

# The evolution of workplace fatigue research

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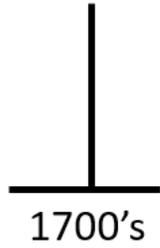
Board of Scientific Counselors Meeting

May 19, 2021

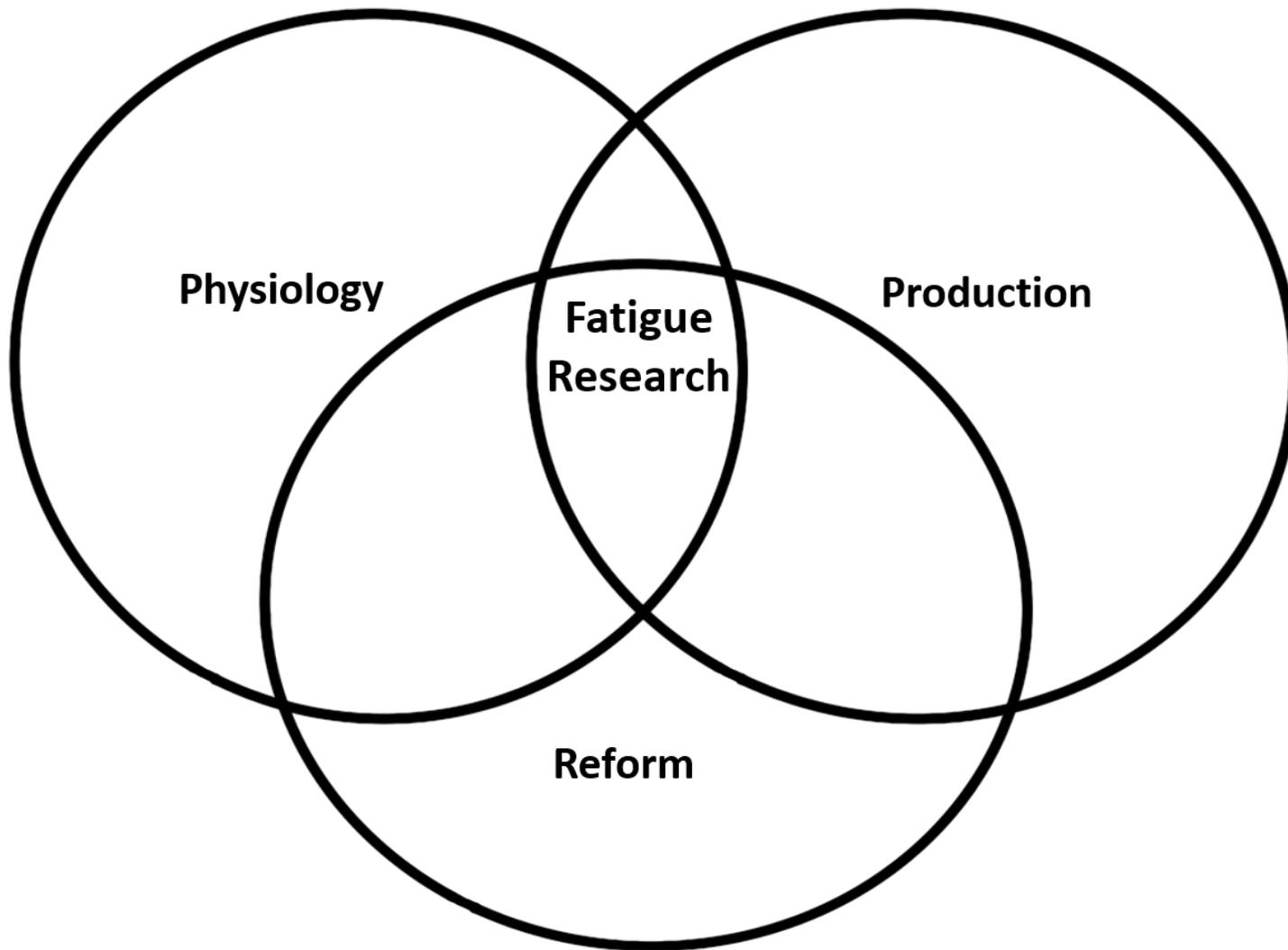
- While there is no standard definition, fatigue is commonly thought of as “exhaustion of the body’s capabilities for effort and exertion.” (Blayney 2017)
- Characteristic of human activity and work.
- Fatigue has a major impact on workers, families, enterprises and the economy.
- This presentation provides a brief overview of the foundations and directions for the study of fatigue.

# History of Fatigue Research

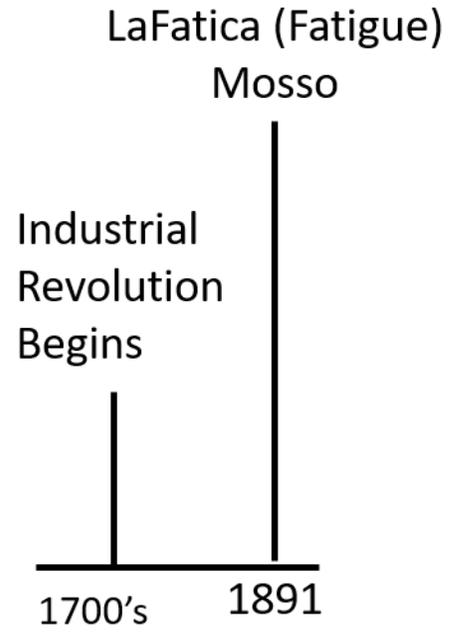
Industrial  
Revolution  
Begins



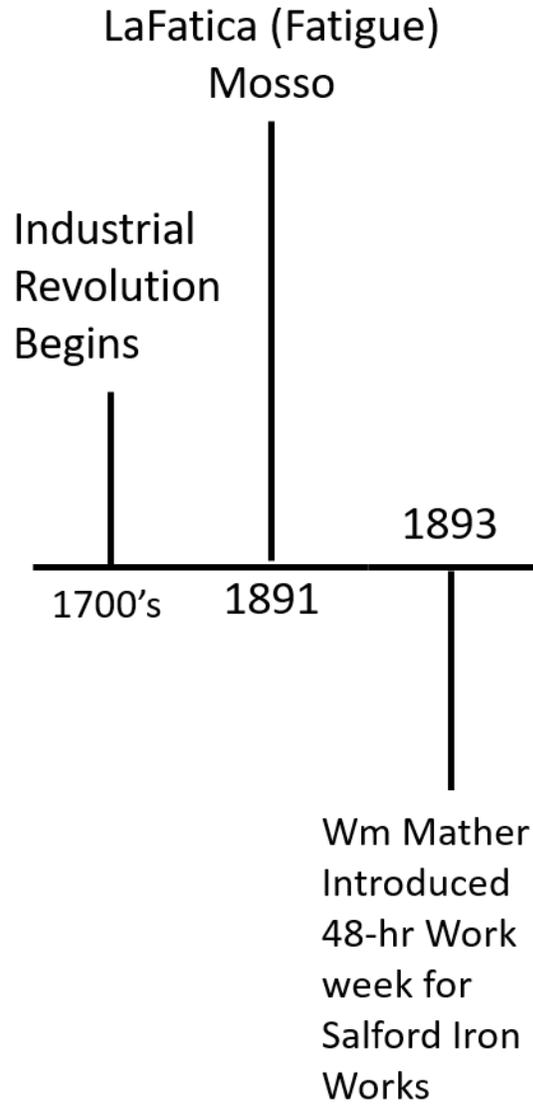
- To put this in perspective, some estimates report that the average worker during the Industrial Revolution worked approximately 3,500 hrs/yr (compared to current estimates of 1,800 hrs/yr annually for US workers {data from OECD}).



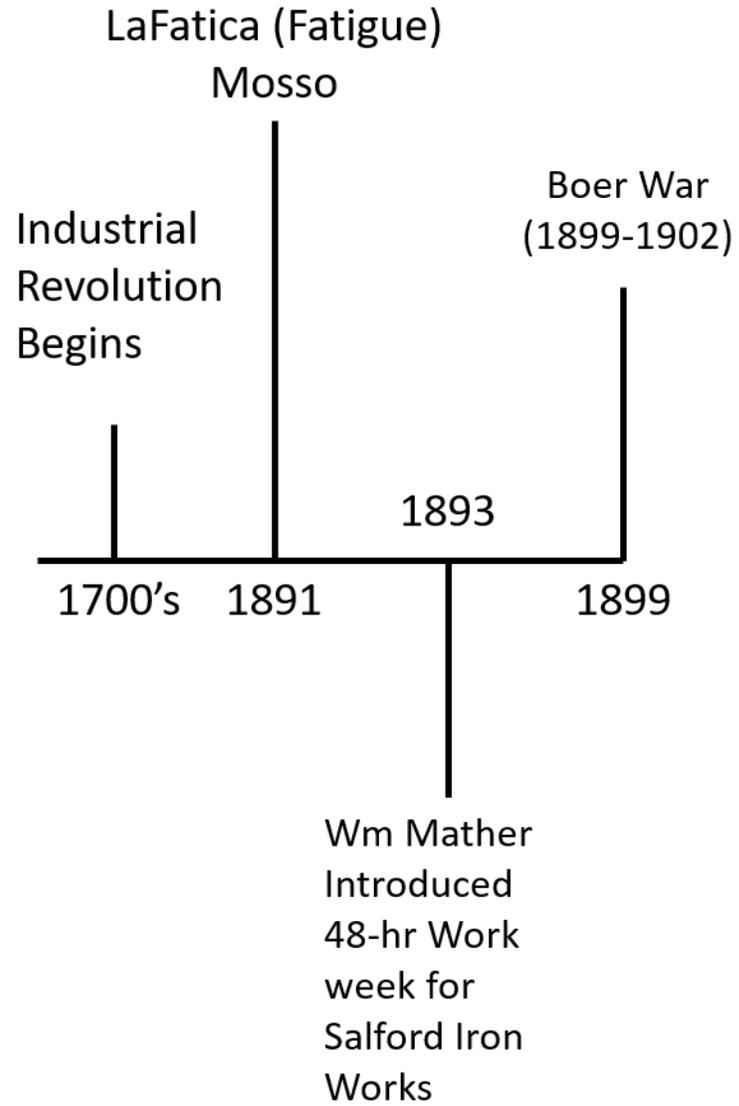
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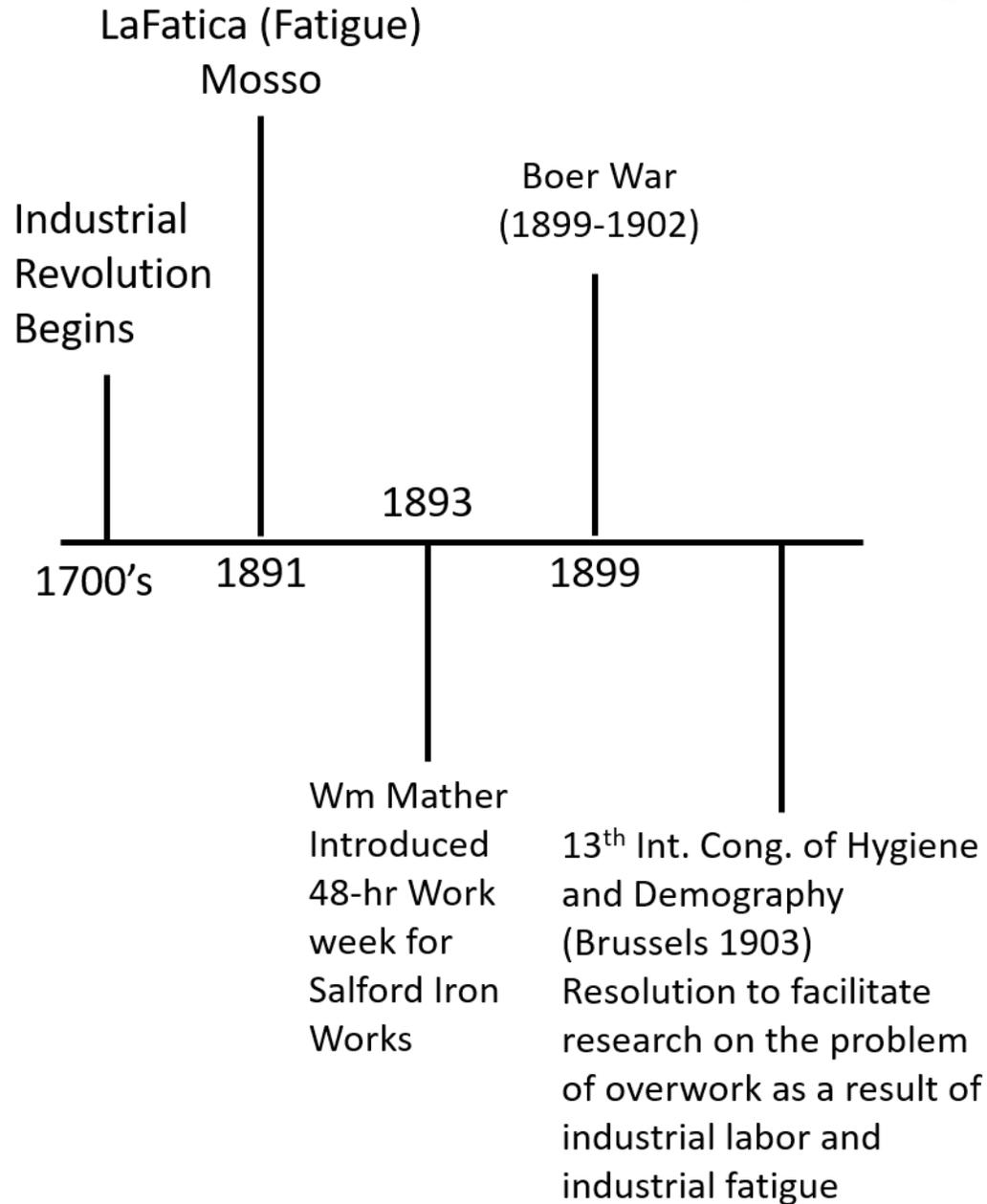
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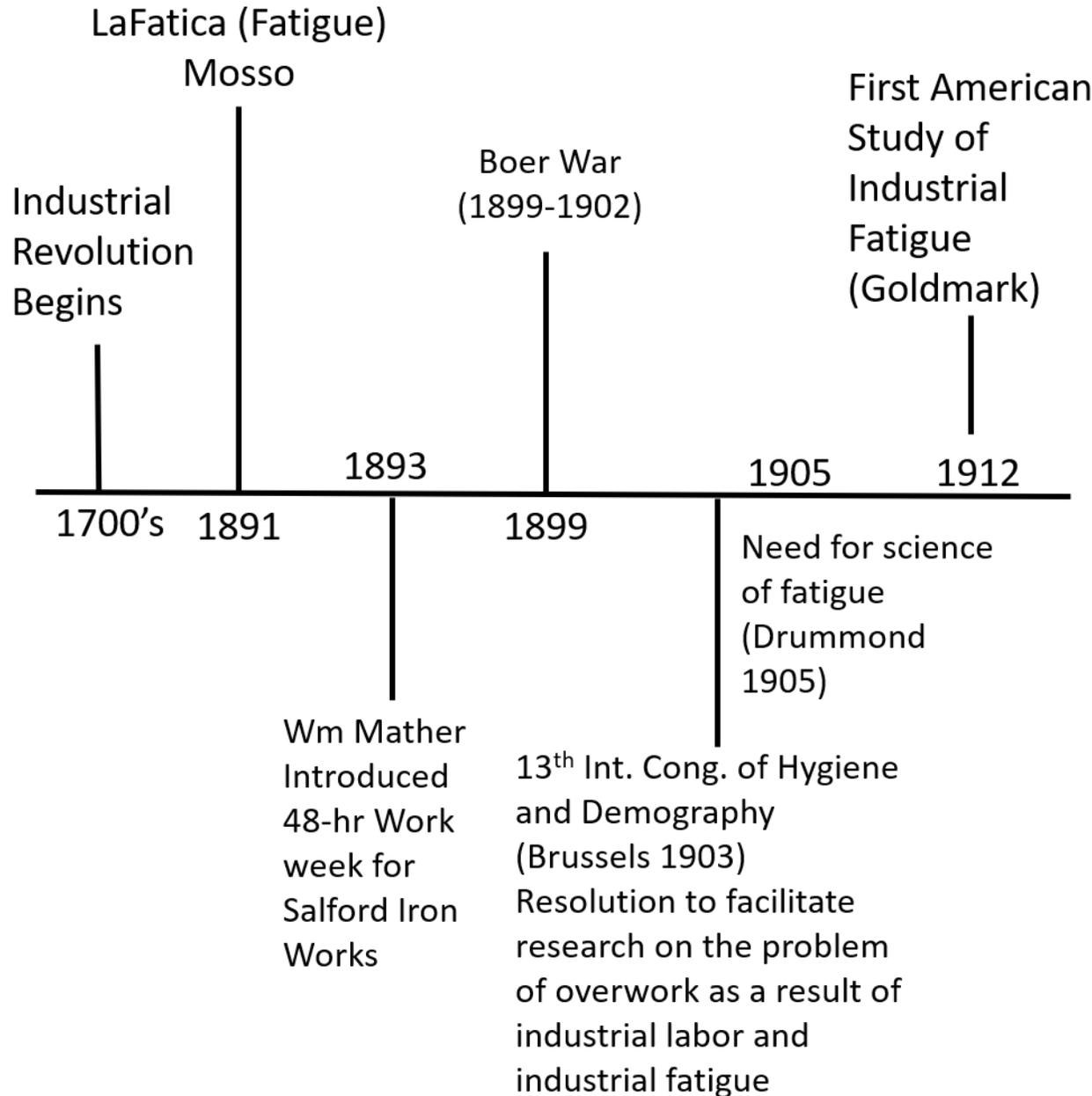
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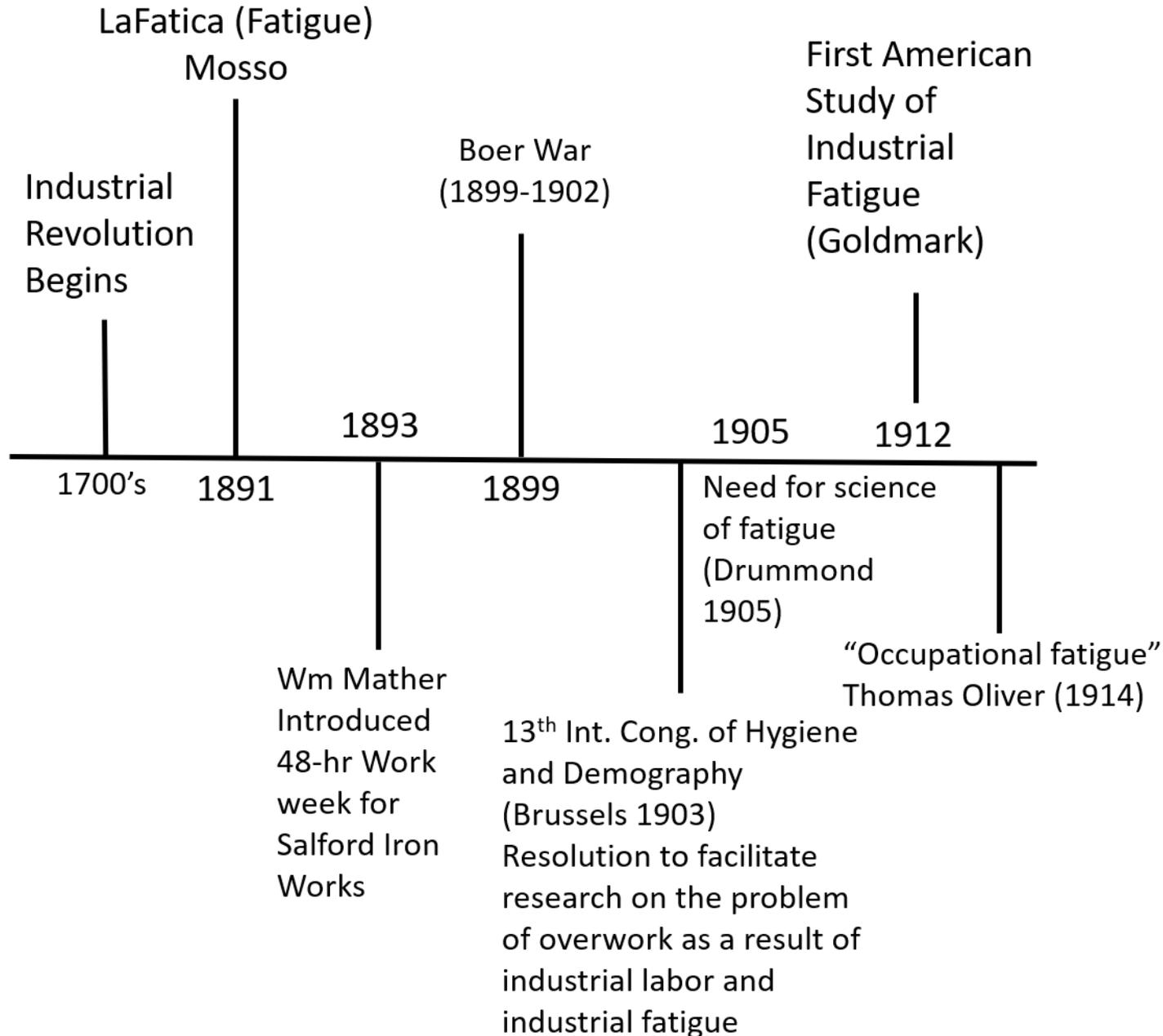
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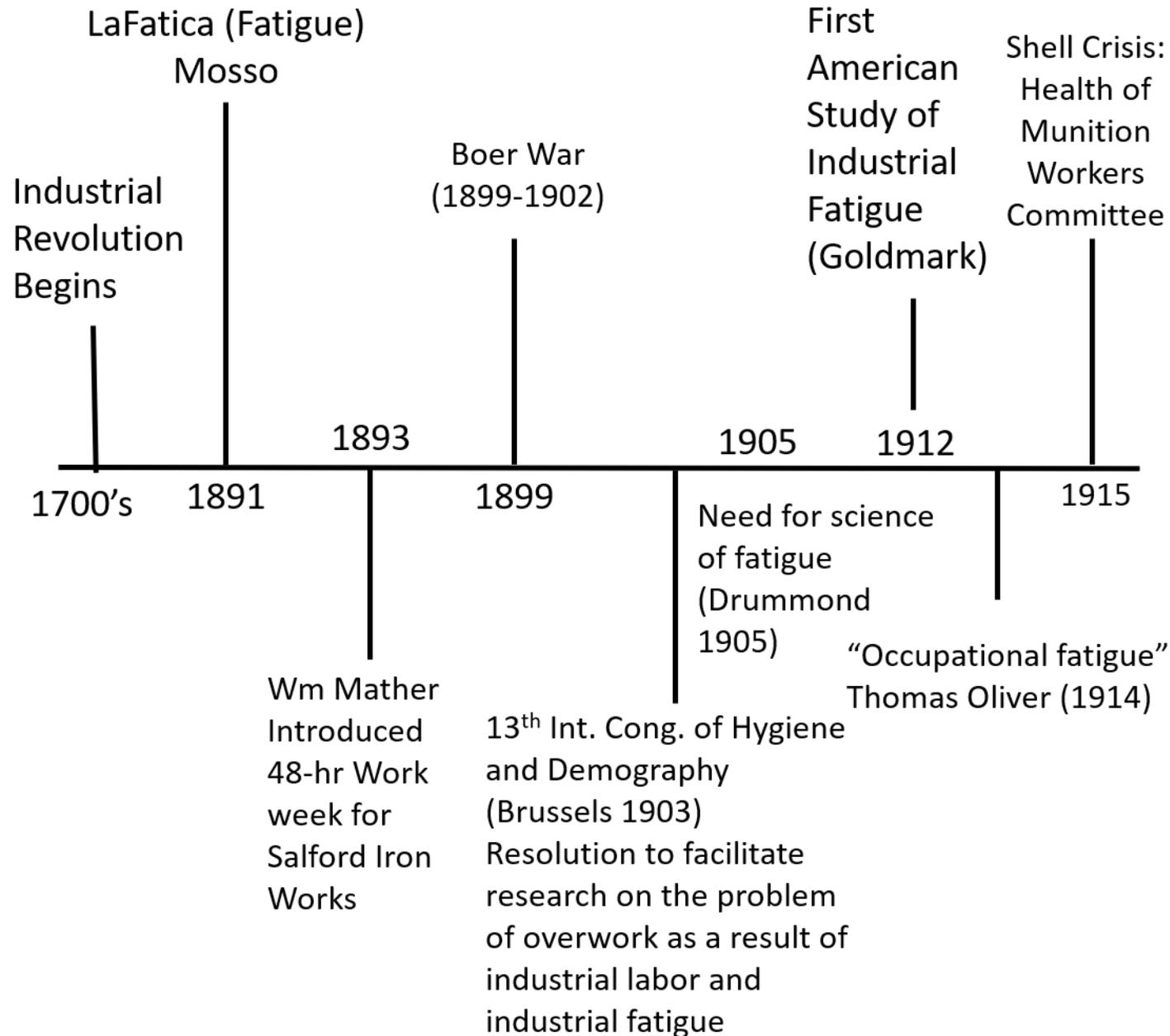


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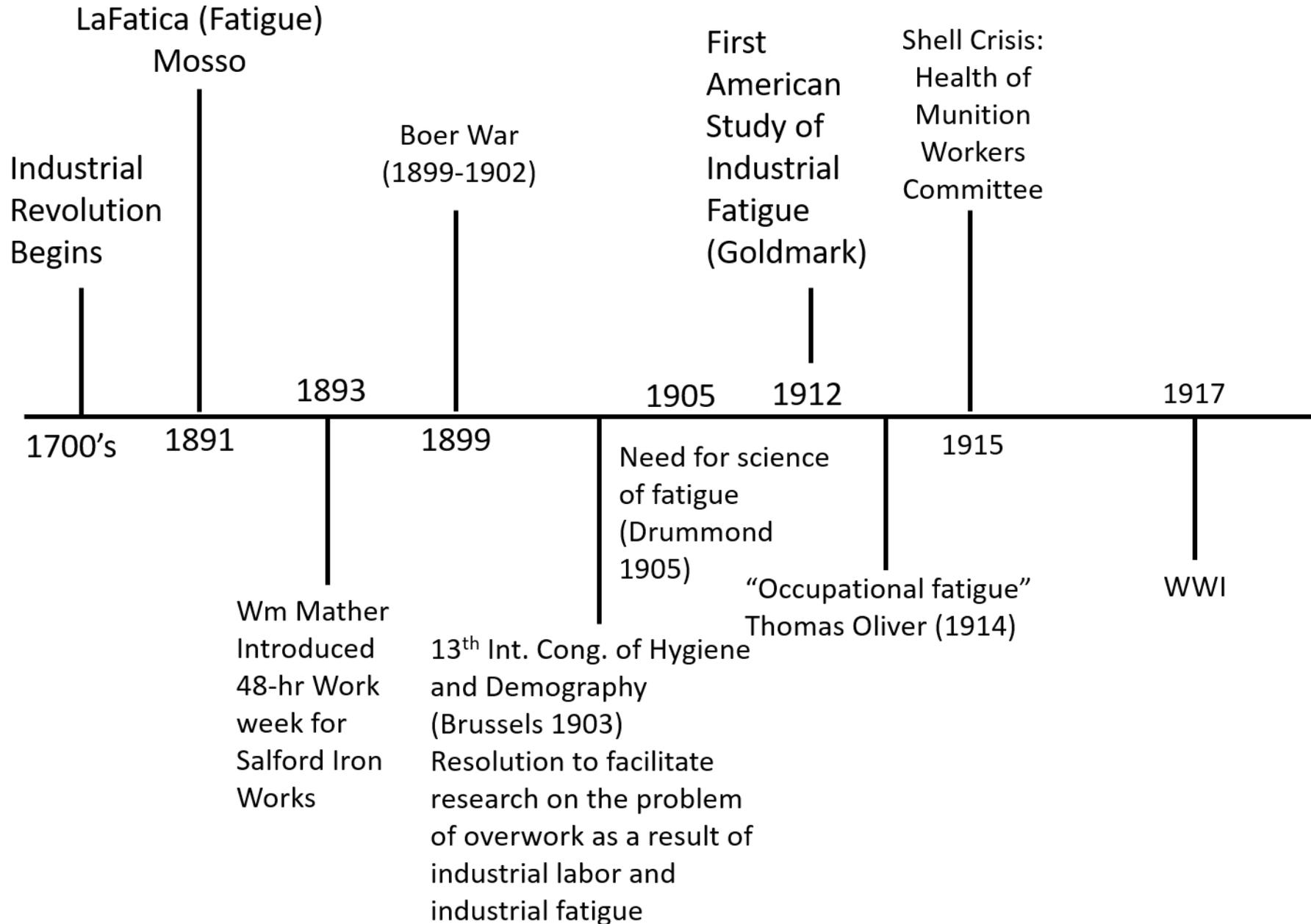


- ‘So tired!’ is the cry of thousands of men, women and young persons at the close of the day. How to meet the complaint and remove its cause are among the problems of the present age. It would seem as if the stress of modern times was becoming too great, and as if the strain of industrial methods through improved machinery was becoming more than human strength can bear. (Thomas Oliver, *Journal of State Medicine*, 1914)

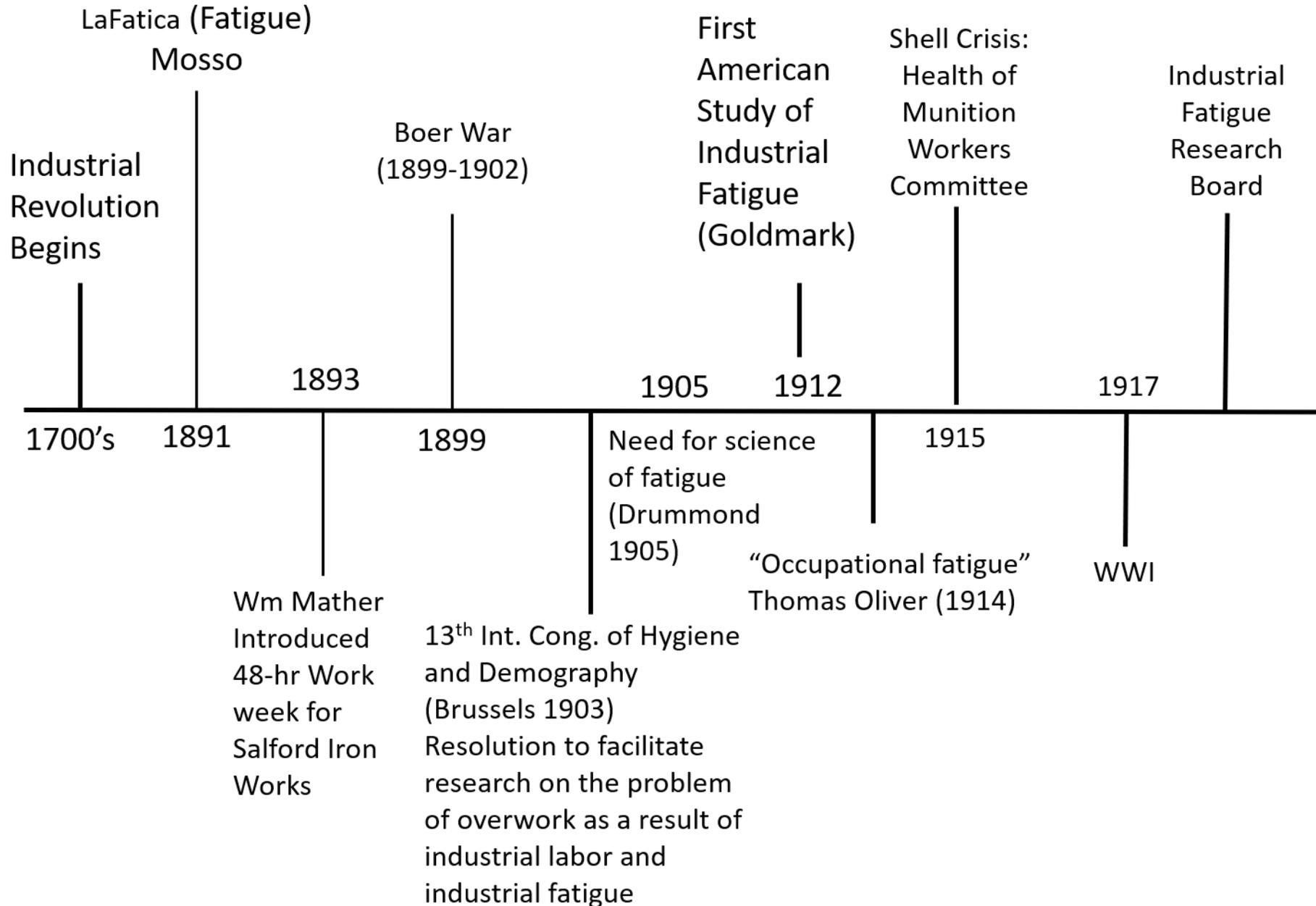
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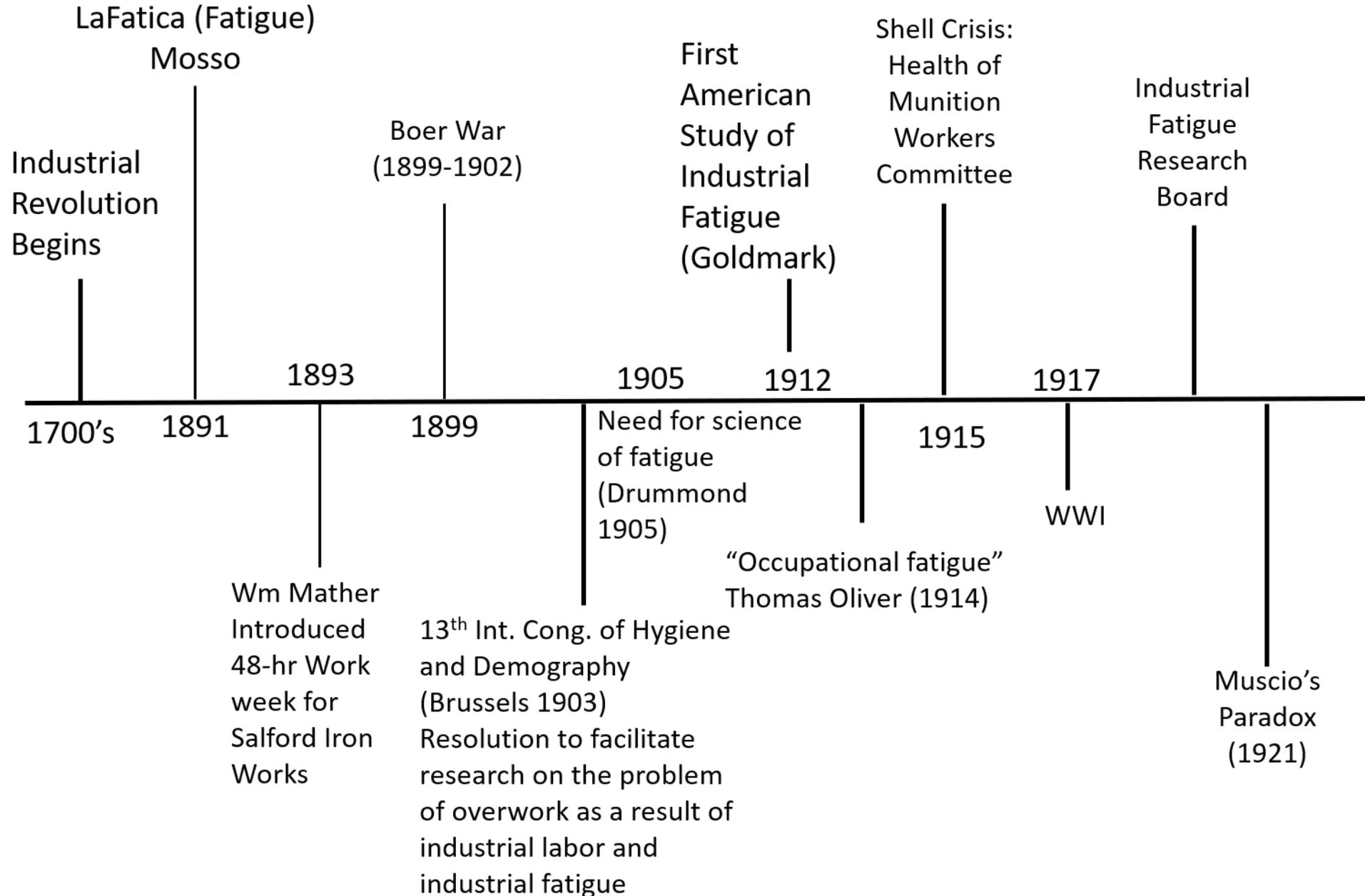
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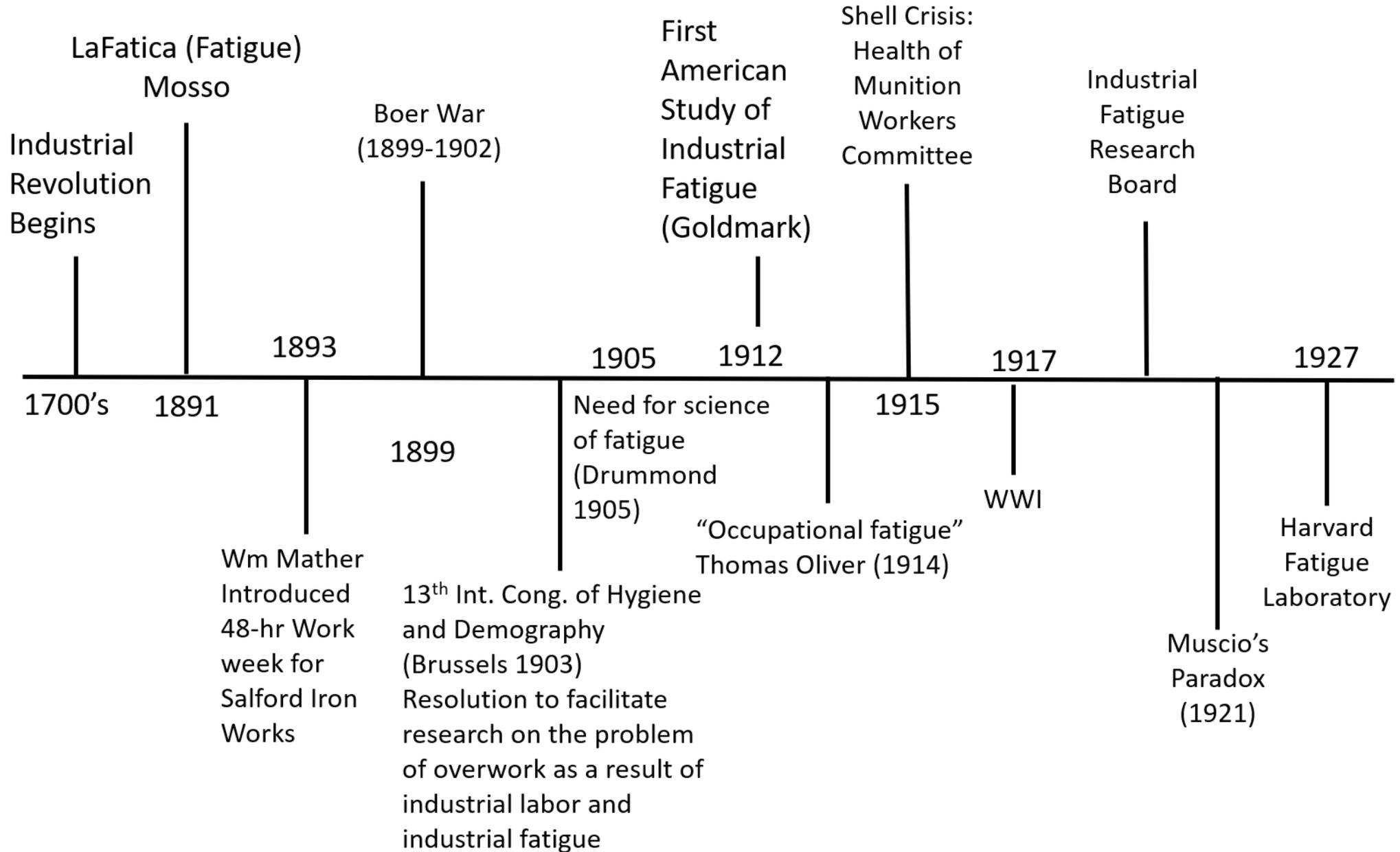


# MUSCIO'S PARADOX

Issues of fatigue definition:

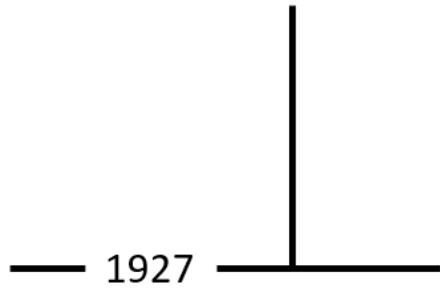
- Plagued researchers for more than 150 years
- In order to measure fatigue we need a clear and unequivocal definition of what it is
- Lacking that we cannot be sure what nominal test are actually measuring
- No definition that Muscio could find in his time, and arguably up to the present, supports quantitative definition
- Fatigue is one of those energetic states of an organism that everyone has experienced (Hancock et al. 2012)

# History of Fatigue Research



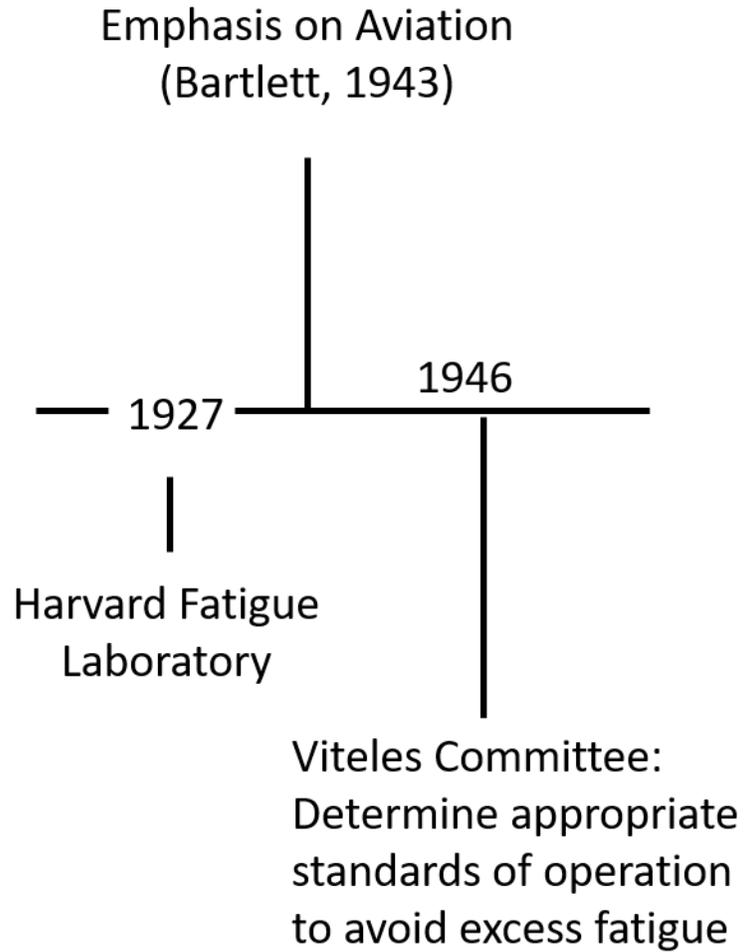
# History of Fatigue Research

Emphasis on Aviation  
(Bartlett, 1943)

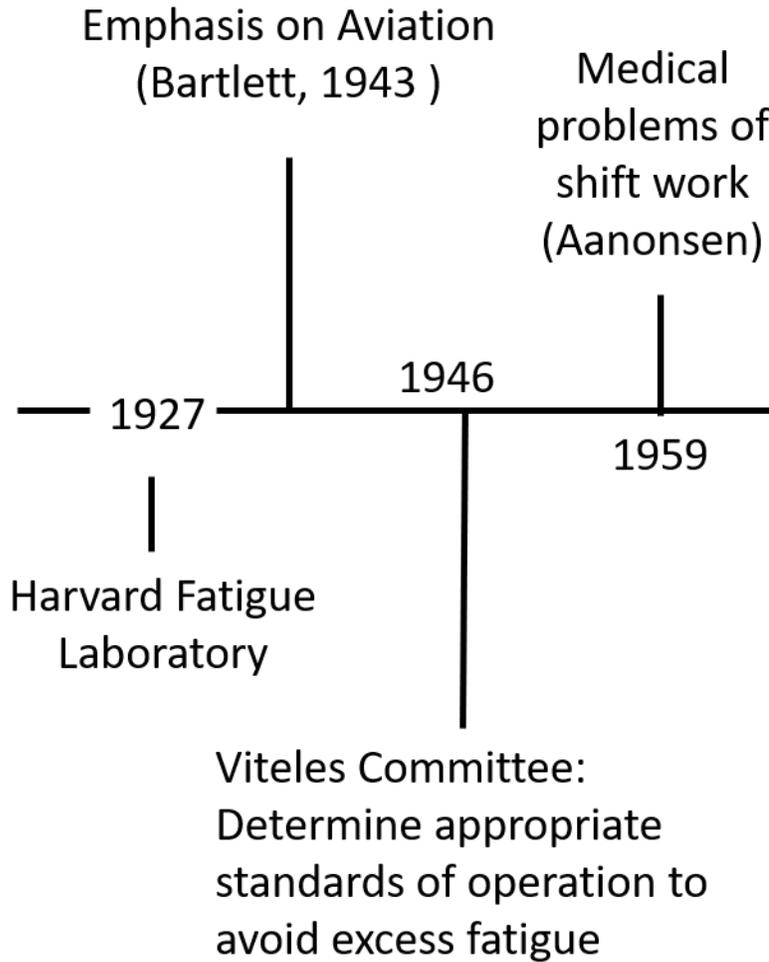


Harvard Fatigue  
Laboratory

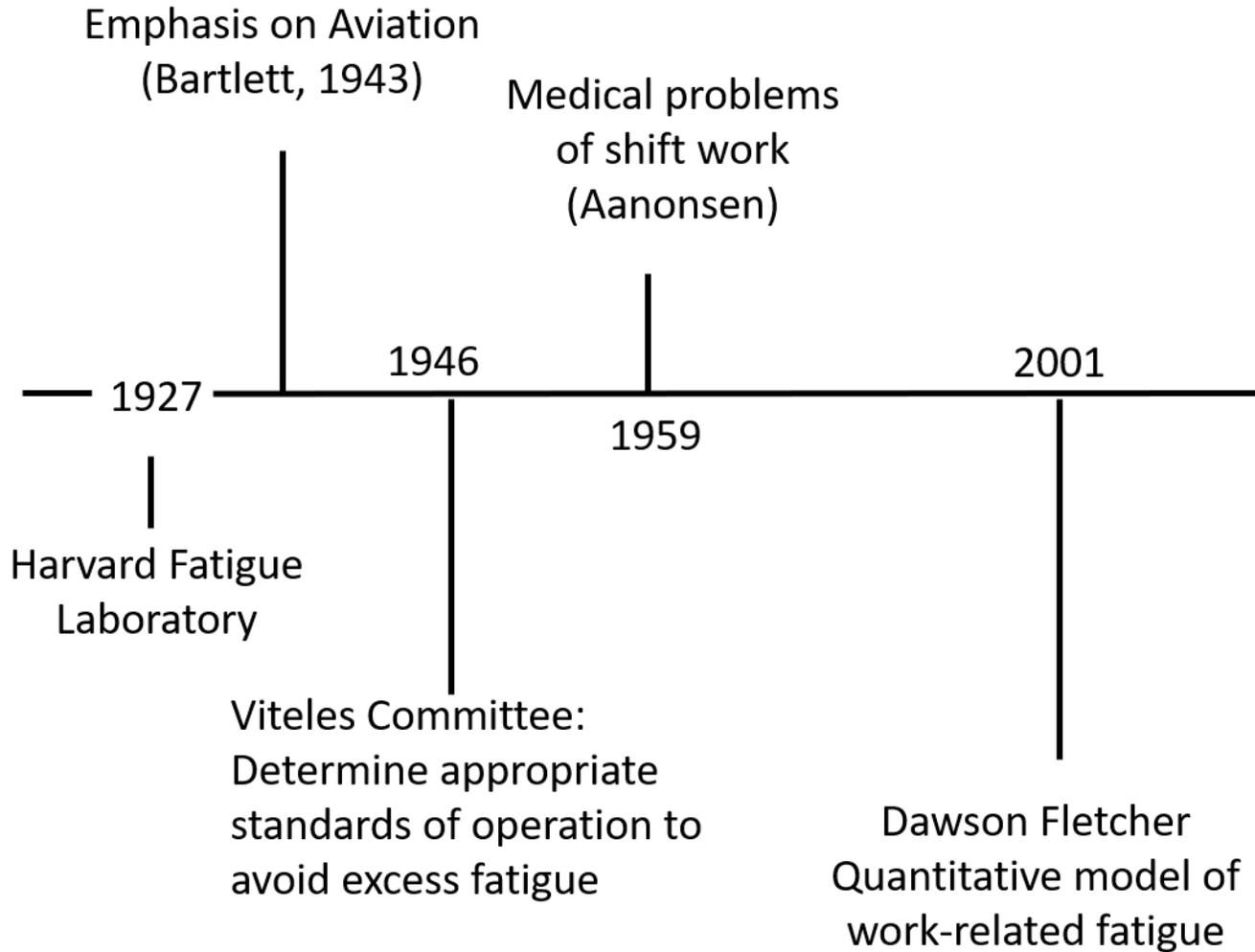
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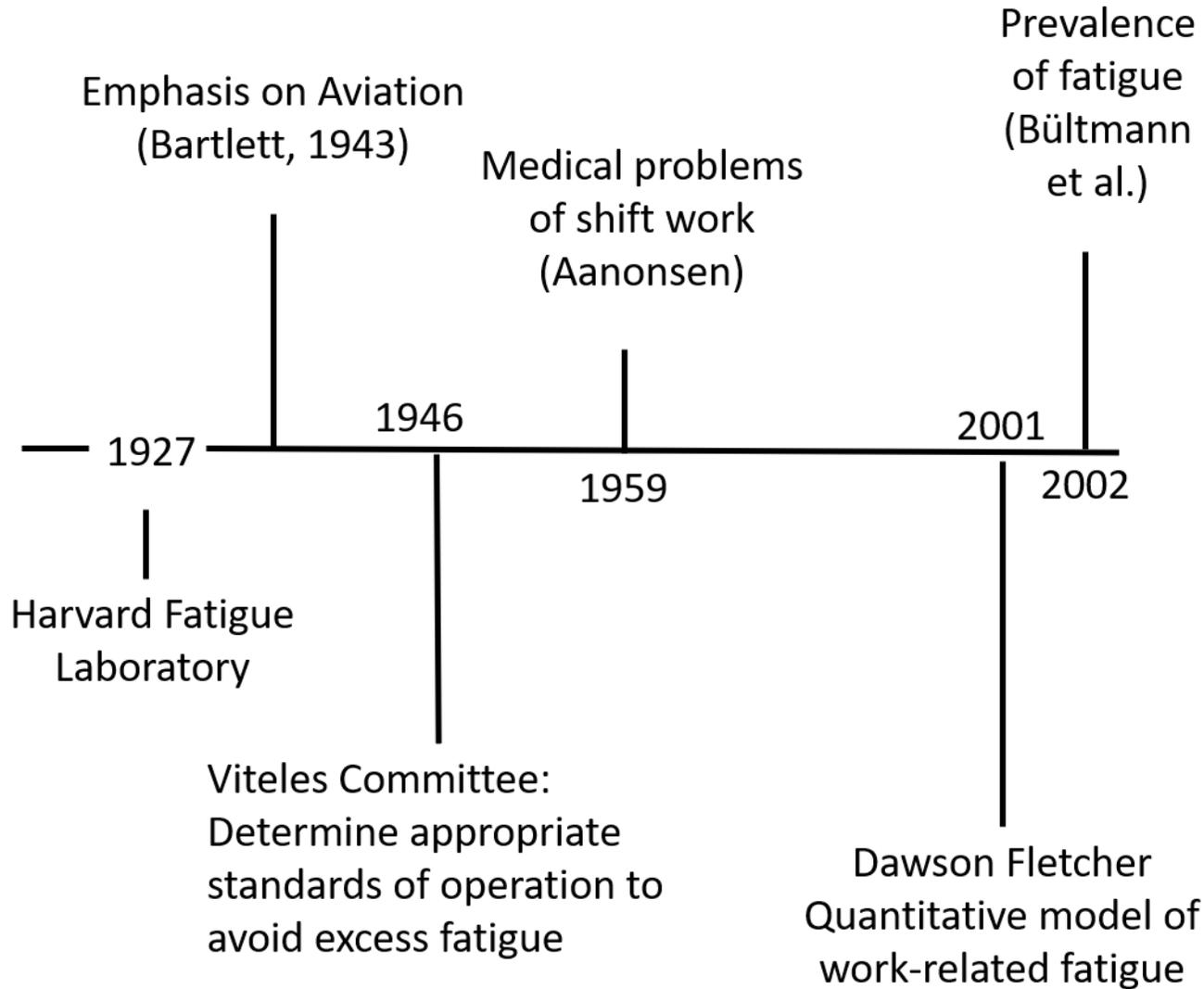
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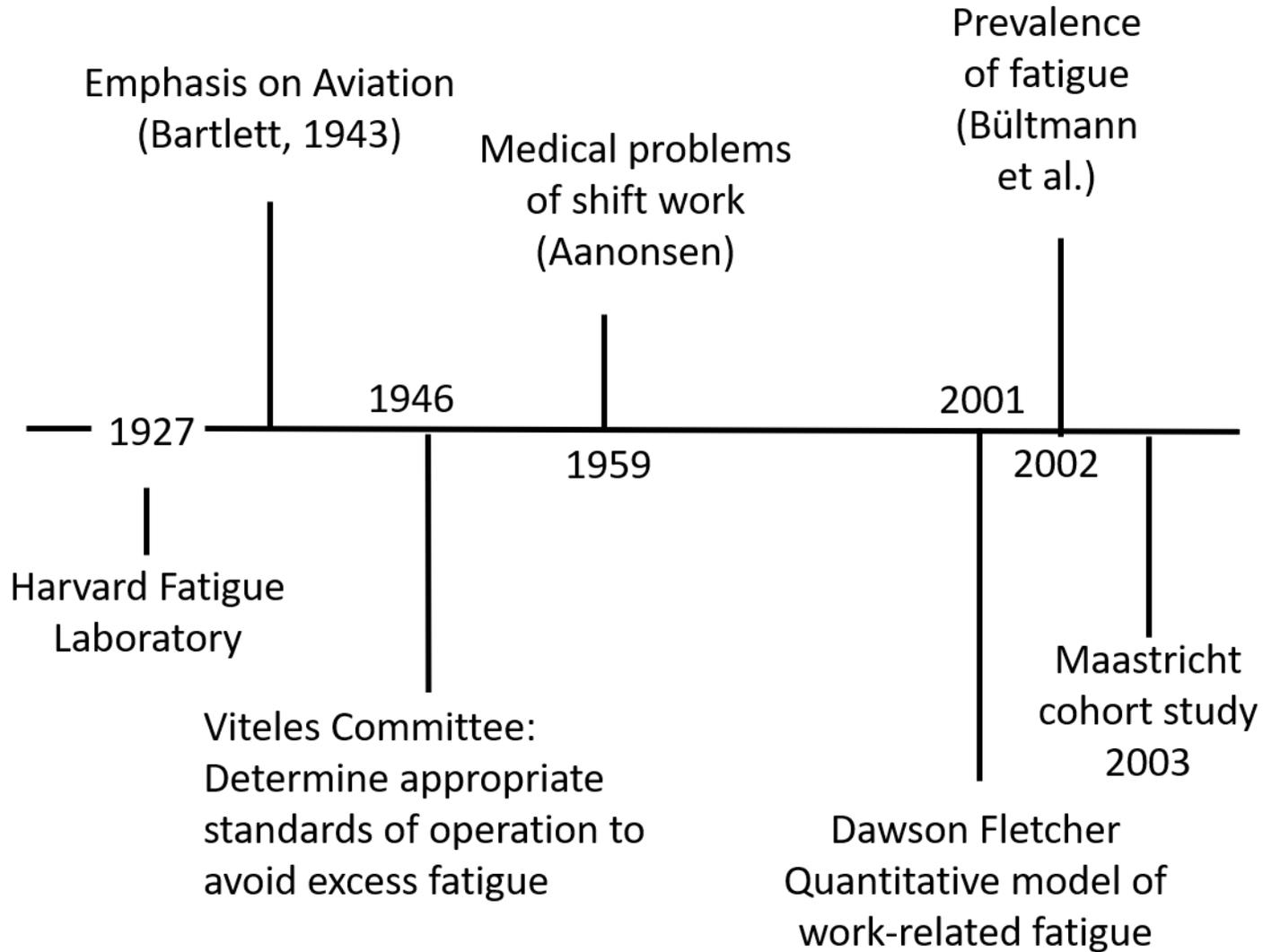
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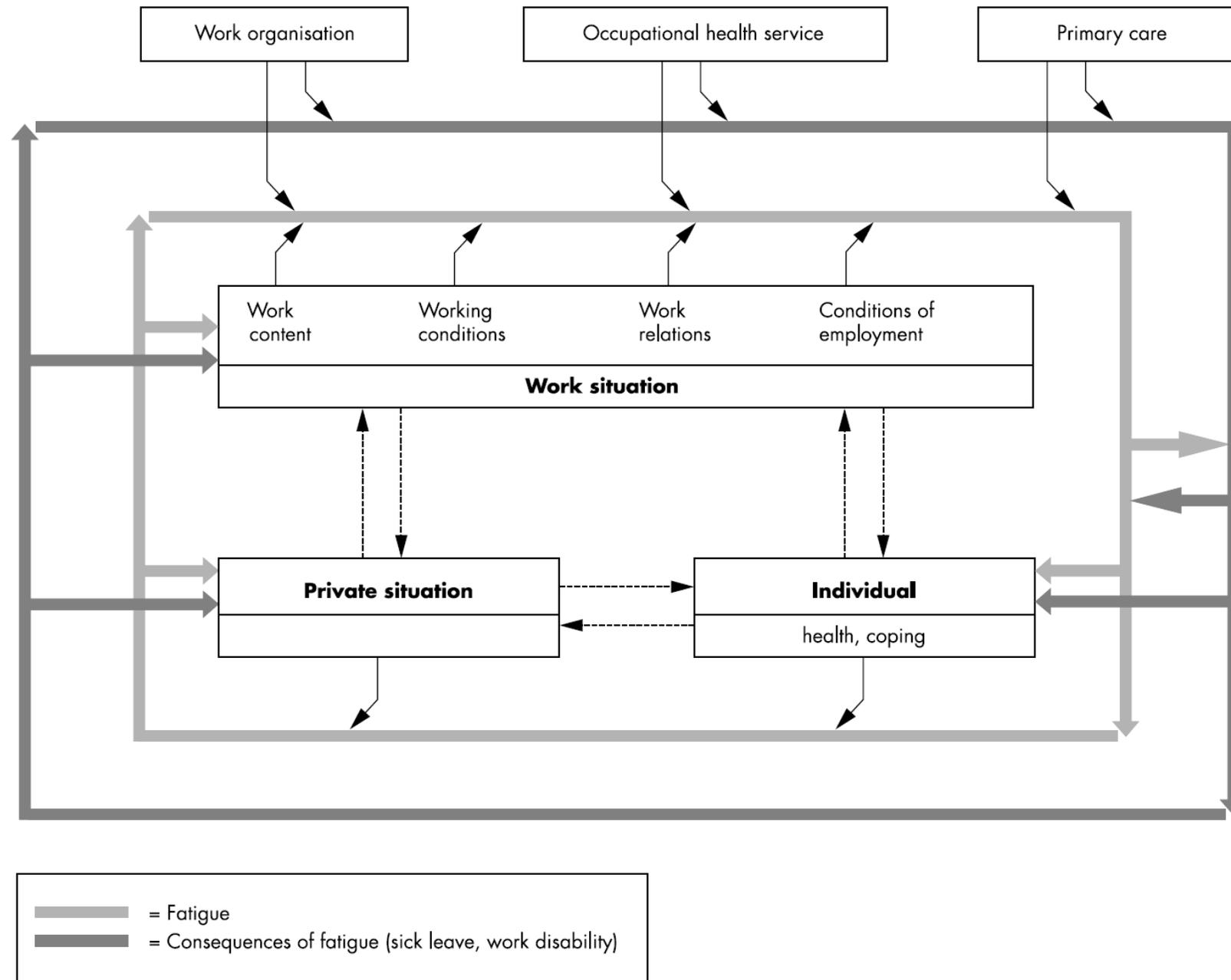


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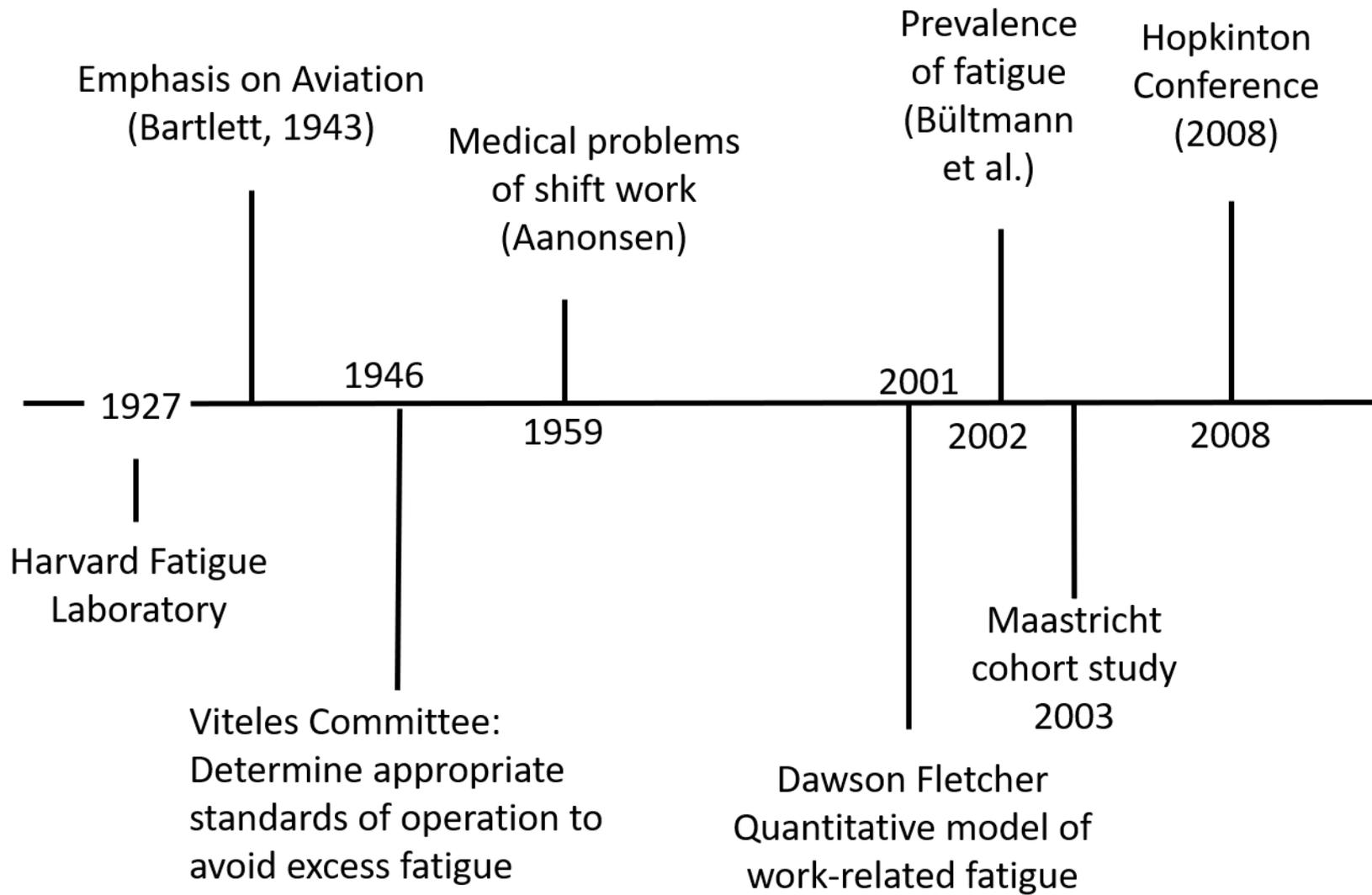
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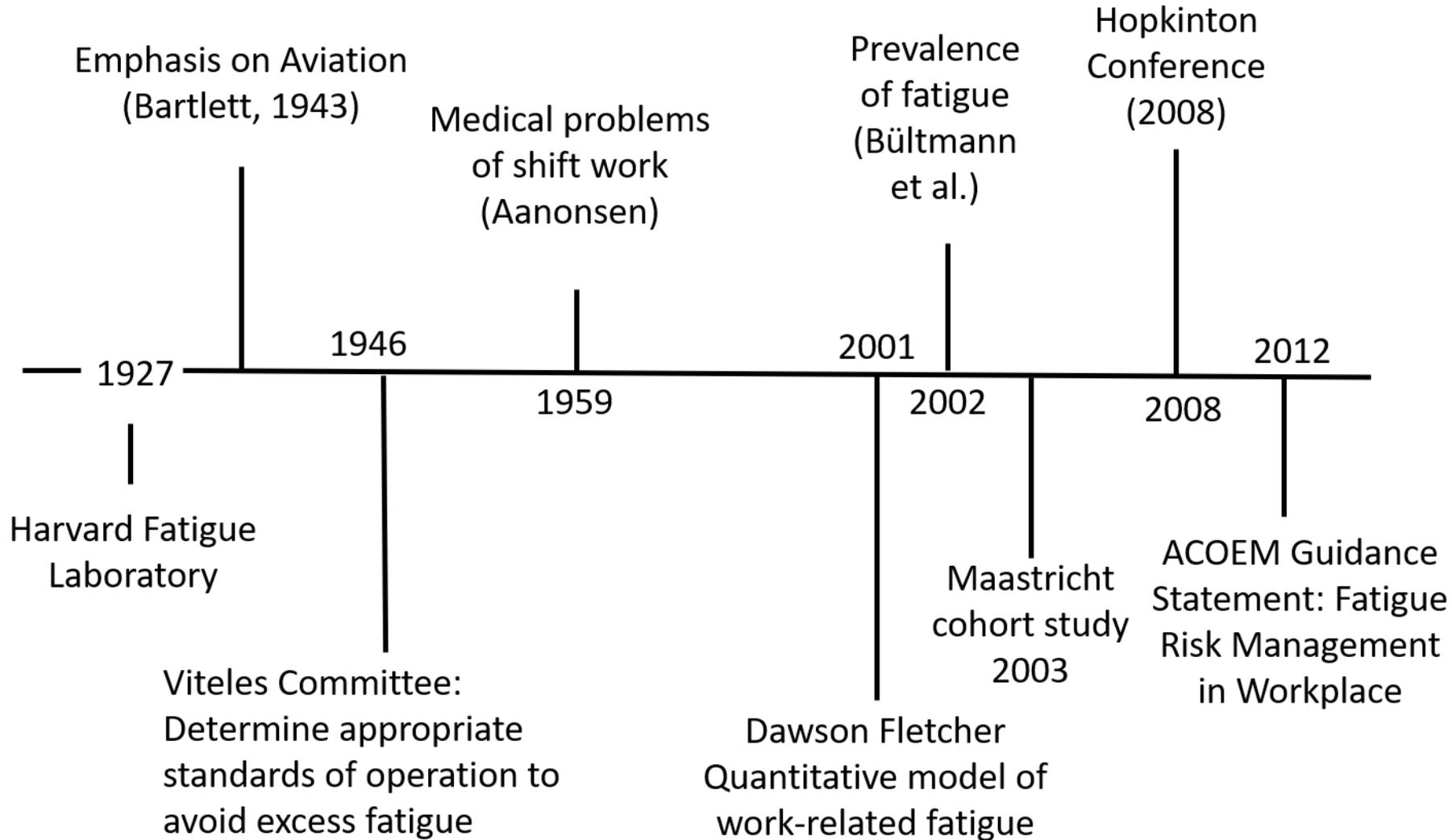


**Figure 1** Conceptual model for epidemiological research on fatigue in the working population.

# History of Fatigue Research



# History of Fatigue Research



# History of Fatigue Research

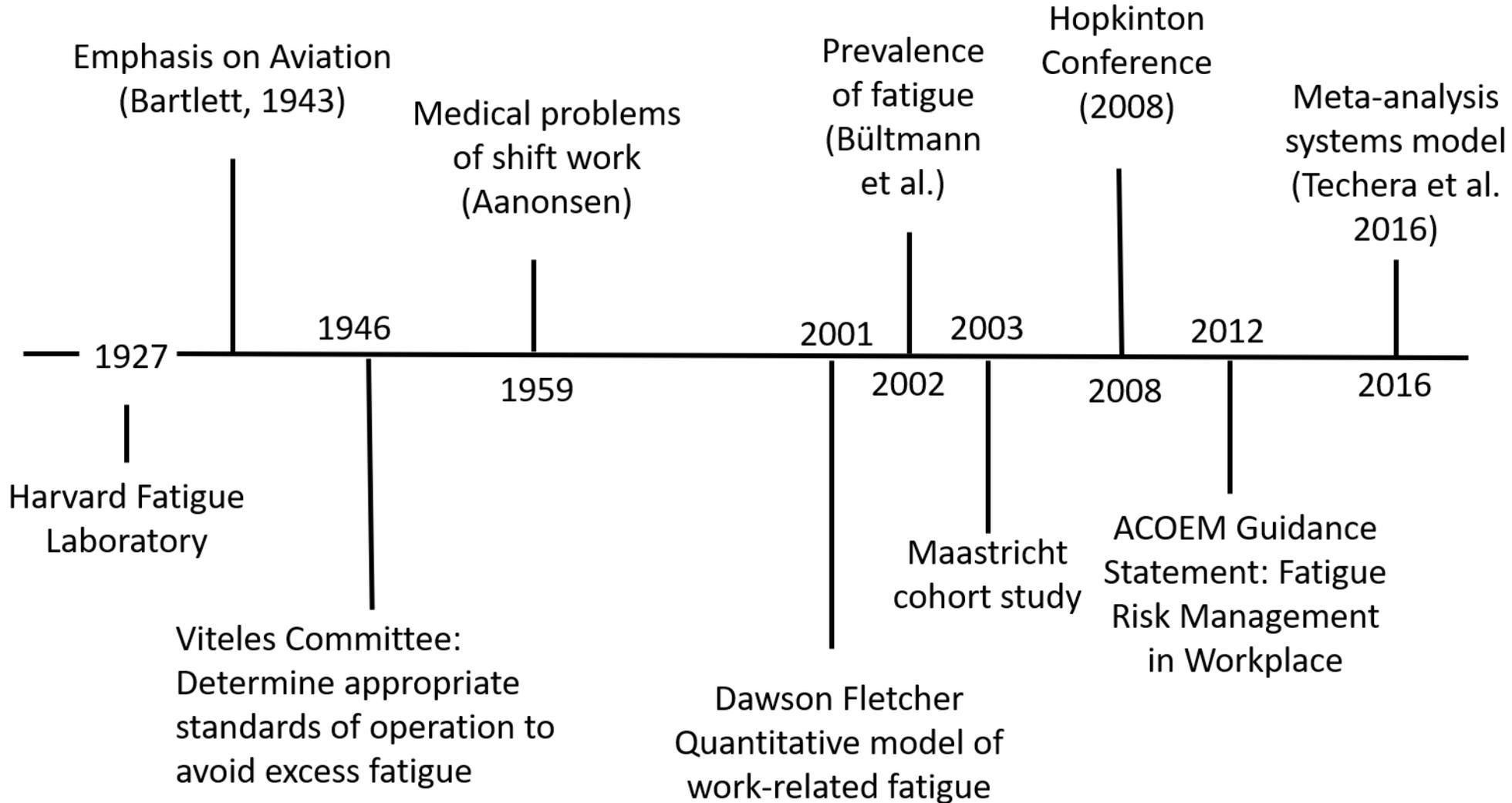
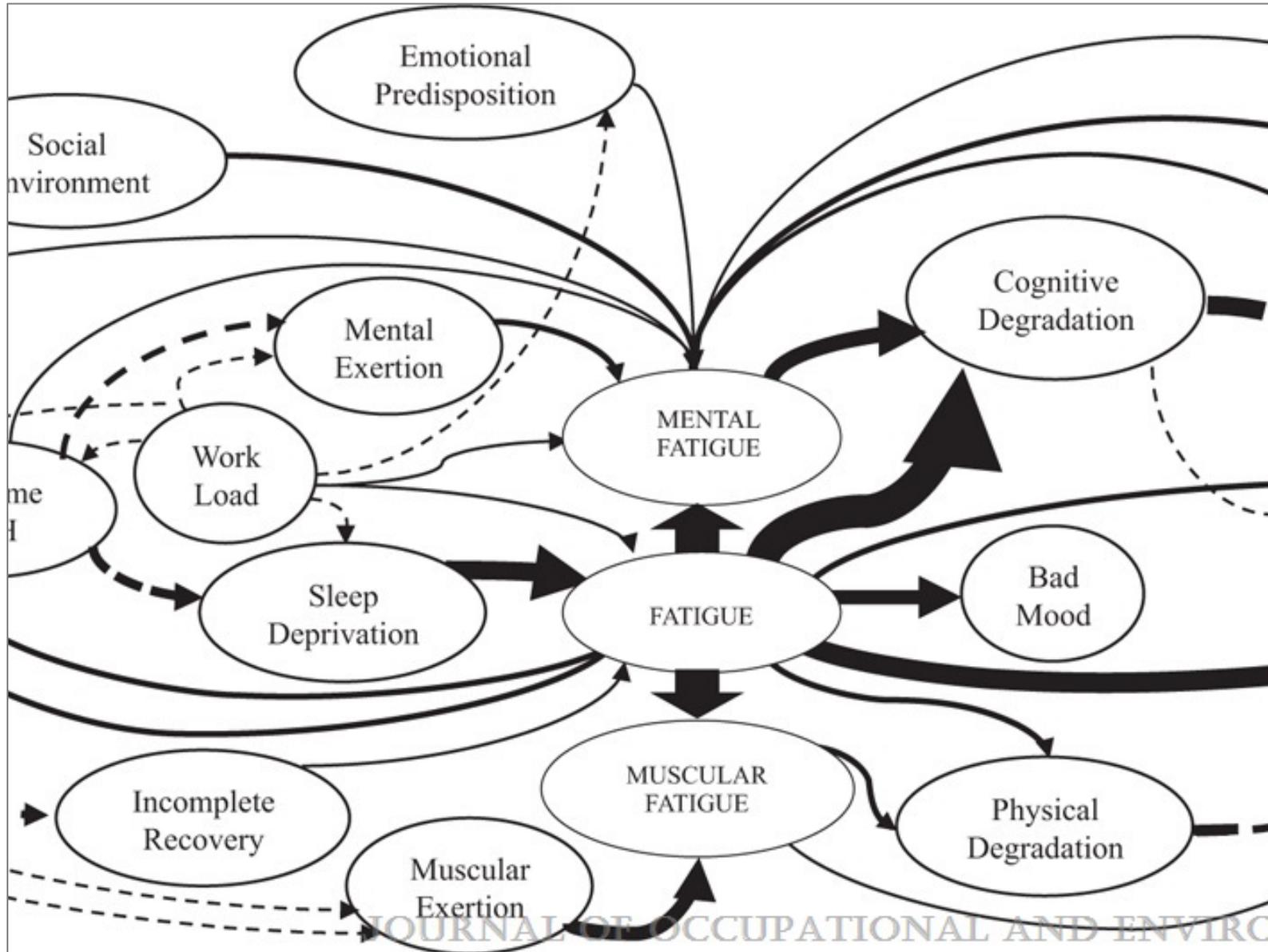


FIGURE 1



[Causes and Consequences of Occupational Fatigue: Meta-Analysis and Systems Model](#)

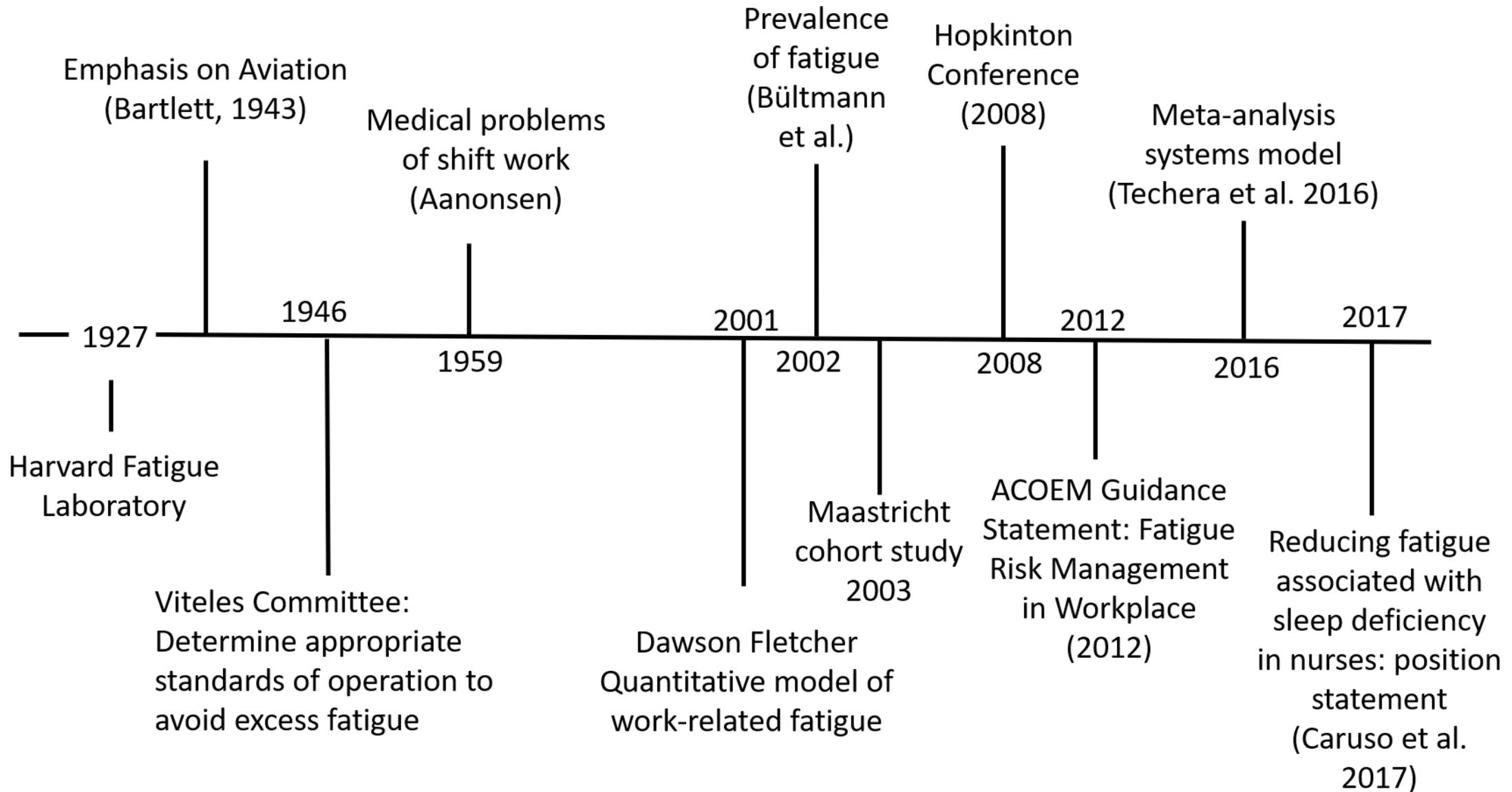
Techera, Ulises; Hallowell, Matthew; Stambaugh, Nathan; Littlejohn, Ray

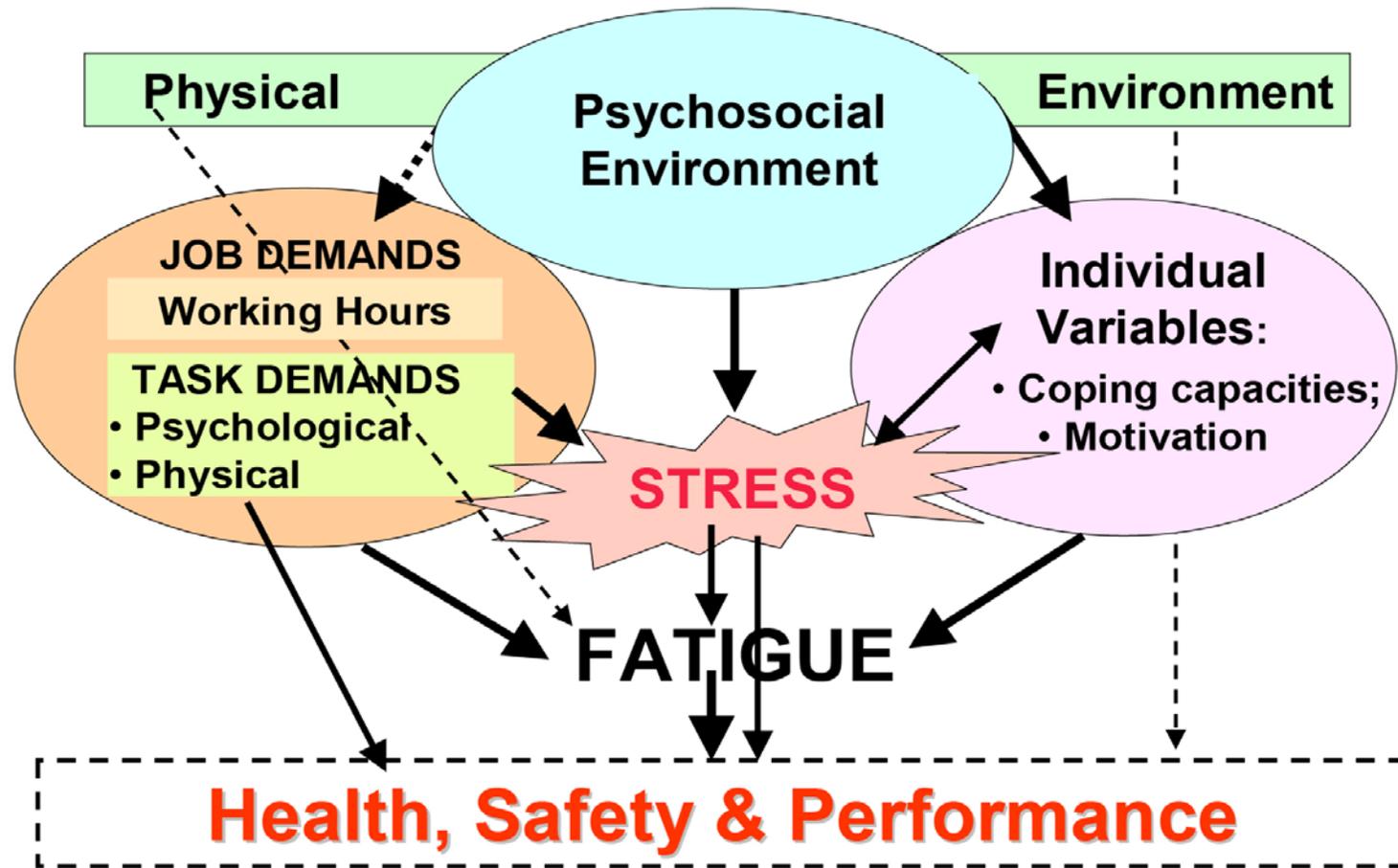
Journal of Occupational and Environmental Medicine 58(10):961-973, October 2016.

doi: 10.1097/JOM.0000000000000837

Systems model illustrating empirical literature on the relationships among causes and effects of fatigue. Dashed lines represent the inter-relationships among the causes and consequences of fatigue and solid lines represent the immediate relationships between causes, fatigue, and consequences. Line thickness corresponds directly to the number of studies devoted to each relationship.

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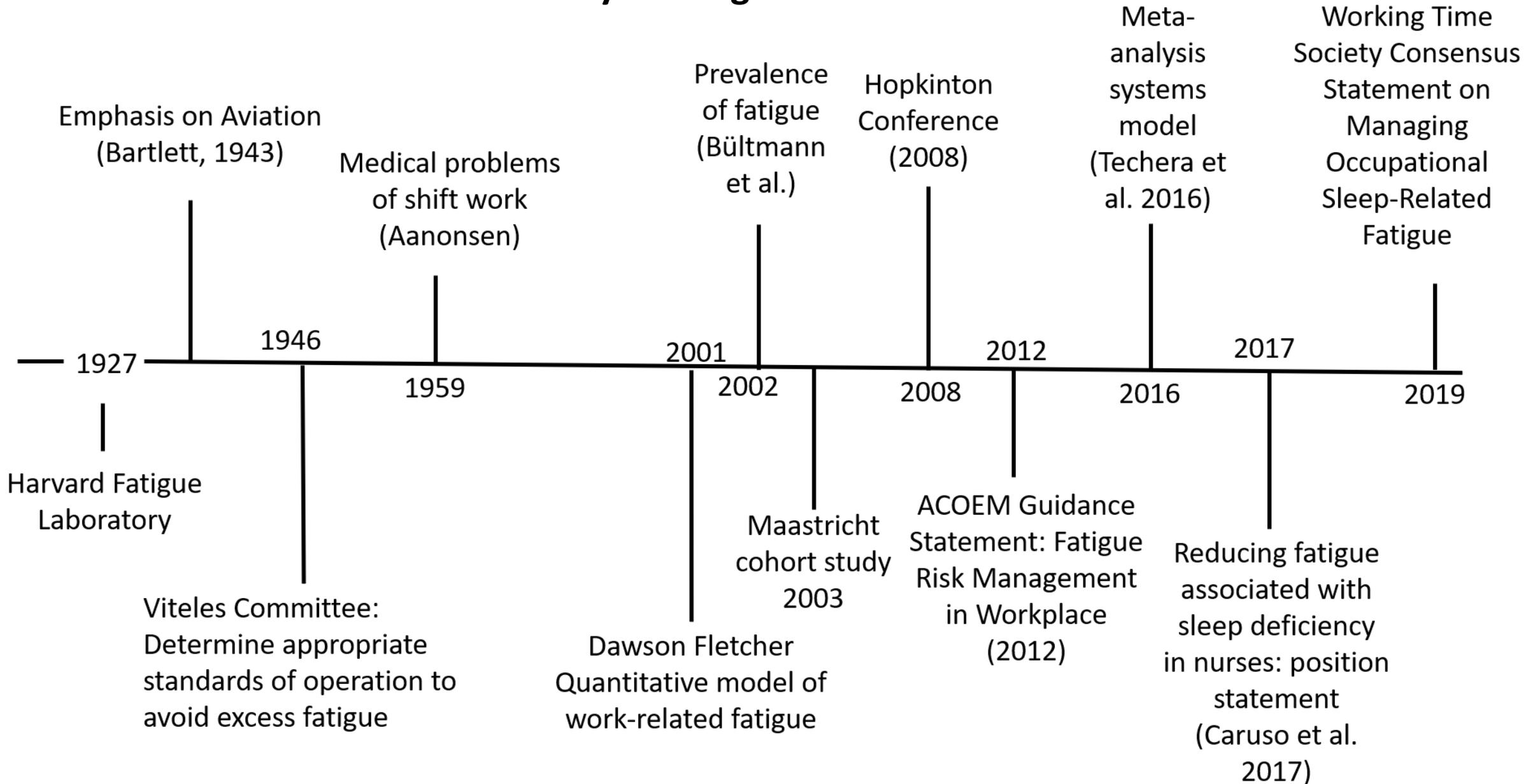




**Figure 1.** Relationships between job demands, physical and psychosocial environment factors, individual variables (relatively stable personal characteristics), more transient personal states such as stress and fatigue, and system outcomes such as work performance, health and safety.

(Safe Work Australia 2016)

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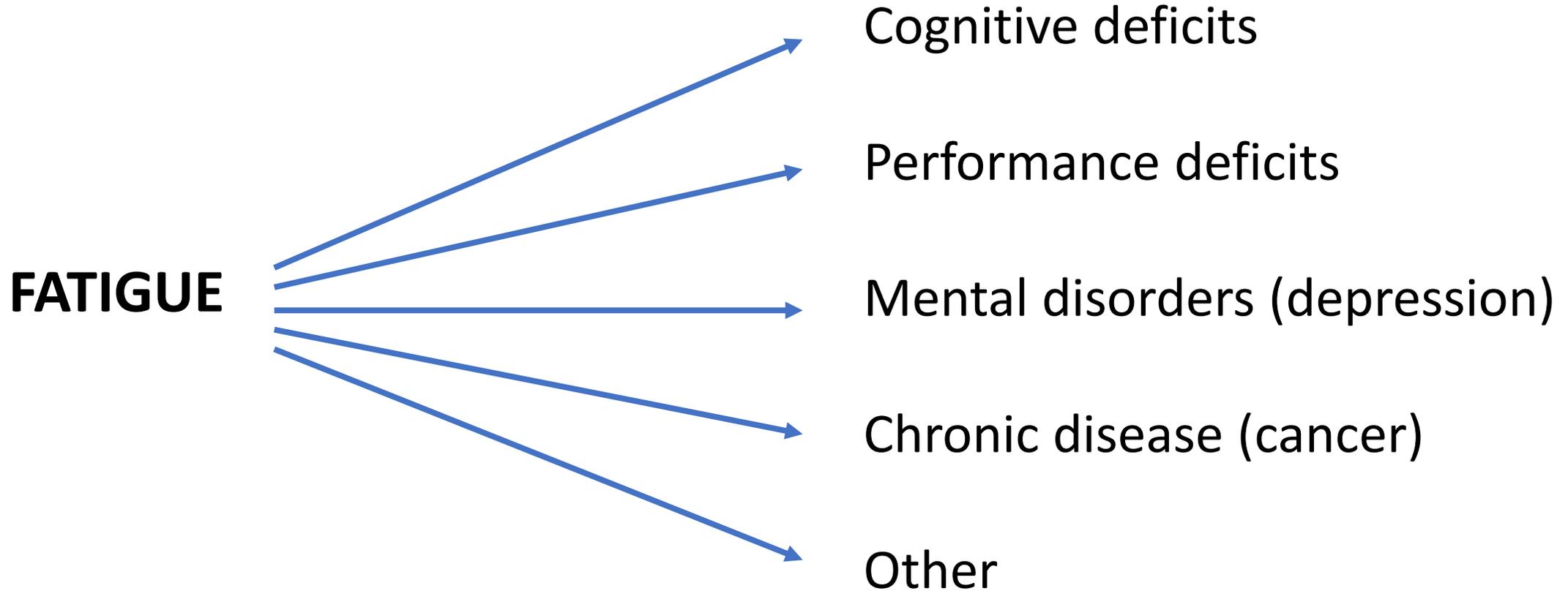


# HISTORY OF FATIGUE RESEARCH

## METHODOLOGICAL FOCAL ISSUES

- Definition
- Measurement
- Interpretation
- Productivity
- Hours of work
- Shift work
- Workload
- Sleep
- Worker characteristics
- Multi-dimensional approach
- Fatigue management

# Effects of fatigue/topics of research



## Risk factors

Sleep deprivation

Circadian variability

Time awake

Health factors (sleep disorders/medications)

Environmental Issues (light, noise)

Workload  
(physical & mental exertion)

**FATIGUE<sup>1</sup>**

## Adverse effects

Cognitive deficits

Performance deficits

Mental disorder  
(depression)

Chronic disease  
(cancer)

Other

(Lerman et al. 2012)

1. Figure not meant to indicate that fatigue is a mediator between risk factors and adverse effects.



**Thank you!**

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