in evaluating acceleration levels.

Practical problems in this area of the race are many. Of course, one remembers the maxim taught to the novice hurdler - "get to the first hurdle first". As the hurdler becomes more sophisticated, further problems present themselves, which will significantly distort the time start to first hurdle, if not dealt with properly.

Does the athlete use 7 or 8 strides to the first hurdle? Most, if not all, female hurdlers use 8 strides to the first hurdle. The last time I saw a woman using 7 strides to the first hurdle was in the heats of the I World Championships in Helsinki. Some male hurdles more often use 7 strides to the first hurdle, especially the long legged athletes.

Some athletes have great difficulty in deciding the number of strides to use – only a change in distance of 13.72m from the start line to the first hurdle will help them in their dilemma!

There are many postural changes in a short period of time in this part of the race, for example:

* Drive low from the crouch position in the blocks
* Come upright very quickly (after the fourth stride, perhaps), to be ready to clear the hurdle.

Based on these two observations, the athletes reach a compromise in driving out of the blocks to hurdle 1. The pure sprinter can "blast" out of the blocks without regard. The sprint hurdler must drive hard from the blocks, but remember the postural positions required during the first 7 or 8 strides. He must also reach a very precise take off point in order to clear the hurdle efficiently. Because this is the accelerative part of the race, it is very important not to strike a hurdle or to lose rhythm at this early point.

3 *Rhythmic Units* - signifying the time taken from touchdown to touchdown, after each hurdle has been cleared. Coaches regard these figures as very significant. However, in reality, it is very difficult for the coach to establish these times without very expensive and sophisticated equipment. This aspect of the research is very valuable.

Significant amongst these statistics are the actual times for each unit and for how long the times can be maintained during the race. To sustain fast rhythmic unit times during a race, the athlete must

— be very precise and technically excellent and NOT hit hurdles

— have very good speed endurance, developed through proper training activities.

The difference between the figures for male and female hurdlers should be observed. They denote an essential difference between the mens' and womens' races and particularly the difference between men and high hurdles and women and relatively low hurdles. Coaches should adapt their training methods accordingly.

4 *The Run In* - I am always amazed at the number of hurdlers and coaches who do not regard the run in from hurdle 10 to the finishing line as significant. This is usually another short period of acceleration – for 5 or 6 strides – and a period of time where change in posture, to effect a good

body dip, is necessary. It is a sector of the race that needs practice to:

— Count the number of strides from the final landing from hurdle 10 to the finish line.

— Change body posture and time the dip finish correctly. If the timing is done badly, the athlete can lose a lot of time in this section of the race.

Armed with these statistics, the coach can develop the ability to evaluate races. The strengths of an athlete can be thought of as their natural assets. The work of a coach is to recognize and eradicate weaknesses as quickly as possible, so that the athlete's overall time is improved.

Based on the figures provided by the research team, an insight into the weaknesses of sprint hurdlers is given. It must then be within the compass of the coach to invent, develop and improve training exercises to meet the goals that are set. Some of these exercises must aim to improve:

— Specific technical skills relating to sprint hurdling

— Specific physiological qualities, particularly elastic and gross strength, pure sprinting speed and speed endurance over times up to 15 seconds.

— The range of movement about specific joints in the body.

Finally, readers of this research must beware of the criticism levelled at the hurdlers in this study. It represents very valid and pertinent analysis of hurdlers at the very highest level. Please treat the criticism in the context that it is intended. Do not be harsh on developing hurdlers who do not meet the statistical criteria presented in the research documents!

□