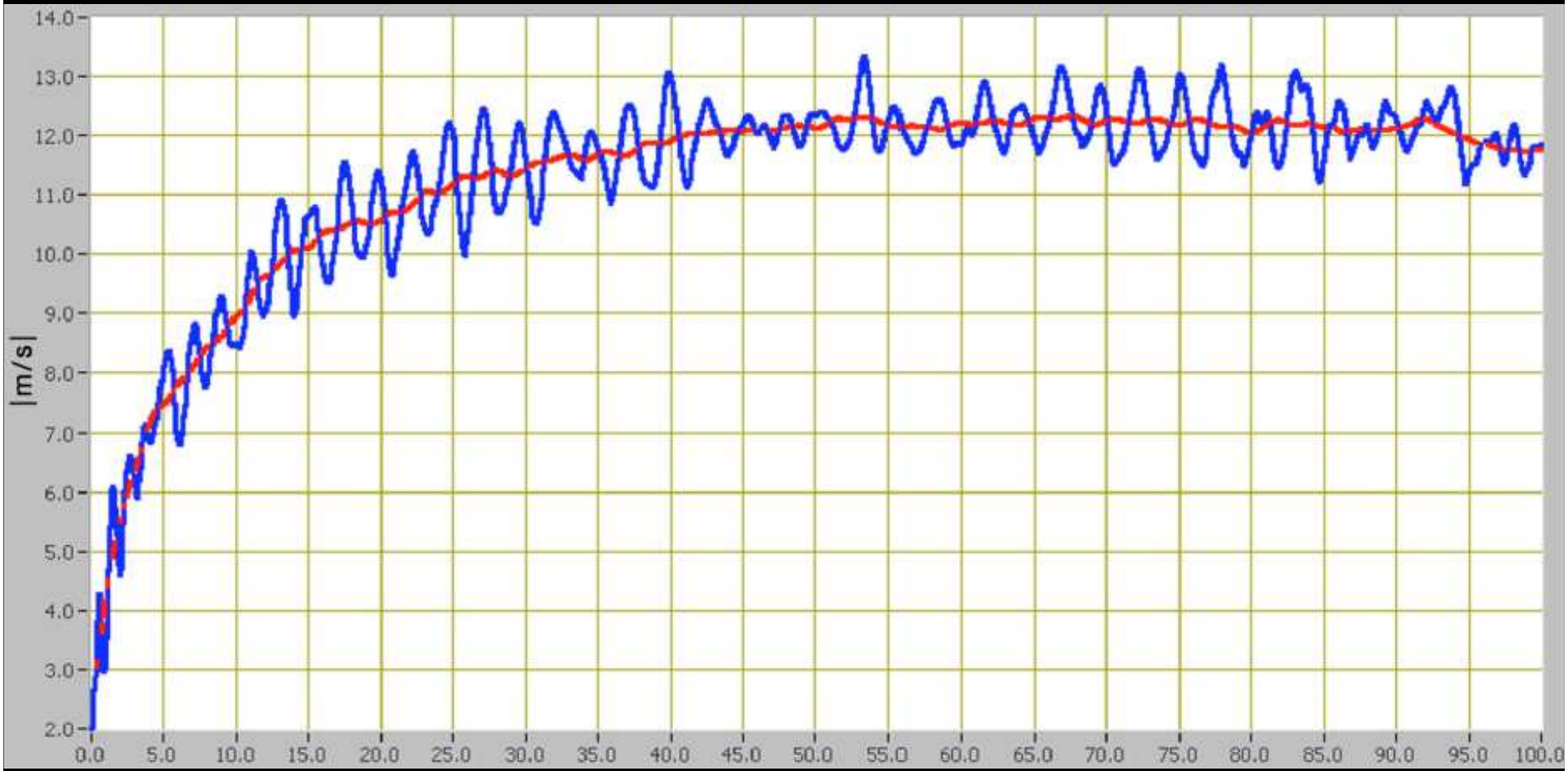
« I am, a stride at a time.
A very short space of time through very short times of space. »

James Joyce, Ulysses (1922)

A HISTORY OF TOP SPEED – Oslo 2014 – PJ VAZEL



1860's

FIRST TRAINING ADVICES FOR TOP SPEED

- Nothing specific yet regarding training for top speed
- Pedestrians are adviced to practice at top speed
- Foot prints on the ground give hints that speed is not constant

John Westley COZAD (USA) wins and breaks the record for a 125y « foot-race » with 12 ½ in Long Island on 23 nov 1868 ►

1860's

FIRST TRAINING ADVICES FOR TOP SPEED

1859

« The trainer will, in preparing his man for these short matches, make him run daily 2 or 3 times over the distance intended; and either run against him with a start of a few yards in advance, which gives confidence, or time him exactly, keeping the result to himself. »

► John Henry WALSH 'Stonehenge' (GBR, former surgeon) ***British Rural Sports***

1863

« For a short race of a 100 or 200 yards the pedestrian, after the body is in good health, does not require very much severe work, but the distance must be accomplished at top speed at least once daily, and about the same time of the day that the match will take place if possible. »

► Charles WESTHALL (GBR) ***The Modern method of training for running***

1868

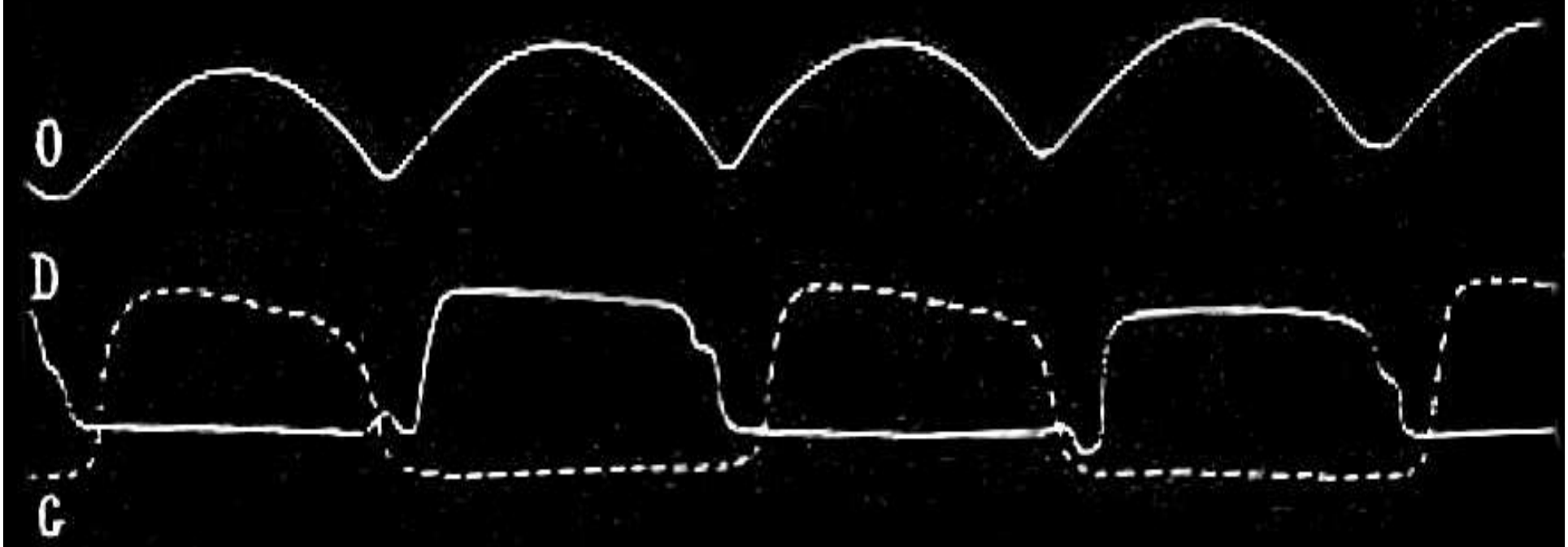
7:00	**Rise, wear heavy shoes and walk 1 mile out, and home. Shower-bath, rub for 20min**
8:30	**Breakfast (mutton chop, tea, dry toast, not any slops), sit 30min not thinking too much of the coming match.**
9:00	**Steady 5 miles walk out, and 5 miles back.** **Take a tumbler of calf's foot jelly and a dry biscuit** **Wear spike shoes and for 1 hour practice start either starting by himself or 'by pistol' as per articles of match, run about 12 yards.** **Dinner (rump steak, mutton, no vegetables, bread and sherry, no smoking**
Afternoon	**Take a straggling walk of 2 or 3 miles accord the fields, throwing stones or shooting to keep the muscles in action, not too severe exertion of any kind, for fear of stiffness. Run the distance for which the match is made about every 3rd day at top speed.**
6:00 pm	**Take a dry toast and tea. This repeated every day.** **(Condition is indispensable, so that a man may not be over-trained and dull)**

► C.A. WHEELER (GBR), ***Sportascrapiana***

1870's

FIRST TECHNICAL DESCRIPTIONS

- *Top speed location is roughly estimated (= after 40 yards)*
- *Ground reaction forces are investigated for running, not yet for sprinting*
- *Training only consists in simulating the competition distance*



▲ *« Lines of human's running », Étienne-Jules MAREY (FRA), The Animal Machine (1873)*

1870's

FIRST TECHNICAL DESCRIPTIONS

1868

« The action of a good 'spirt' runner is generally perceptible by his running from the thigh, or say the hip, rather than from the knee. In illustration of the superiority of the former mode, I would cite the contrast between 2 horses: 1 with round action cannot get well over the ground; good trotters throw their forelegs out straight, so should a man. »

► C.A. WHEELER (GBR), *Sportascrapiana*

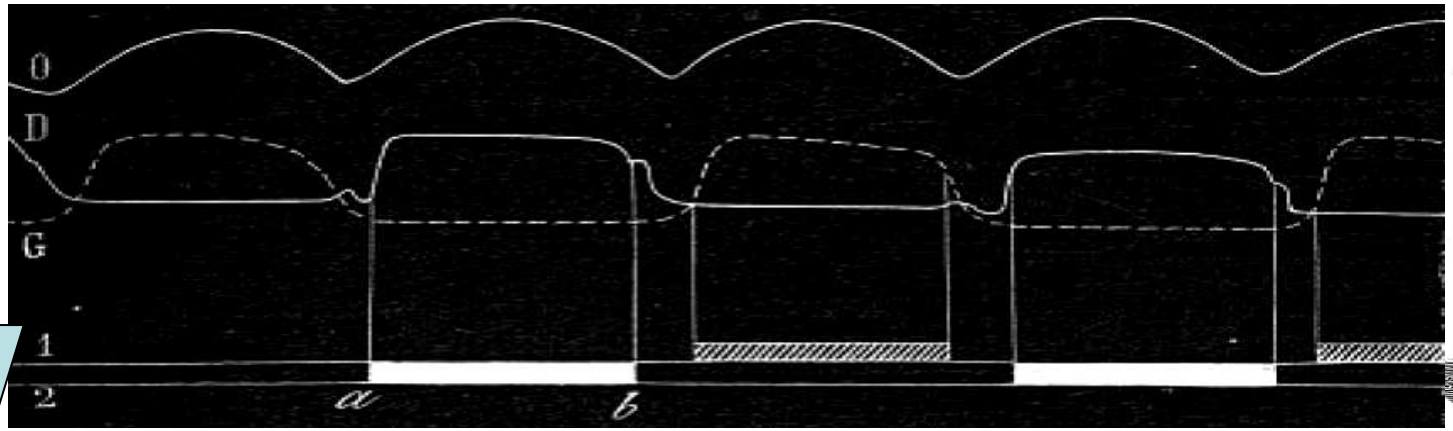
1873

Cinematographical and dynamographical techniques to *explore* « vertical reactions » during various gaits (walking, running, galloping, jumping – not yet fast running which is « irrelevant from a physiological point of view » and useless as impossible to maintain it for prolonged T.)

As speed increases :

- **forces, step freq & length,**
- **contact time**
- **suspension time (« *silence* »).**

▼ Étienne-Jules MAREY (FRA), *La Machine animale*



1877

The top speed is seldom obtained until 40 yards are covered. For sprinting, wind is not such a desideratum as elasticity of muscle.

► Ed JAMES (USA) *Practical Training (Sprint training)*

1880's

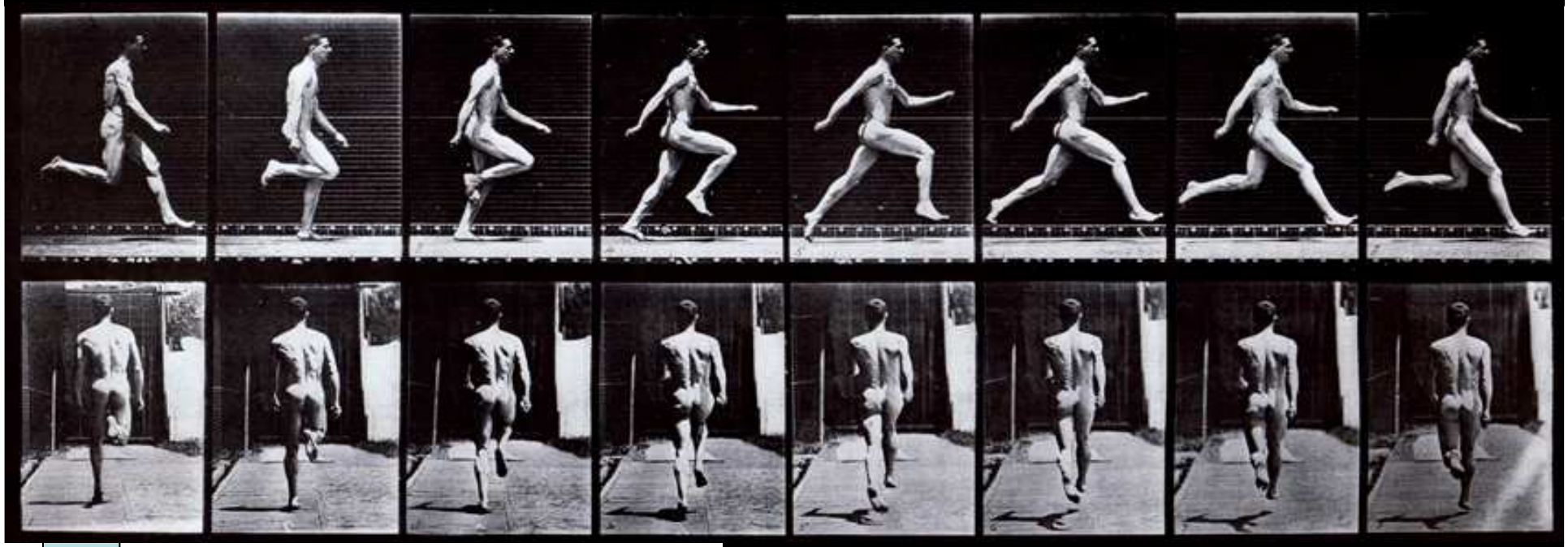
FIRST KINEMATIC & DYNAMIC ANALYSIS

- Rough estimation of speed « maxima » : 10 meters / seconds (Marey)
- Chronophotographies of « running full speed » ▼
- Considerations on « style » of running

▲ Athlete Running, Eadweard J. MUYBRIDGE (USA) Plate 99, executed in Palo Alto, CA, 1878-1879 , published in 1881

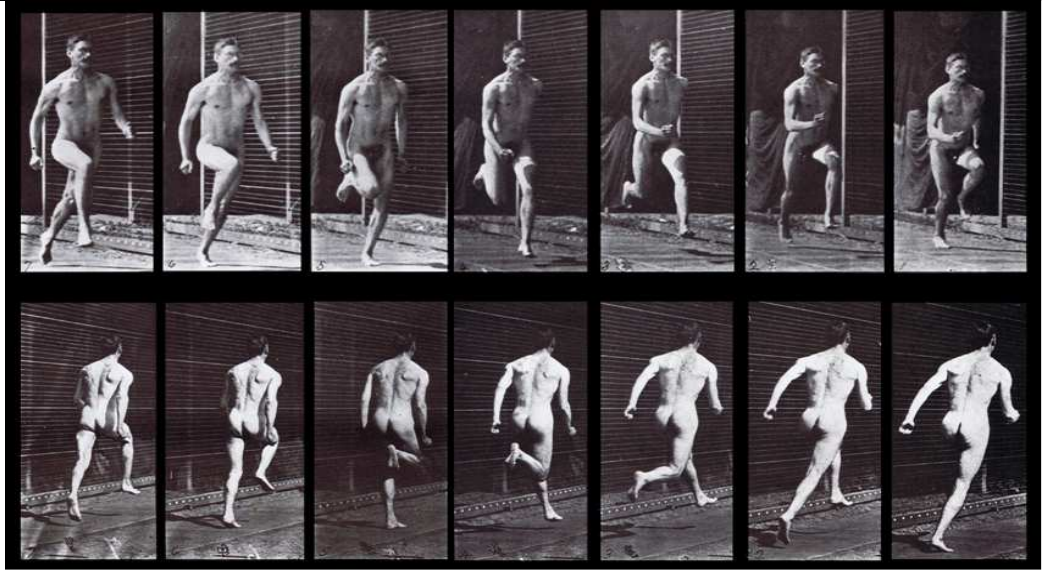
1880's

FIRST KINEMATIC & DYNAMIC ANALYSIS



1885

Nude Male Running Full Speed
Eadweard J. MUYBRIDGE (USA)
Animal locomotion
(Plates 65 & 66, publ. 1887)



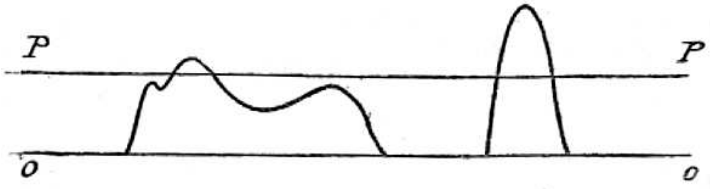
1880's

FIRST KINEMATIC & DYNAMIC ANALYSIS

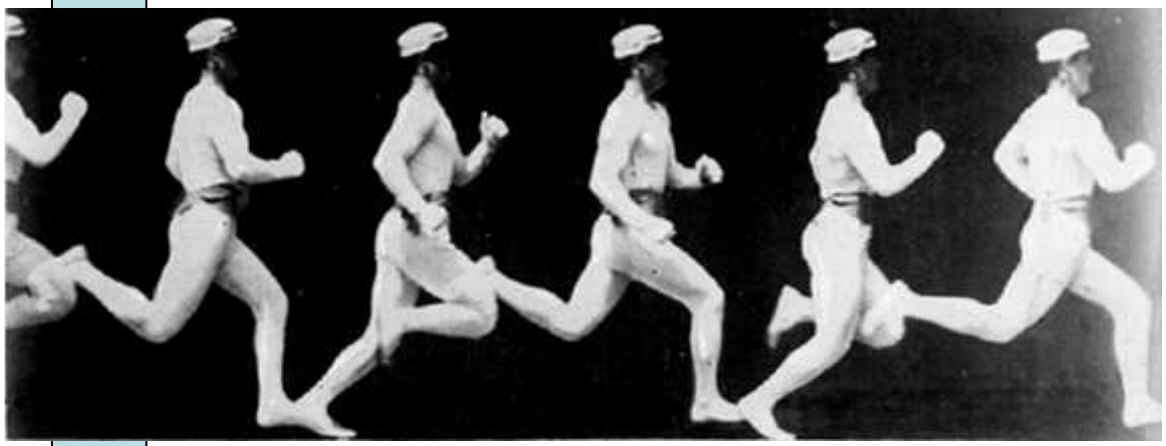
1886

« Kinematic analysis of running »

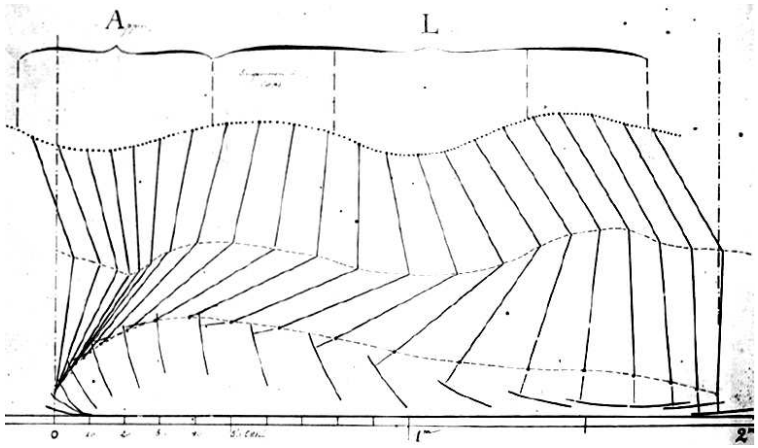
- **Foot touches the ground on tiptoe if step is long**
- **Curve of vertical force has only one peak**
- **The peak of the curve is as high as the cadence**



► É.-J.MAREY & G. DEMENY (FRA), *Proceedings of Académie des Sciences*, Sept-Oct session

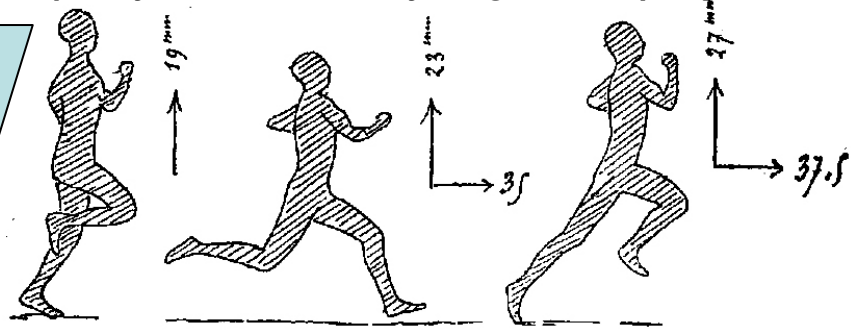


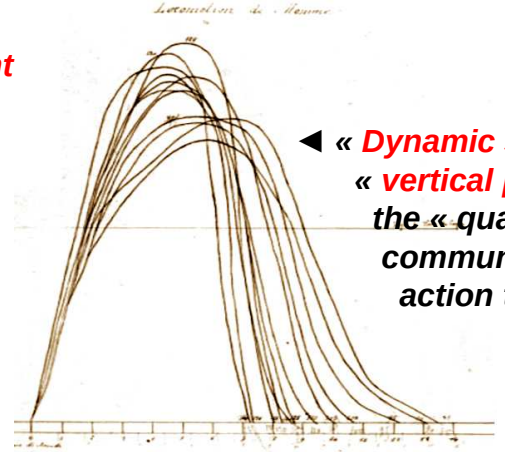
▲ « Photo-chronography » of « velocity run »



« Analyse » of lower limb's movement during running ▲

▼ Attitude of running with indication of CG displacement (Marey worked from Muybridge's 1881 pics)





◄ « Dynamic study » dynamograph of « vertical pressure », expressing the « quantity of movement communicated by muscular action to the body »

1880's

FIRST KINEMATIC & DYNAMIC ANALYSIS

1882

French instutition defines 3 degree of cadence :
- Moderate race 140 mouvements per min. (2,3 step/sec)
- Fast race 200 mpm (3,3 sps)
- Velocity race 240 mpm (4 sps) SL « undetermined »

► Ministère de l'Instruction Publique, *Manuel de gymnastique*

A very fast sprinter.

1887

● « Another curious thing about sprinting is the varieties of action in which good performers indulge. Junker sprinted as if he were badly bandy-legged, although we never knew that he was so. Lockton, who was even faster than Junker, ran in the style most affected by professional pedestrians, with his body low and well forward. W. P. Phillips, who managed to beat Lockton for the championship in 1880, ran almost erect, looking even more than his full height of six feet. »

● « A man should never practise sprinting alone; he becomes sluggish, and can never really tell whether he is doing well or ill. If he is simply training for a 100 or a 120 yards race, after half-a-dozen of these spins he should take a few minutes' rest and then run the full distance, or at any rate a burst of seventy or eighty yards, before he goes in to have a rub down and resume his clothes. »

► M. SHEARMAN (GBR, 100y and co-founder of AAA), *Athletics and Football*

FIRST KINEMATIC & DYNAMIC ANALYSIS

Use of foot-prints for training

▼ *Facts about Cary's run*, New York Times, 21 Oct 1890

Mr. Cary says he had taken special care of himself during the past week. Since his race at Washington with Owen he gained three pounds. During the past week he gave special attention to starting, and his tracks show by actual measurement that he was "into his stride" at the third stride, which measured over six feet.

« One other most valuable test (and this applies to all distances run) is, ***measure your strides daily;*** the proper way to do this is to take two strides in each measurement; this must be done, because most men take a longer stride with one leg than with the other. Several measurements at different parts of the track should be taken during the ordinary practice spins, and these must be carefully compared. Should they be found accurate and alike, day by day, you may be quite sure that you are running well and in your best form; should, however, they be short or irregular, there is surely something wrong. Give this, then, your best attention and find out the cause: the most usual one is *staleness.* »

► Walter GEORGE (GBR, Mile record holder) *Training*, 1902

Date.	Morning Work.	Afternoon Work.	Weight.
1882 Nov. 8	Did not run for three days. Was	distinctly stale. Changed mode of	(stripped) in lbs.
" 9	living. Measured strides very irr	egular.	115
" 10			

FIRST KINEMATIC & DYNAMIC ANALYSIS

1890

► Malcom W. FORD (USA, 100y National champ 1884-85-86)

***How to run*, The Sunday Union, 31 Oct 1890**
***How they run*, The Sun, 23 Nov 1890**
***Sprinters and their methods*, Outing 1891**

« Value of long stride »: « All sprinters run on their toes, and those who understand their business run with the body well forward. A long stride comes next in importance. »

≠ ?

« The running part of sprinting consists simply in striding as rapidly as possible. No effort should be made to take a long stride; simply step out naturally. »

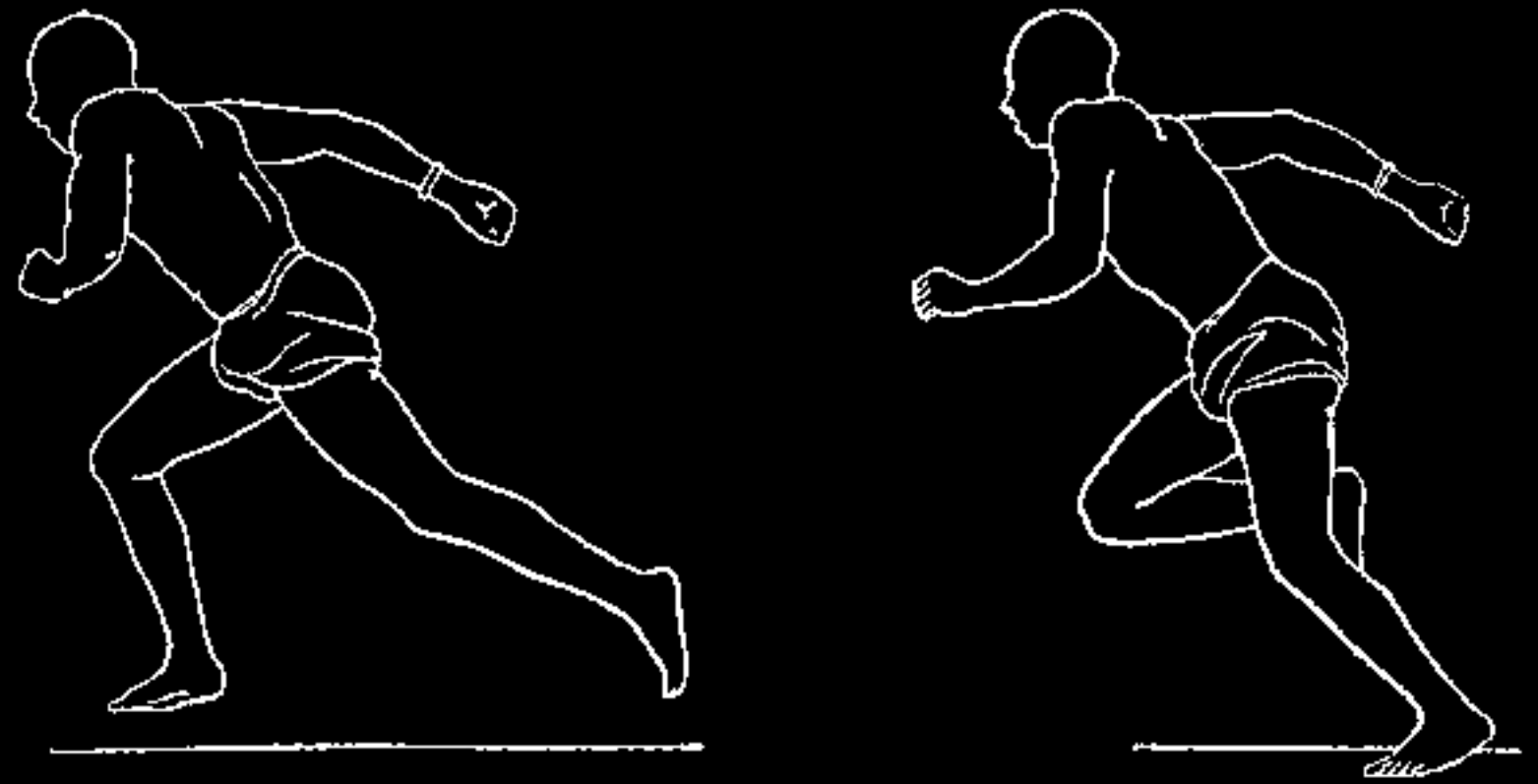
Sub10 sprinters (1886-90)	Body H	Stride Length
Fred WESTING	1.67m	1.83m (6ft)
Luther CARY	1.73m	2.08m (6ft 10in)
John OWEN	1.74m	2.13m (7ft)
H.M. JOHNSON	1.83m	2.24m (7ft 4in)
Wendell BAKER	1.80m	2.36m (7ft 9in)

« " BAKER Showing Speed", is an instantaneous photograph of this long strider running at his best. His motion is very easy, and no picture can give an adequate idea of how fast he travels. He was striding at this time 7ft 8 or 9in and was showing speed at the rate of 200 yards in 20s (…) JOHNSON did not travel in the smooth way that characterizes BAKER, but more like a succession of thrusts with the legs. His running impressed one with the idea of a large, heavy machine propelling itself along ; BAKER, on the other hand, glides.. » ►

1890's

FIRST COMPLEX WORKOUTS

- First weekly training schedules published
- Description of the running form of World's best sprinters



▲ Senegalese runner demonstrating velocity race, É.-J. MAREY, La course en flexion (1898)

FIRST COMPLEX WORKOUTS

1893 **Critics in France regarding the Championnat Général d'Athlétisme:**
« Does it make any sense that a top-notch runner, like Gauthier who is without undoubtedly the best sprinter in France, is forced to train over 400m or even 2000m in order to have a chance to win? He only can lose some of his speed in the process. »
► Henri BERNHEIM (FRA) *Le Journal*, 31 octobre

1894 **Sprint running : « No sport is so open to variety in mode of practice. »**
▼ Michael C. MURPHY (USA, Yale, coach John OWEN) *College Athletics*

It is an indisputable fact that no animal is so much improved by training as man—none stands such long and severe preparation with advantage—and none displays the difference between condition and its absence in so great a degree. But

▲ AAU final in Washington DC on 11 Oct 1890 – John OWEN Jr. first Amateur to run sub 10

1890's

FIRST COMPLEX WORKOUTS

1894

« Nearly all the green men training for the short distances do too much work. »
« On the day before a contest no exercises should be taken. Standing around while waiting for the games to start weakens the legs. Contestants should lie down until called for their event. »

► William F. GARCELON (USA, Harvard) *Some Points on Sprinting*, Lewiston Evening Journal, 17 April

The following would be an ordinary week's work for a man training for the 100 and 220 yards run:

Sunday, rest.
Monday, 220 yards, not at top speed, and 100 yards.
Tuesday, 440 yards at almost top speed.
Wednesday, 220 yards slowly and three fast, sharp sprints of 50 yards each with rests intervening.
Thursday, 440 yards at two-thirds speed.
Friday, 100 yards at best speed, followed by a five or ten minute rest and then 220 yards at fastest.
Saturday, 100 yards at two-thirds speed and repeat.

1896

Monday.—Practise the start six times, running at speed only about 20 yards from the scratch. Rest between each attempt, and end up by jogging 50 yards, finishing up the 100 at speed.
Tuesday.—Jog a quarter of a mile, for the purpose of developing the stride.
Wednesday.—Run 75 yards at speed; rest, and then run 50 yards at speed.
Thursday.—Practise the start ten times, running, as before, not farther than 20 yards each time; jog 220 yards slowly for stride.
Friday.—Run 50 yards at speed twice, with a rest between.
Saturday.—Run a trial 100 yards on time, and, after a rest, jog around the track for 220 yards.

« To an ambitious young athlete who feels he is a future record-holder this schedule may seem altogether too light. (…) at the slightest sign of fatigue at this work quit for the day. »

► Albert LEE (USA), *The sprints*, Track Athletics in details

FIRST COMPLEX WORKOUTS

1896

- **« [The runner] should run with only the very slightest forward inclination of the body, but with the chin thrust well out. »**
- **« The man who naturally has a long stride has an advantage over his fellows, but the man who has not a long stride need not attempt to increase his spread of leg. An athlete can run much better with his natural stride than with an adopted gait.»**
- **« [The heel must not touch the ground by any mean] Yet a man does not run on his toes; he runs on the ball of his foot; and, in order that the spikes of his shoes may enter the track to the best advantage, the sole should strike flat, that the nails may dig well in and secure a firm hold. »**

► Albert LEE (USA), *The sprints*, Track Athletic in details

Alfred DOWNER (GBR born in JAM)

Bernard WEFERS (USA)

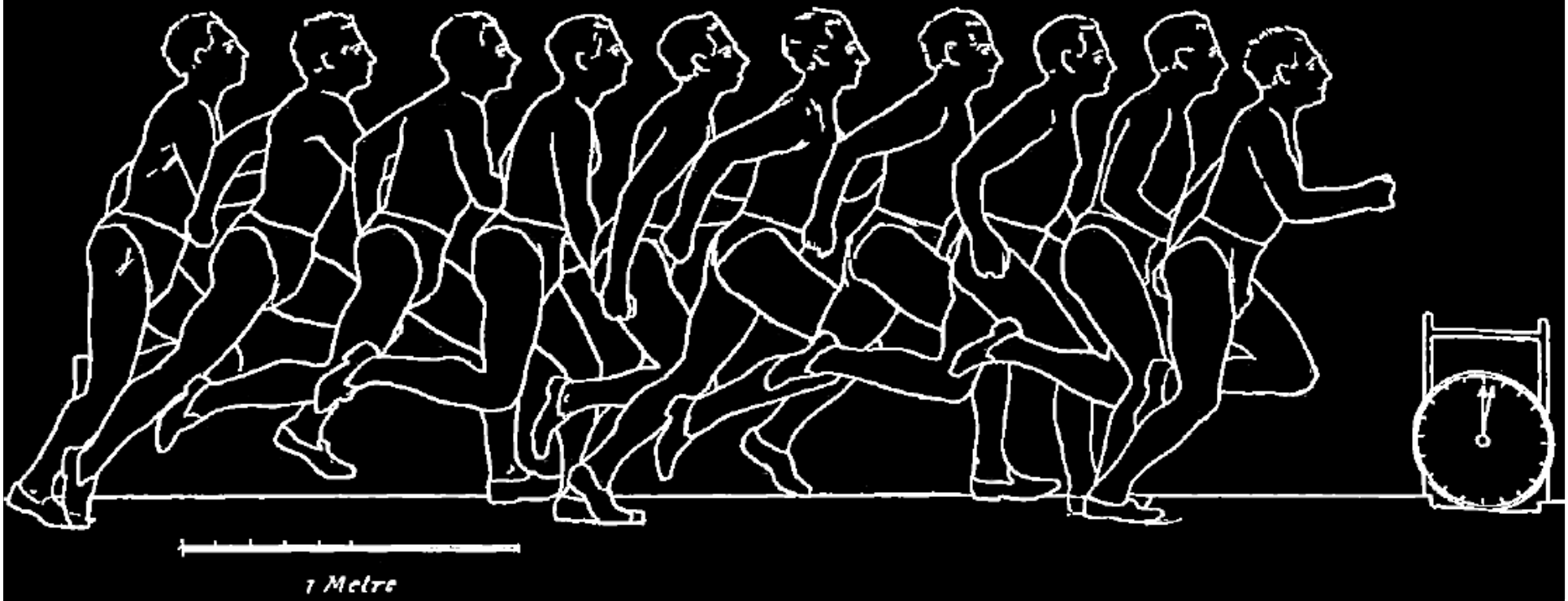
John CRUM (USA)

▲ Sprinters who matched the 100y WB in 1895 (9.$^{4/5}$) photographed during practice trying to show a perfect running form

1900's

FIRST TRAINING STRATEGIES

- Estimation of top speed revised : up to 11 m/s (Demeny)
- Training advices of champion sprinters
- Progression in sprint workouts



▲ « Épure of velocity race », É.-J. Marey (1900, Official Olympic report)

FIRST TRAINING STRATEGIES

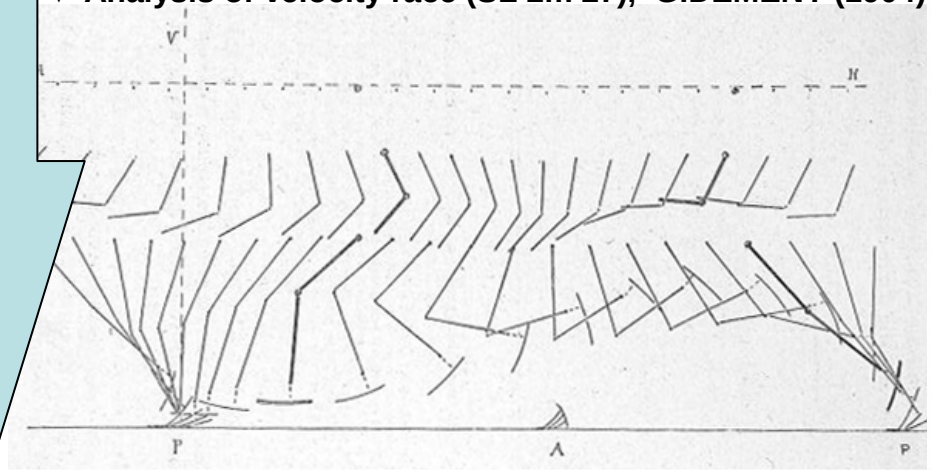
1900

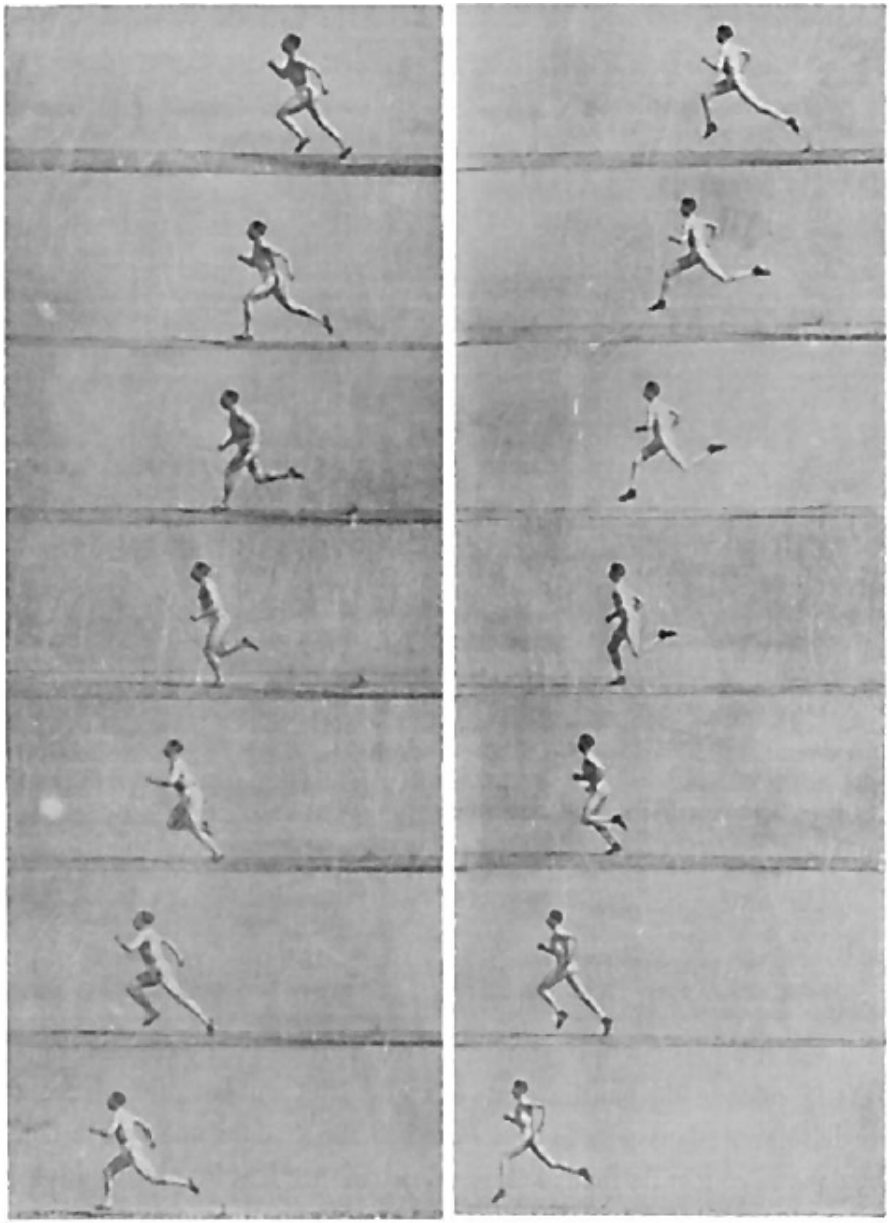
At the occasion of the Olympic Games and the International Exposition in Paris, MAREY recorded the movement of some of the world best athletes

► Official Olympic Report

Comparison between distance and velocity races
« The distance runner, in lengthening his suspension phases, creates some recovery time so that the legs just have to move by themselves. During the velocity race, where the suspension time is almost nil, the impulsive effort of the legs is nearly continuous. » É.J. MAREY ►

▼ Analysis of velocity race (SL 2m 27), G.DEMENY (1904)



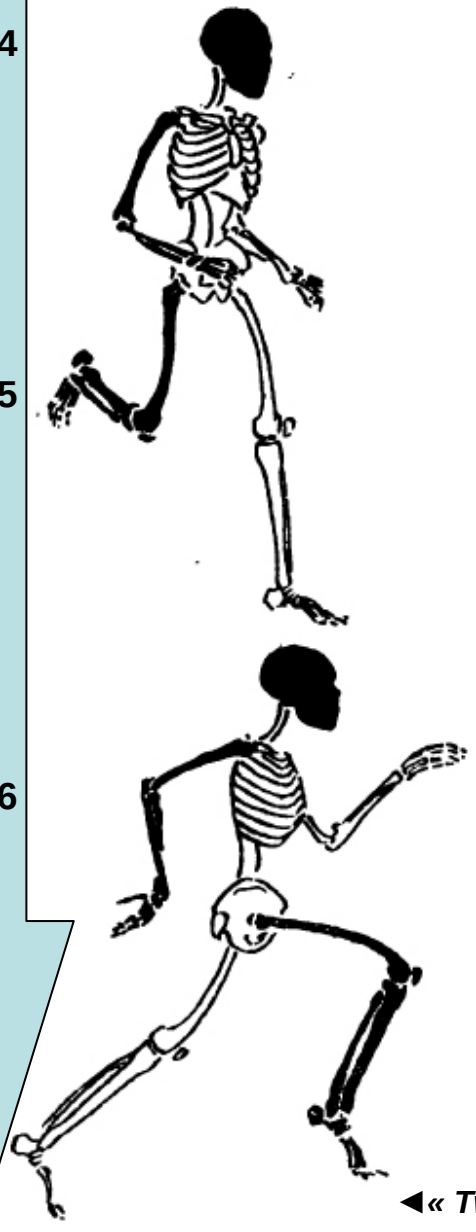


FIRST TRAINING STRATEGIES

1904

1905

1906



« Never kick your heels up behind, as by so doing you cause loss of locomotion and speed by making the legs trail through a greater space than necessary. Care should be taken to come down upon the ground lightly at every step. This is something that may be easily learned in practise and is far more important than it sounds, since much jarring soon tires the muscle and nerves. »

► W. A. SCHICK (USA, Harvard), *T&F Athletics,* in Book of School & College sports.

« The human body is at best but an awkward machine for producing speed. Any self-respecting hound or rabbit could make all our Duffeys and Weferses look like thirty cents. (…) those who overreach themselves and fall merely because the brain's ambitious command cannot be obeyed by the muscles, the tendons that snap now and then at the supreme moment, show how weak are the runner's means compared with his desire. »

► Arthur RUHL (USA) *Track Athletics*

« My own style of running and action does not find favour with some trainers, and I certainly will not attempt to argue whether it be correct or not »

► Jack MORTON (GBR, 100y AAA Champ 1904-07)

How to run 100 yards

« I find that if I runmore upright my stride is shorter and no faster action » ►

◄« Two correct styles for the sprint » Eustace MILES (GBR) An alphabet of Athletics, 1904

FIRST TRAINING STRATEGIES

1902

« One reason I held on, I think, was that my training has always been of the very lightest character. In the opening of a season I have begun with a little jogging, only a little to limber up my muscles and get them into shape, and not enough to make my movements slow. Then I have practised starts in an easy way, with now and then a run of about 30 or 40 yards. »

► Alexander KIDD, *The Fastest Sprint, How DUFFEY made a new world's record*, Outing 40 n°4

Arthur DUFFEY running 9.3/5 in New York on 31 May 1902

FIRST TRAINING STRATEGIES

1908 100m Olympic Champion used a S to L plan – Reginald WALKER (RSA) Textbook of sprinting ▼

1905

SHORT TO LONG PLAN

- **2 weeks of cross-country 2 or 3 times a week to get into condition**
- **Increased training distances:** Work 1 - starts, bursts of 40y, 1x220y
  Work 2 - starts, 2x60y, 1x160y
  Work 3 - starts, 1x75y, 1x150/220y
  Work 4 - starts, 1x100y, 1x220y

« The whole secret of training lies in knowing which kind of work should be applied to suit the particular individual »

► Arthur DUFFEY (USA, 100y WB holder), *How to sprint*

1906

LONG TO SHORT PLAN

First week

Day 1 – 1500m or 2000m very slow pace
Day 2 – 800m a little faster
Day 3 – 2x300m lengthening the strides
Day 4 – Idem
Day 5 – 1x400m a little faster
Day 6 – idem

Second week

Everyday – 2x150m fast pace, 1x100m faster

Third week

3 or 4 x 30 or 40m, 1x100m, at all speed.

Race day

2 or 2 x 30m in order to loosen the muscles.

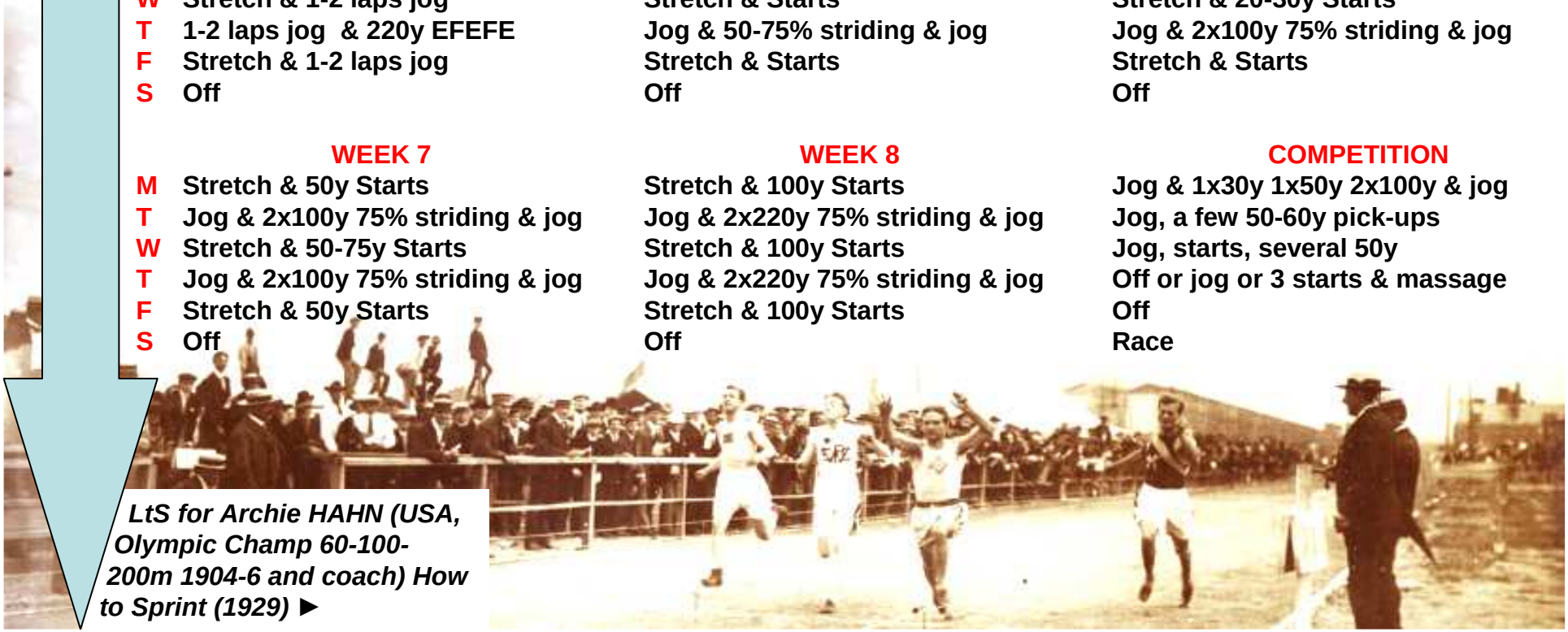
► Frantz REICHEL (FRA) *Courses à pied*, in Les Sports illustrés

FIRST TRAINING STRATEGIES

	WEEK 1	WEEK 2	WEEK 3
M	1-3 laps jogging	Stretch & 1-2 laps jog	Stretch & 1-2 laps jog
T	1-3 laps jogging	1-2 laps jog & 1-2 striding 50%	1-2 laps jog & 1-2 striding 50%
W	1-3 laps jogging	Stretch & 1-2 laps jog	Stretch & 1-2 laps jog
T	1-3 laps jogging	1-2 laps jog & 1-2 striding 50%	1-2 laps jog & 1-2 striding 75%
F	1-3 laps jogging	Stretch & 1-2 laps jog	Stretch & 1-2 laps jog
S	1-3 laps jogging	1-2 laps jog & 1-2 striding 50%	1-2 laps jog & 1-2 striding 50%

	WEEK 4	WEEK 5	WEEK 6
M	Stretch & 1-2 laps jog	Stretch & Starts	Stretch & 20-30y Starts
T	1-2 laps jog & 1-2 striding 75%	Jog & 50-75% striding & jog	Jog & 2x100y 75% striding & jog
W	Stretch & 1-2 laps jog	Stretch & Starts	Stretch & 20-30y Starts
T	1-2 laps jog & 220y EFEFE	Jog & 50-75% striding & jog	Jog & 2x100y 75% striding & jog
F	Stretch & 1-2 laps jog	Stretch & Starts	Stretch & Starts
S	Off	Off	Off

	WEEK 7	WEEK 8	COMPETITION
M	Stretch & 50y Starts	Stretch & 100y Starts	Jog & 1x30y 1x50y 2x100y & jog
T	Jog & 2x100y 75% striding & jog	Jog & 2x220y 75% striding & jog	Jog, a few 50-60y pick-ups
W	Stretch & 50-75y Starts	Stretch & 100y Starts	Jog, starts, several 50y
T	Jog & 2x100y 75% striding & jog	Jog & 2x220y 75% striding & jog	Off or jog or 3 starts & massage
F	Stretch & 50y Starts	Stretch & 100y Starts	Off
S	Off	Off	Race

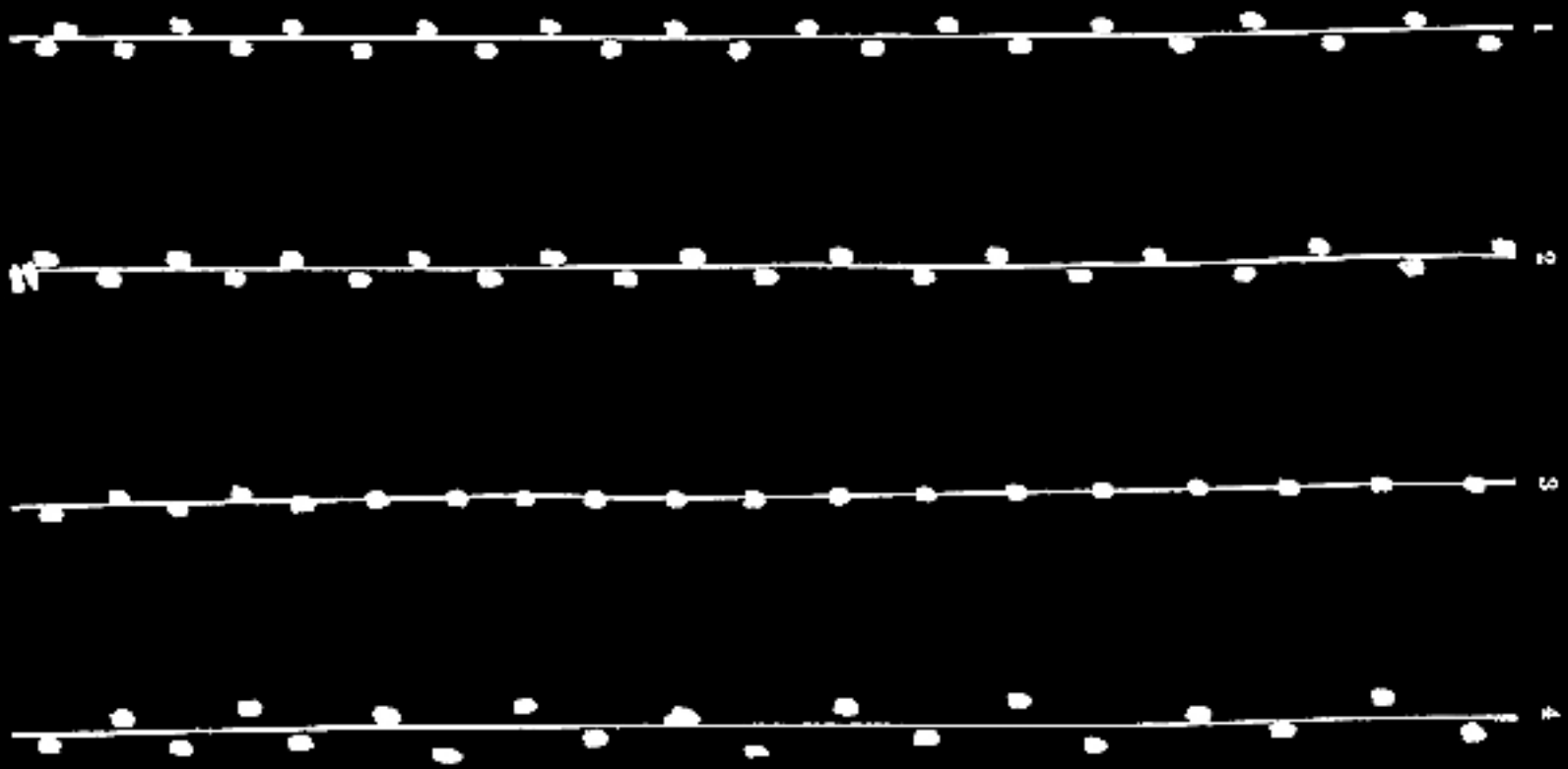


LtS for Archie HAHN (USA, Olympic Champ 60-100-200m 1904-6 and coach) How to Sprint (1929) ►

1910's

FIRST TECHNICAL STUDIES

- Distinction between style and technique of running
- Training workload and duration increased



▲ Foot prints on the cinder track (Mussabini)

FIRST TECHNICAL STUDIES

1913

► Sam MUSSABINI (GBR) ***Complete athletic trainer***

● 13 weeks of training: 4 weeks of « preliminary practice », followed by « serious course of exercise morning and afternoon (Sundays excepted) in the 2nd month », time trials to boost confidence and « little or no fast running for several days » before a competition.

●Schedule of average times made by the various classes of sprint runners at 120y

	50 yds.	75 yds.	100 yds.	120 yds.
The 12 secs. man	6 2/5 secs.	9 1/10 secs.	12 secs.	14 1/4 secs.
,, 11 3/4 ,, ,,	6 3/10 ,,	8 9/10 ,,	11 3/4 ,,	13 9/10 ,,
,, 11 1/2 ,, ,,	6 1/5 ,,	8 4/5 ,,	11 1/2 ,,	13 3/5 ,,
,, 11 1/4 ,, ,,	6 1/10 ,,	8 3/5 ,,	11 1/4 ,,	13 1/4 ,,
,, 11 ,, ,, (The average sprint-runner)	6 ,,	8 1/2 ,,	11 ,,	12 9/10 ,,
The 10 3/4 secs. man	5 9/10 ,,	8 3/10 ,,	10 3/4 ,,	12 6/10 ,,
,, 10 1/2 ,, ,,	5 4/5 ,,	8 1/10 ,,	10 1/2 ,,	12 3/10 ,,
,, 10 1/4 ,, ,,	5 7/10 ,,	7 9/10 ,,	10 1/4 ,,	12 ,,
,, 10 ,, ,,	5 3/5 ,,	7 7/10 ,,	10 ,,	11 7/10 ,,
The "inside evens" prodigies	5 1/2 to 5 1/4 secs.	7 1/2 ,,	9 3/5 to 9 1/5 secs.	11 4/10 to 9 1/8 secs.

1916

Position against training time trials

▼ James E. SULLIVAN (USA, secretary of AAU and USOC) ***How to become an athlete***

work. Personally I have never been in favor of what are known as time trials for athletes. An athlete usually gets all the time trials that are necessary in competition. Such trials only tend to make the athlete nervous and unstrung, and on the day of his race he is liable to go to the mark in a weakened condition.

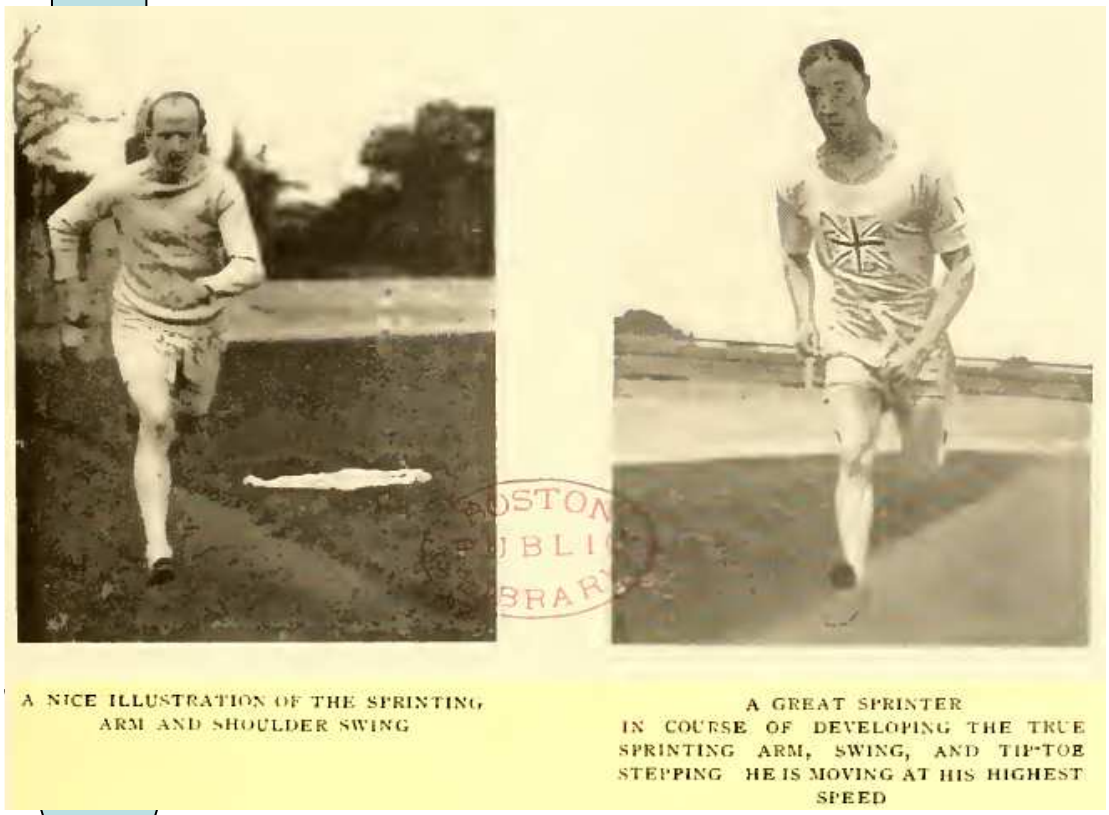
1910's

FIRST TECHNICAL STUDIES

1913

« The technique of sprinting is a study in itself »

► Sam MUSSABINI (GBR) ***Complete athletic trainer***

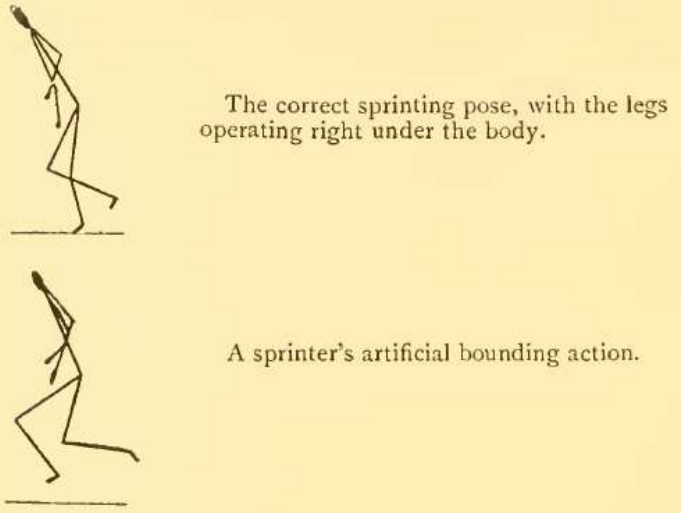


A NICE ILLUSTRATION OF THE SPRINTING ARM AND SHOULDER SWING

A GREAT SPRINTER IN COURSE OF DEVELOPING THE TRUE SPRINTING ARM, SWING, AND TIP-TOE STEPPING HE IS MOVING AT HIS HIGHEST SPEED

The sprinting style (front view).

The sprinting style (side view).



The correct sprinting pose, with the legs operating right under the body.

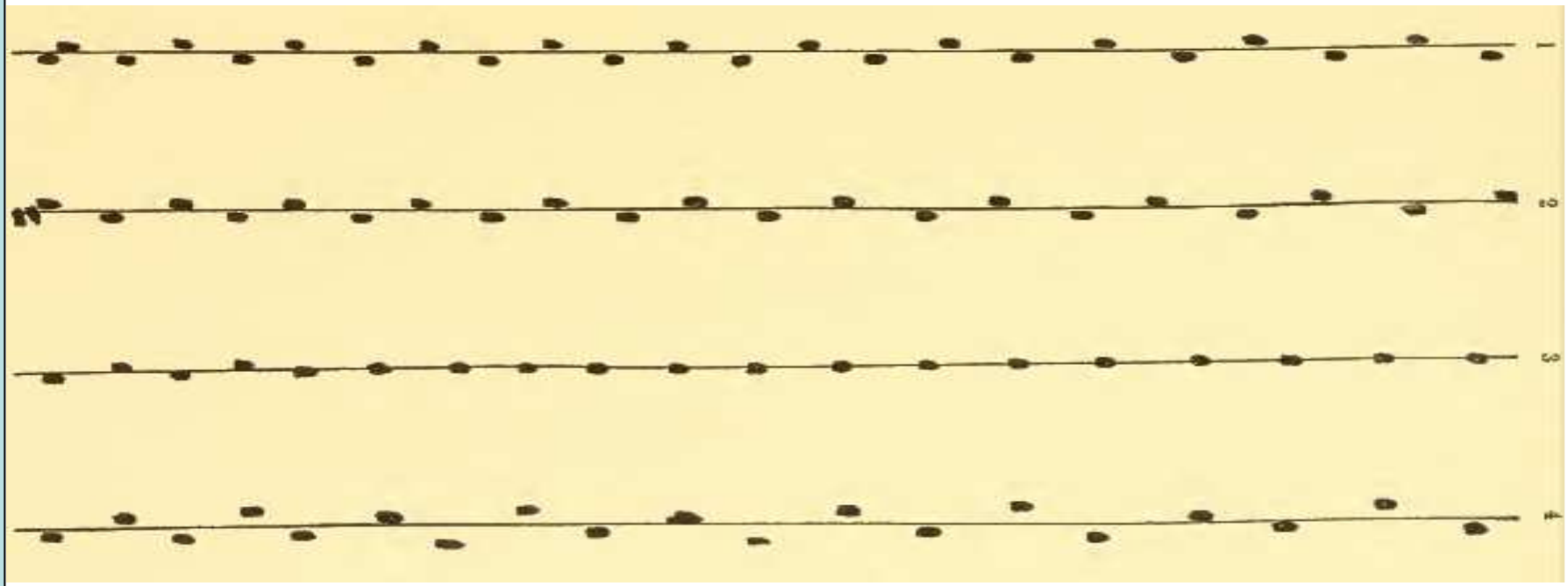
A sprinter's artificial bounding action.

FIRST TECHNICAL STUDIES

1913

Stride measuring and tracing

► **Sam MUSSABINI (GBR)** ***Complete athletic trainer***



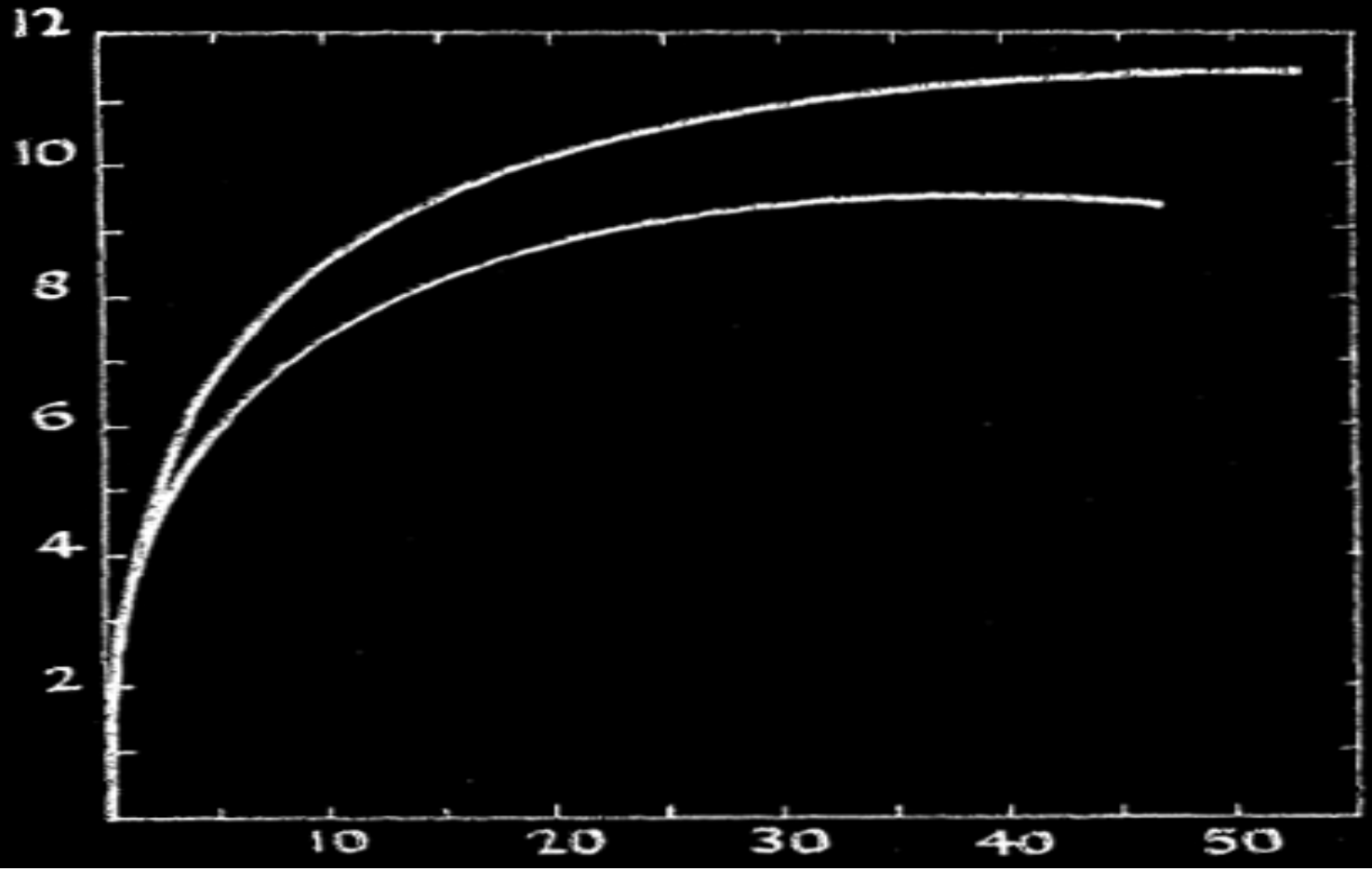
1. Good level running from the modern 'crouch' start, giving an idea of how the strides lengthen out.
2. From the old-fashioned upright start.
3. How the rolling-hipped or bow-legged type of runner soon settles down to run in a dead straight line.
4. An example of bad, slovenly running, the footmarks are irregular and the strides uneven.

« Not 1 sprinter in a 1000 can run 100y through at the increasing rate of speed which he should and is generally rated to do. He will almost certainly fade away to some extent in the last 10 or 12y »

1920's

FIRST TOP SPEED CURVES

- Top speed measured : 10.48m/s
- Scientific studies with World class athletes



FIRST TOP SPEED CURVES

1920 **Charley PADDOCK (USA, 100m Olympic Champion 1920)**

▼ RIPLEY, America's Olympians, The Milwaukee Journal, 19 Jul

Paddock is better at 100 meters than he is at 100 yards. His true distances are from 100 yards to 150 yards. He does not reach top speed for about 60 yards. His slowness in gathering speed counts more at 100 yards than it does at 100 meters, where he has an extra 9.3 yards to pick up. From 100 meters to 200 meters Paddock should knock all records galley west.

"Dean and I worked for weeks in lengthening my stride. Each afternoon we would go out on the track which had been carefully brushed so that each spike print would show. I would run down the first lane for fifty yards, using my natural form without trying to lengthen my regular stride. My spike prints would then be marked and I would move over to the second lane. This time I would forget about speed, and try to make each stride out-distance the ones I had taken in the first lane. These marks were also measured. In the third lane, I would attempt to combine speed and form with length of stride. Of course this was not possible to accomplish in a single day. As the weeks passed I found that I had lengthened my stride by a full six inches on every step so that I was running several yards faster than I had ever done."

FIRST TOP SPEED CURVES

▼ Charley PADDOCK (USA, 100m OG 1920),
***Training schedule for sprinting,* in The Fastest Human (1932)**

WEEK 1

Mon-Fri	Jog 1 mile (spikes)
Sat-Sun	Rest

WEEK 2

Mon	1 mile jog, 220y strides, 440y jog
Tue	1 mile jog
Wed	1 mile jog, 220y strides, 440y jog
Thu	1 mile jog
Fri	1 mile jog, 220y strides, 440y jog
Sat-Sun	Rest

WEEK 3

Mon	880y jog, starts, 440y jog
Tue	880y jog, starts, 440y jog
Wed	880y jog, starts, 300y at 75%, 440y jog
Thu	880y jog, starts, 440y jog
Fri	880y jog, starts, 440y jog
Sat-Sun	Rest

WEEK 4 & 5

Mon	Rest
Tue	440y jog, 6 starts, 3x75y, 440y jog
Wed	440y jog, 3x220y at 50%, 440y jog
Thu	1 mile jog (interval)
Fri	Rest
Sat	WU, 3 starts, 150y, rest 20', 220y
Sun	Rest

WEEK 6

Mon	440y jog, 6 starts, 1x300y at 50%, 440y jog
Tue	WU, 6 starts, 75y & 120y at 100%, 440y jog
Wed	WU, 6x50y, Rest 10', 1x250y at 100%, 440y jog
Thu	Rest
Fri	Rest
Sat	Competition 100y & 220y
Sun	Rest

FIRST TOP SPEED CURVES

1923

Measurement of speed during a 100m race

► **E. SCHILF & W. SAUER (GER)** ***Über der Geschwindigkeit von 100m,*** **Berlin, Pflügers Archive 200.**

Tabelle I.

				liefen W. B. in	liefen F. M. in
Die	ersten	2,5	m	0,6 Sek.	0,8 Sek.
,,	,,	5	,,	**1,2** ,,	**1,7** ,,
,,	,,	10	,,	2,0 ,,	2,4 ,,
,,	zweiten	10	,,	1,2 ,,	1,0 ,,
,,	dritten	10	,,	1,4 ,,	1,3 ,,
,,	vierten	10	,,	1,5 ,,	1,3 ,,
,,	fünften	10	,,	1,7 ,,	1,4 ,,
,,	sechsten	10	,,	1,4 ,,	1,3 ,,
,,	siebenten	10	,,	1,8 ,,	1,3 ,,
,,	achten	10	,,	1,7 ,,	1,3 ,,
,,	neunten	10	,,	1,2 ,,	1,4 ,,
,,	zehnten	10	,,	1,6 ,,	1,4 ,,
die 100 m liefen sie in				15,5 Sek.	14,1 Sek.

Tabelle II.

				liefen W. B.	liefen F. M.
In	der	ersten	Sek.	4,5 m	3,0 m
,,	,,	zweiten	,,	5,5 ,,	5,0 ,,
,,	,,	dritten	,,	8,0 ,,	8,0 ,,
,,	,,	vierten	,,	8,0 ,,	8,5 ,,
,,	,,	fünften	,,	7,0 ,,	8,5 ,,
,,	,,	sechsten	,,	6,5 ,,	7,0 ,,
,,	,,	siebenten	,,	6,0 ,,	7,5 ,,
,,	,,	achten	,,	6,5 ,,	7,5 ,,
,,	,,	neunten	,,	8,0 ,,	8,0 ,,
,,	,,	zehnten	,,	6,5 ,,	8,0 ,,
,,	,,	elften	,,	6,5 ,,	8,0 ,,
,,	,,	zwölften	,,	7,0 ,,	8,0 ,,
,,	,,	dreizehnt.	,,	6,0 ,,	6,5 ,,
,,	,,	vierzehnt.	,,	7,0 ,,	6,5 ,,
,,	,,	fünfzehnt.	,,	7,0 ,,	—

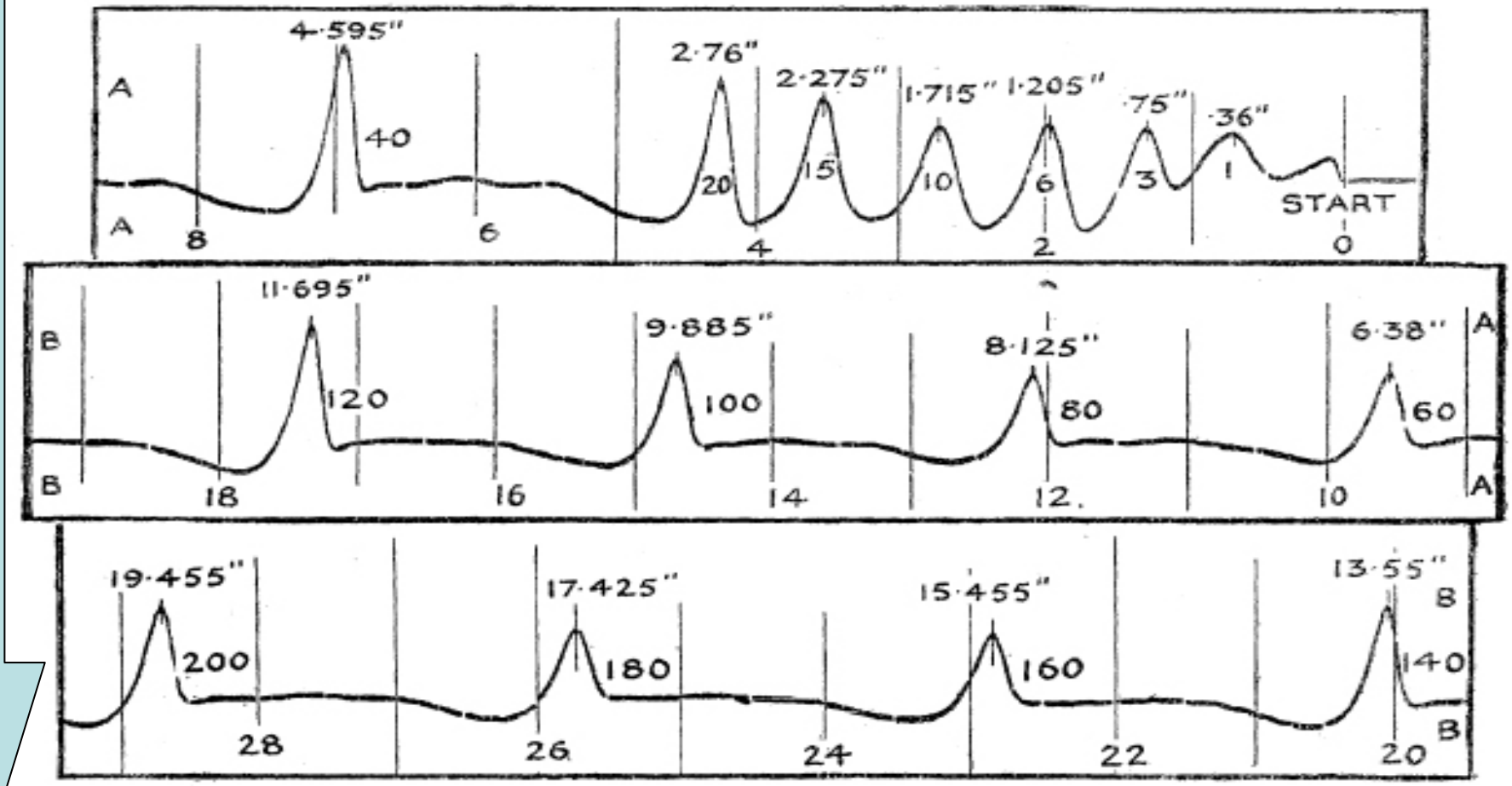
- **It takes 1 sec until a runner reaches his top speed, after about 5 m**
- **The speed curve progresses until fatigue sets in at about 30-40m**
- **An increase of terminal speed can't be determined in a 100m runner**

FIRST TOP SPEED CURVES

1927

Electric timing of a runner over a series of distances along a 200y race

► K. FURUSAWA, A. HILL & J. PARKINSON, *The Dynamics of sprint running*, Proc. R. Soc London B 1927



- **Participation of a World-class sprinter to a scientific study**
- **Henry RUSSELL (USA, 4x100m Olympic Champion in 1928) reached a top speed of 10.48 m/s between 60 & 80y**

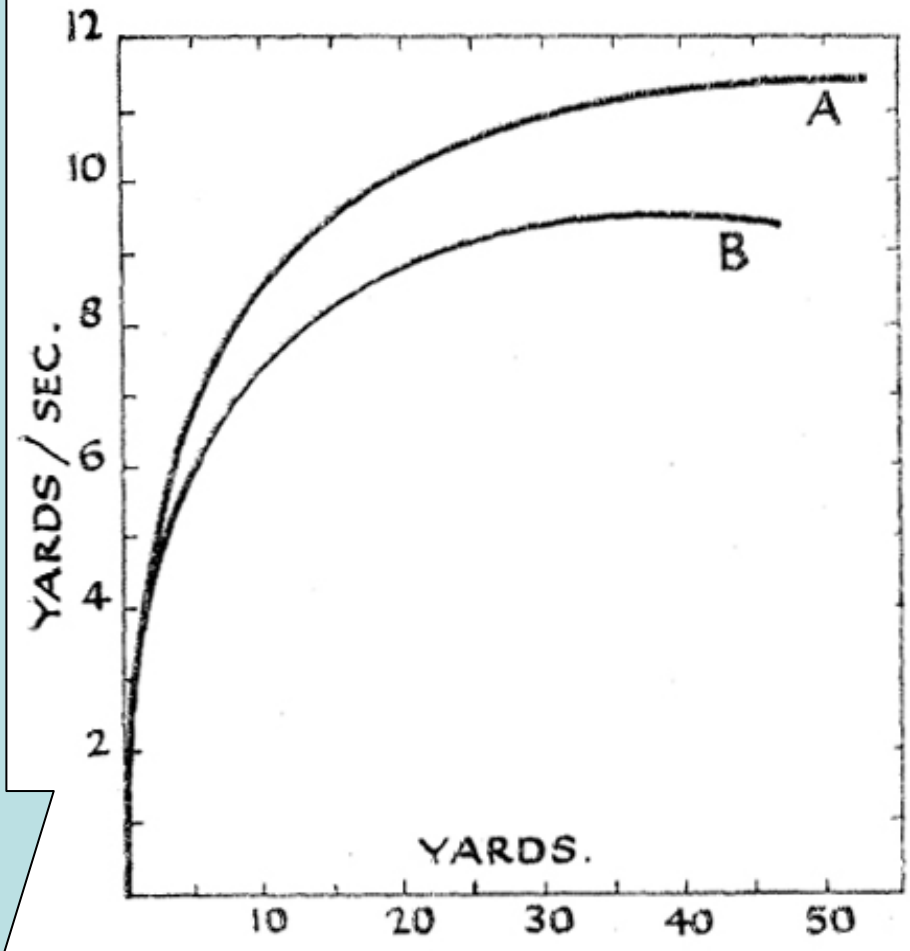
1920's

FIRST TOP SPEED CURVES

1929

Electric timing of a runner over a series of distances along a 200y race

► C. H. Best & R. C. PARTRIDGE, Observations on Olympic Athletes, Proc. R. Soc. LondonB 1929 105



Change of speed with distance.

A.—Percy Williams. B.—Myrtle Cook.

- **Participation of 1928 Olympic Champions Percy WILLIAMS (100m) and Myrtle COOK (4x100)**
- **Speed changes recorded every 5 yards.**

WILLIAMS 10.44 m/s

COOK 8.69 m/s

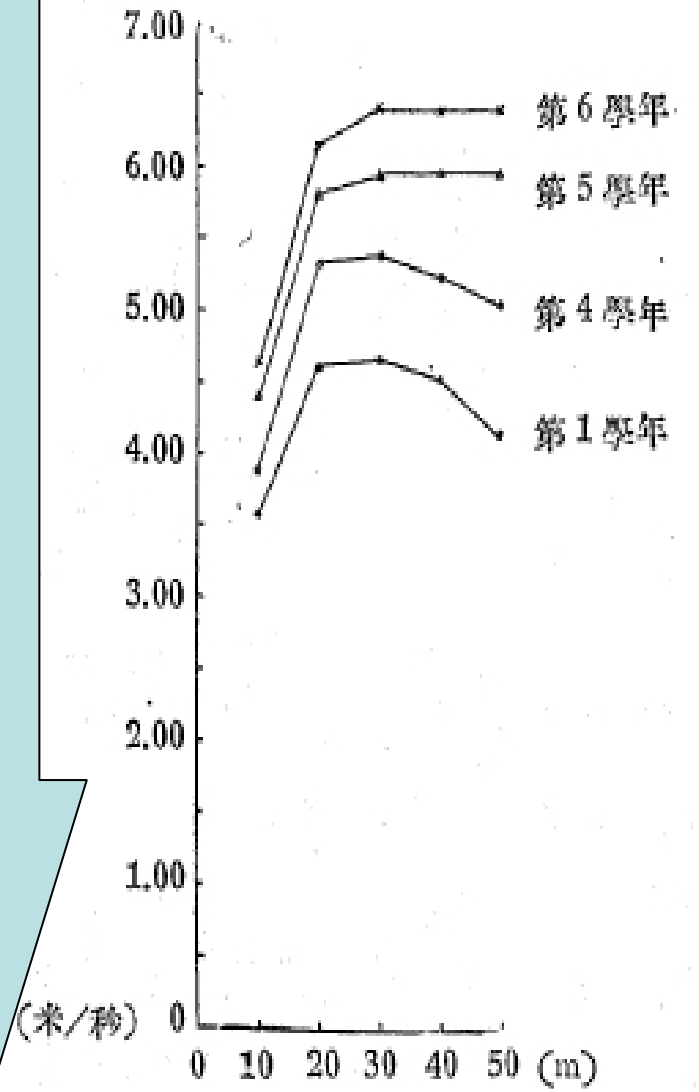
1930's

FIRST STATISTICAL EXPERIENCES ON TOP SPEED

1933

Comparison of speed curves for different level of sprint performers

► **WADA Masatsugu (JPN), *About the speed of the primary school while running*, Vol 11 n10.**



第 5 表　50 m 疾走時間の撒布

學年	人員	7.01–8.00 Sec.	8.01–9.00 Sec.	9.01–10.00 Sec.	10.01–11.00 Sec.	11.01–12.00 Sec.	12.01–13.00 Sec.	13.01–14.00 Sec.	14.01–15.00 Sec.
1	50				8	29	9	2	2
2	50			6	26	13	5		
3	60		1	21	28	10			
4	50		2	19	21	6	2		
5	48	4	19	21	3	1			
6	36	9	19	7	1				
合計	294	13	41	74	87	59	16	2	2

- **Higher level performers reach their top speed later and can hold it for a prolonged time.**

1930's

FIRST STATISTICAL EXPERIENCES ON TOP SPEED

1936

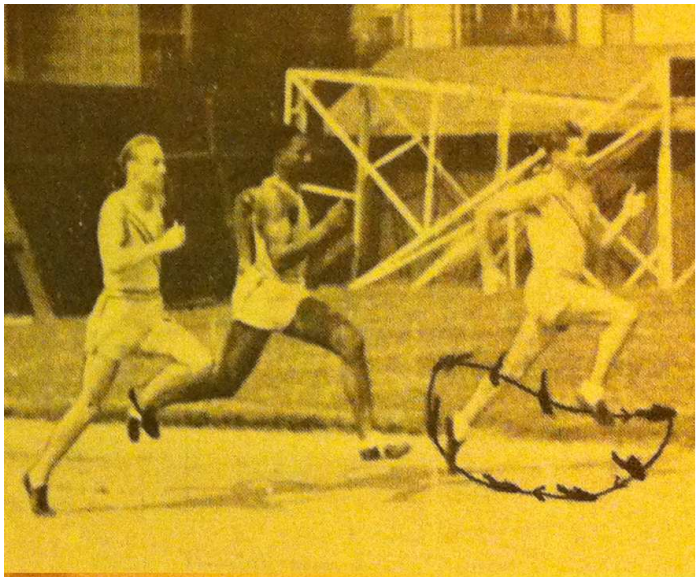
►Schedule by Dean CROMWELL (USA, Frank WYKOFF)

Mon	**Jogging and a few wind sprints**
Tue	**6 - 10 starts, 1 - 3 x 220y**
Wed	**Starts, 30 - 50y sprints, wind sprints or 300y**
Thu	**short sprints up to 50y**
Fri	**Rest**
Sat	**Competition**
Sun	**Competition or rest**

1937

►Schedule by Charles HOYT (USA, Eddie TOLAN)

Mon	**Starts, fast 75y, 125y with fast finish**
Tue	**Starts, 2x75y fast**
Wed	**4 - 6 starts, 1x150y at 80%**
Thu	**Few starts, fast 50y & 75y, 125y at 75% with fast finish**
Fri	**Rest**
Sat	**Competition**
Sun	**Competition or rest**



Notice the perfect drive, knee action and right arm action of Metcalfe. Note the position of Wykoff's left ankle and the position it has taken from the preceding picture. He has perfect form and is getting beautiful knee action and follow through from the left leg. Parsons' form is also good. The circular motion of the foot in a stride is shown by plotting in the feet in this picture.

1930's

FIRST STATISTICAL EXPERIENCES ON TOP SPEED

1936

- ***Minimum training distance for starts: 50y (always run 20y more in freewheeling)***
- ***Maximum training distance: 300y (time trial 29.5)***

When Charley Riley, his Junior High coach at Cleveland, said, "Put your feet on the track as if you were touching a hot stove," that didn't mean to Jesse that the track was his enemy. It meant that it was an object to be treated with great tenderness. He learned to caress the track with the lightest tread I have ever seen. His beautiful timing, his smoothness of every movement while running gave the impression that he was making all the correct movements of sprinting, but that instead of him moving forward some unseen hand was pulling the track under his feet. His form from the start to the finish has never been equaled. . . . How many times the question was asked, "How fast could he run if he really tried?"

► ***Larry Snyder "The Training of Jesse Owens"***

FIRST ATTEMPT TO RUN OVER SPEED

1947

Workouts including short sprints from flying start

► **R. LYULKO (URS), *The short distance races* (1949)**

План тренировки Е. Сеченовой на период с 7 по 13 июля

Специальность — бег на 100 и 200 *м*.

7 июля. Днем. 1. Разминка, в которую входили: а) бег 600—800 *м* очень легко; б) гимнастика 10—15 мин. (общеразвивающие упражнения); в) бег с ускорением 2 × 60—80 *м*.; г) упражнения бегуна (семенящий бег и бег с высоким подъемом бедра и т. д.). 2. Старт 5—6 раз. 3. Бег 100 *м* — 12,5 сек.

8 июля. Днем. Тренировка в эстафетном беге 4 × 100 *м*.

9 июля. Вечером. 1. Разминка. 2. Старт 5—6 раз. 3. Бег 2 × 50 *м*. 4. Техника финиширования с хода 3 раза с 30 *м*. 5. Бег 2 × 150 *м* с хода.

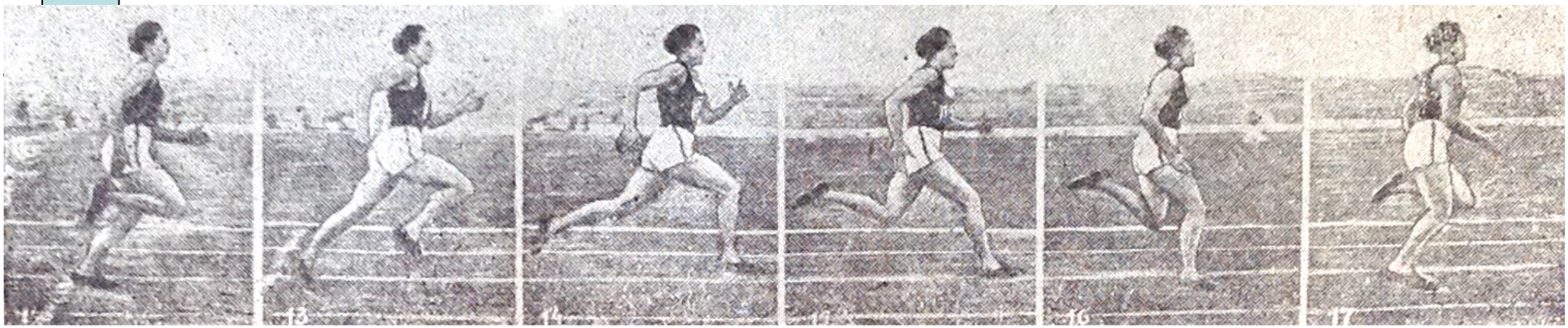
10 июля. Вечером. 1. Разминка. 2. Старт 4—5 раз на повороте. 3. Бег 2 × 100 *м* на повороте легко.

11 июля. Днем. Легкая беговая разминка в течение 15—20 минут.

12 июля. Отдых.

13 июля. Соревнование.

▲ ***July 1947 training plan for Yevgeniya SECHENOVA (URS 100m National Record 1946 11.9)***



1940's

FIRST ATTEMPT TO RUN OVER SPEED

1949

► **Nikolay OZOLIN (URS)** ***Training of athletes***

Towing using a moto **3x50m flying start tow (r5'), 2x50m normal (r6') = 0.3 improvement**

► **Nikolay PONOMARYEV (URS, 10.7) & coach Anatoly FRUKTOV**

Slope track (4-5°) training plan

Efficiency :

	30m	60m	*30-60m*
Day 1	4.5	7.8	*3.3*
Day 31	4.0	7.3	*3.3 !*

Music (drumbeats) during workouts

Example of Russian folk dancers reaching higher levels of speed of movements: ***« This can be explained by the fact that the dancer is not aware of the rhythm he has set for himself, but submits to the rhythm of the beat to which he conforms. »***

Tag	Inhalt der Trainingsarbeit		Laufstrecke	Zeit in Sek. auf horiz. Bahn
1.	Übliche Auflockerung	Zulage	30 m, 60 m	4,5 7,8
2.–4.	Übliche Auflockerung	Maximal schneller Lauf aus dem Gehen (Anlauf 20 m)	3×30 m	
5.–6.		*Erholungspause*		
7.–10.	Übliche Auflockerung	Maximal schneller Lauf aus dem Gehen (Anlauf 20 m)	4×30 m	
11.–12.		*Erholungspause*		
13.–16.	Übliche Auflockerung	Maximal schneller Lauf aus dem Gehen (Anlauf 20 m)	4×30 m	
17.–18.		*Erholungspause*		
19.–22.	Übliche Auflockerung	Maximal schneller Lauf aus dem Gehen (Anlauf 20 m)	5×30 m	
23.–24.		*Erholungspause*		
25.–28.	Übliche Auflockerung	Maximal schneller Lauf aus dem Gehen (Anlauf 20 m)	5×30 m	
29.–30.		*Erholungspause*		
31.	Übliche Auflockerung	Zulage	30 m, 60 m	4,0 7,3

FIRST SYSTEMATIC SPEED CURVE RECORDINGS

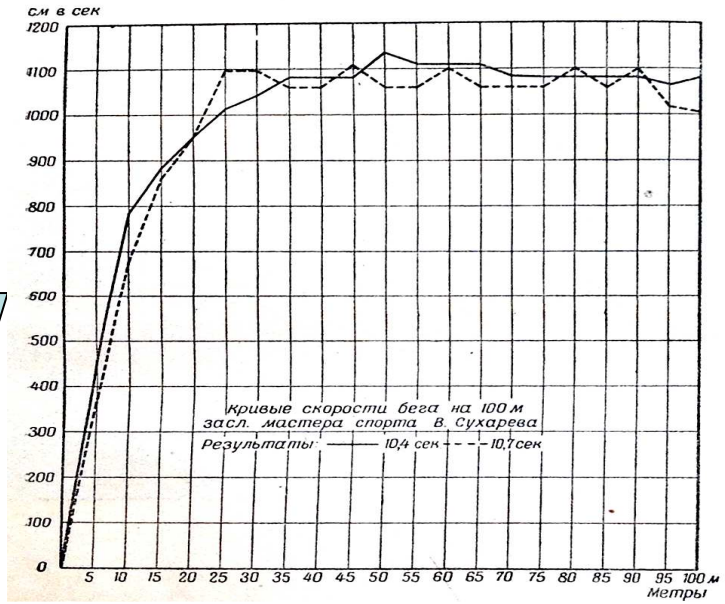
1952

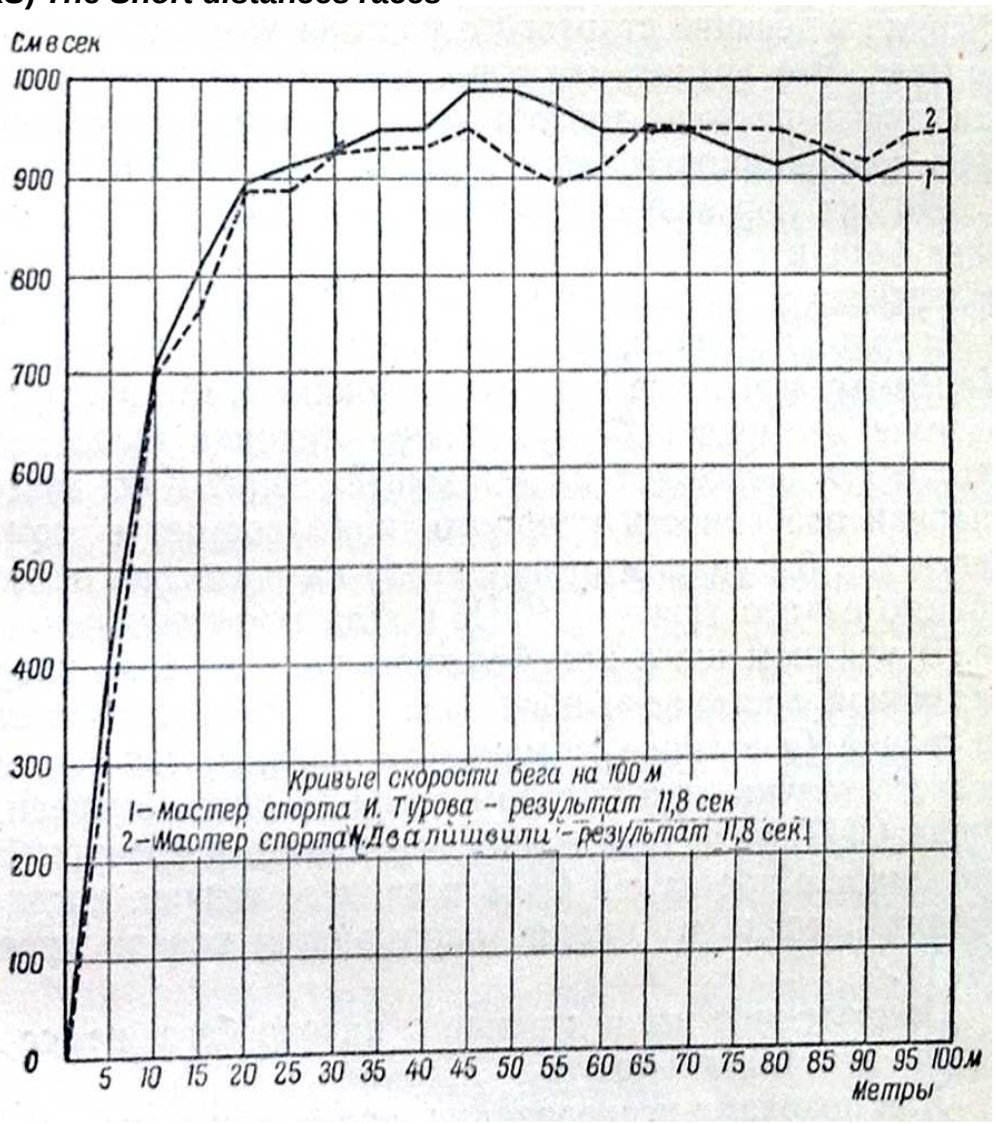
100m speed-curves from intermediate times recorded every 5m from special films

► A. STUKALOV, cited by L. CHOMENKOV (URS) ***The Short distances races***

« Sprinters reach their top speed too late, the length of the 1st phase should be reduced to 18-20m »

	100m	Top Speed	Location
TUROVA	11.8	9.9m/s	50m
KALASHINOVA	11.9	9.7m/s	60m
SUKHARYEV	10.4	11.3m/s	50m
SANADZE	10.8	11.0m/s	55m

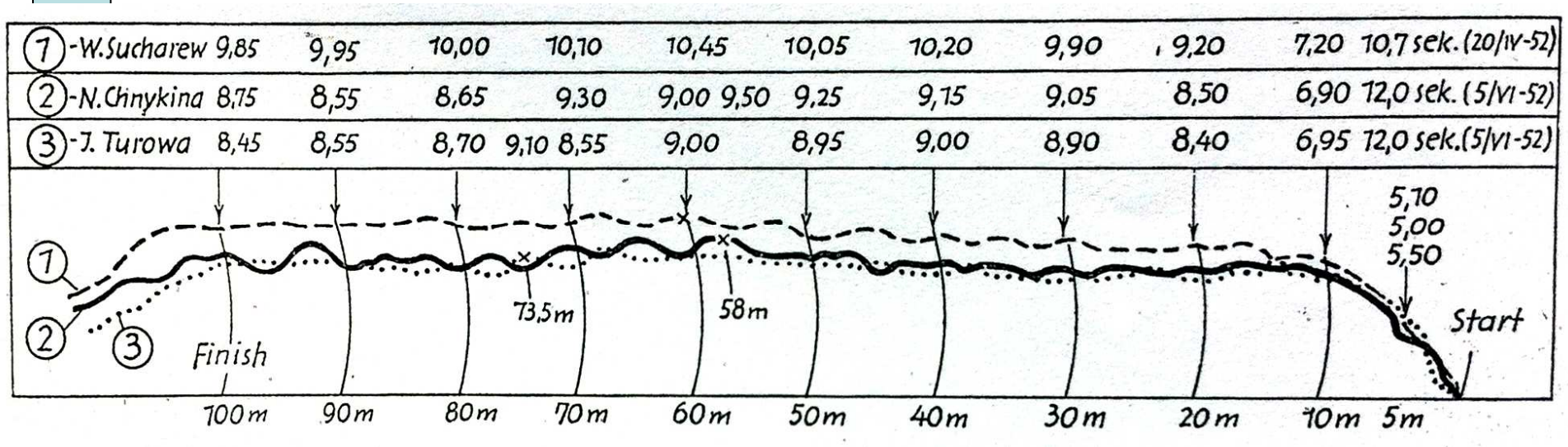


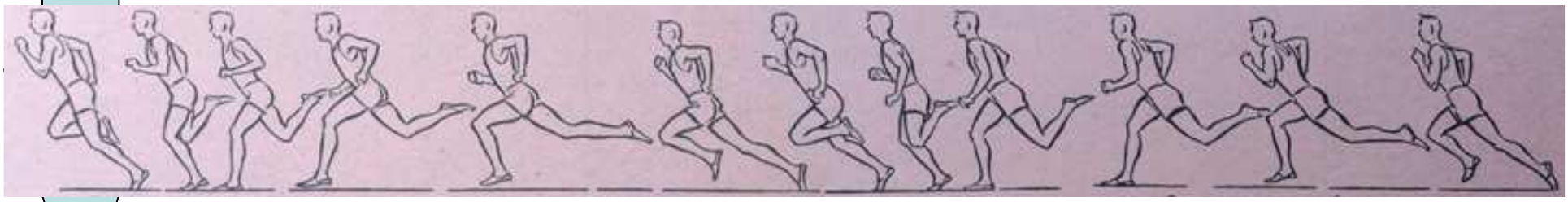


FIRST SYSTEMATIC SPEED CURVE RECORDINGS

1953 **100m speed-curves from Spidogramme**

► **W. ABALAKOV, cited by N. OZOLIN (URS)** ***Eine Methode zur objektiven Messung, TuPdK 1953/5-6***





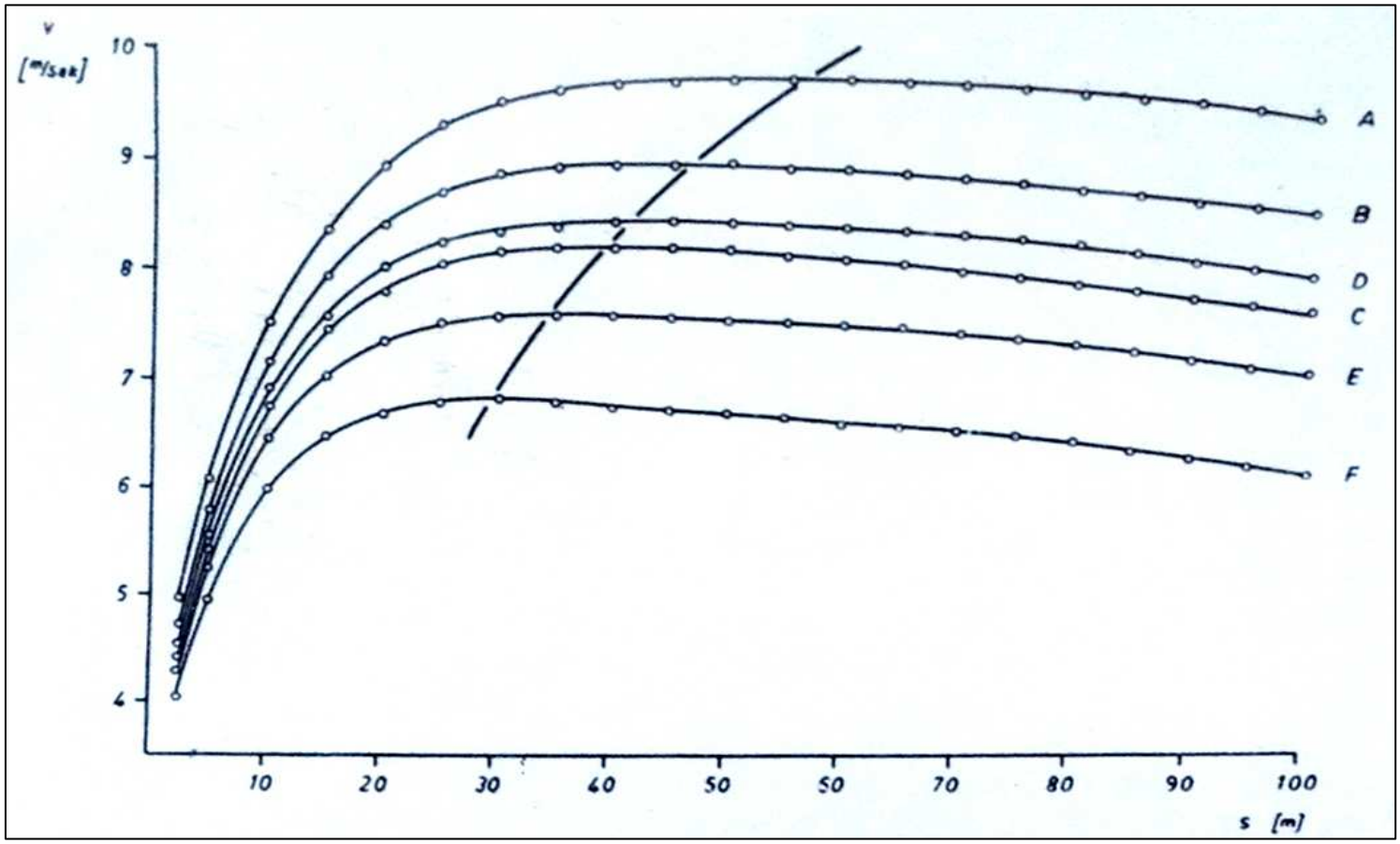
▲ ***Vladimir SUKHARYEV (URS, 100m EuroR 10.3 in 1951)***

FIRST TRAINING PLANS DERIVED FROM SPEED CURVES

1961

100m speed-curves and their applications to training

► **Heinrich GUNDLACH (GDR)** ***Untersuchungen über den Zusammenhang zwischen Schrittgestaltung*** **(Diss.)**



FIRST TRAINING PLANS DERIVED FROM SPEED CURVES

1968

100m speed-curves and their applications to training

► **Heinrich GUNDLACH (GDR)** ***Application of high-speed intensity in sprinting*** **TuPdL 6**

Vergleich der 30-m-Laufzeiten (s) im Wettkampf und Training

	Bestl. 1966	30 - 60 m im Wettkampf	flieg. 30 m im Training	Differenz
Erbstößer	10,4	2,84	2,98	+ 0,14
Lewandowski	10,2	2,84	3,06	+ 0,22
Berger	10,4	2,85	3,07	+ 0,22
Franken	10,5	2,95	3,17	+ 0,22
Domscheid	10,3	2,89	3,12	+ 0,23
Eggers	10,2	2,83	3,10	+ 0,27
Mittelwert		2,87	3,09	+ 0,22

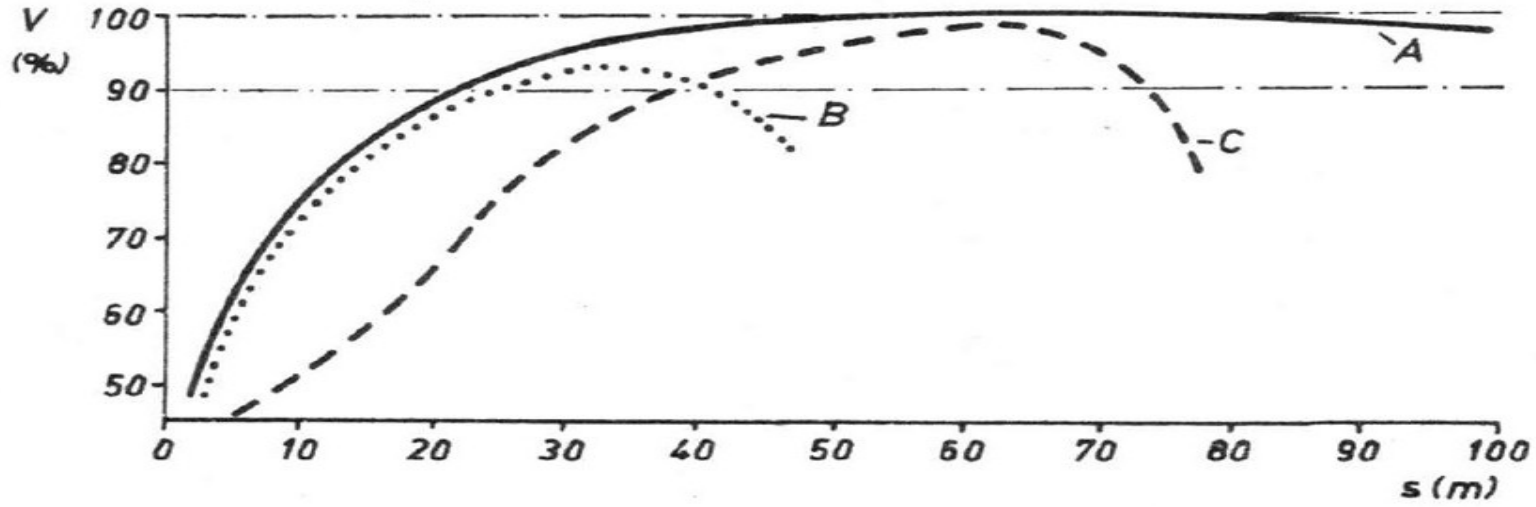


Abb. 1: Schema des Geschwindigkeitsverlaufes beim 100-m-Wettkampf (A), beim Beschleunigungslauf über 30 m aus dem Tiefstart (B) und beim Schnelligkeitslauf über 30 m mit fliegendem Start (C)