

Introduction to the special issue of the journal *Temperature* on Japanese thermal physiology

Osamu Shido*

Department of Environmental Physiology; Faculty of Medicine; Shimane University; Shimane, Japan

This editorial introduces the special issue of the journal *Temperature* on thermal physiology in Japan and acknowledges significant contributions of Japanese scientists to the development of thermal biology and physiology. This special issue contains articles on the history of Japanese thermal physiology and physiologists, invited reviews, research papers, and other contributions. It shows clearly that thermophysiology is a vibrant discipline in today's Japan.

It has been recognized that one of the most important scientists at the dawn of Japanese thermal physiology is Dr. Yas Kuno, who received numerous awards for his invaluable works,¹ including the prestigious Japanese Order of Cultural Merits. His volition and ardor for thermal physiology was succeeded by thermal and environmental physiologists in the following

Keywords: history, heat acclimation, Japanese physiologists, orexin, oxygenase, neurogenesis, prostaglandin transporter, psychogenic fever, stress-induced hyperthermia, β -amyloid

Abbreviations: LHA, long-term heat acclimation; PGE², prostaglandin E₂; PSH, psychological stress-induced hyperthermia; TRP, transient receptor potential.

© Osamu Shido

*Correspondence to: Osamu Shido; Email: o-shido@med.shimane-u.ac.jp

Submitted: 07/29/2015

Accepted: 07/29/2015

<http://dx.doi.org/10.1080/23328940.2015.1078927>

This is an Open Access article distributed under the terms of the Creative Commons Attribution-Non-Commercial License (<http://creativecommons.org/licenses/by-nc/3.0/>), which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited. The moral rights of the named author(s) have been asserted.

generations and by young researchers in the present generation. His enormous contributions to Japanese thermal physiology are summarized by Dr. Morimoto, Professor Emeritus of Kyoto Prefectural University of Medicine.² Japanese thermal physiologists cooperated with numerous physiologists in the world. Among them, Dr. Eckhart Simon, an outstanding German physiologist, is distinguished by his exemplary contributions to Japanese thermal physiology, which are outlined in the essay of Dr. Gerstberger.³

Studies of the febrile mechanism have been continuously made in the field of thermal physiology. In their legacy article that opens this issue, Dr. Urade et al.⁴ summarize the outstanding contributions of Dr. Osamu Hayashi, including his discovery of oxygenases. His vital findings are essential for analyzing the role of prostaglandin E₂, a lipid that is produced by cyclooxygenase and mediates fever. In the same issue, Dr. Hosotani et al.⁵ show a significant role of prostaglandin transporter in clearing prostaglandin E₂ during the recovery phase of fever by studying prostaglandin transporter mRNA expression in rat brains. The “ins” (synthesis) and “outs” (transport and catabolism) of prostaglandin E₂ during fever are also analyzed in the editorial comment by Dr. Schuster.⁶ Whereas infectious fevers are prostaglandin-dependent, psychogenic fevers seen in young women exposed to mental stress are not. This conclusion is made by Dr. Oka⁷ based on his clinical observations showing that cyclooxygenase inhibitors fail to block psychogenic fevers.

Recently, central neural circuits used for thermoregulation have been intensively studied using a variety of novel methods.⁸ Dr. Nakamura's review⁹ focuses on psychological stress-induced hyperthermia in laboratory animals and analyzes, in detail, the pathway from the

dorsomedial hypothalamus and paraventricular hypothalamic nucleus to thermoeffectors, especially brown adipose tissue. Drs. Ootsuka and Tanaka¹⁰ review, mainly from the electrophysiological point of view, the neural circuit for controlling the blood flow in the skin, where arteriovenous anastomoses are abundant.

In his challenge article, Dr. Kobayashi¹¹ proposes a model of the thermoregulatory system, in which peripheral thermal receptors play the role of thermostats. His model is critically evaluated in letters from several leading thermophysiology published in the same issue.

One of the themes which thermal and environmental physiologists are interested in is the mechanism of sleep-wake cycle. For example, this was a topic intensively researched by Dr. Osamu Hayashi.³ In this special issue, Dr. Fuller et al.¹² overview the emergence of conditional genetic manipulations (such as gene silencing using RNA interference or ablation and genetically engineered receptor-channel systems) and claim the usefulness of these tools for studying neural circuits regulating the sleep-wake cycle. Orexin-containing neurons are likely to be involved in these circuits; in fact they were first thought to be an essential component of the wakefulness regulator. Dr. Kuwaki¹³ describes the anatomy of orexin neurons and comprehensively reviews the role of these neurons in autonomic functions.

The central mechanism of heat acclimation has not yet been understood. In contrast to the short-term heat acclimation, thermoregulatory changes of long-term heat acclimation are sustained and accompanied by persisting morphological changes in the thermoregulatory centers. Drs. Shido and Matsuzaki¹⁴ propose that long-term heat acclimation in rats is established by generating new functional neurons in the hypothalamus. In addition, Dr. Matsuzaki et al.¹⁵ show in their

original research paper that the ability to acclimate to heat over a short period of time is attenuated in Alzheimer disease model rats, thus suggesting that short-term temperature acclimation may also have central (brain-mediated) mechanisms.

We are providing this special issue to the readers with the sincere hope that it can effectively introduce the historical and current contributions of Japanese thermal and environmental physiologists and biologists to the development of thermal physiology. In addition, we hope that this issue will help to promote further cooperation between Japanese and

non-Japanese thermal physiologists and researchers.

Disclosure of Potential Conflicts of Interest

No potential conflicts of interest were disclosed.

References

1. Kuno Y. Human Perspiration. Springfield, IL: Charles C. Thomas Publisher; 1956.
2. Morimoto T. *Temperature* 2015; 2(3):310-6; <http://dx.doi.org/10.1080/23328940.2015.1066920>
3. Gerstberger R. *Temperature* 2015; 2(3):316-9; <http://dx.doi.org/10.1080/23328940.2015.1066922>
4. Lazarus M, et al. *Temperature* 2015; 2(3):303-8; <http://dx.doi.org/10.1080/23328940.2015.1072658>
5. Hosotani R, et al. *Temperature* 2015; 2(3):425-36; <http://dx.doi.org/10.1080/23328940.2015.1062953>
6. Schuster V. *Temperature* 2015; 2(3):326-8; <http://dx.doi.org/10.1080/23328940.2015.1077923>
7. Oka T. *Temperature* 2015; 2(3):368-79; <http://dx.doi.org/10.1080/23328940.2015.1056907>
8. Morrison SF, et al. *Front Biosci* 2011; 1:74-104; <http://dx.doi.org/10.2741/3677>
9. Nakamura K. *Temperature* 2015; 2(3):352-62; <http://dx.doi.org/10.1080/23328940.2015.1070944>
10. Ootsuka Y, et al. *Temperature* 2015; 2(3):392-405; <http://dx.doi.org/10.1080/23328940.2015.1069437>
11. Kobayashi S. *Temperature* 2015; 2(3):341-4; <http://dx.doi.org/10.1080/23328940.2015.1039190>
12. Fuller PM, et al. *Temperature* 2015; 2(3):406-17; <http://dx.doi.org/10.1080/23328940.2015.1017090>
13. Kuwaki T. *Temperature* 2015; 2(3):379-91; <http://dx.doi.org/10.1080/23328940.2015.1066921>
14. Shido O, et al. *Temperature* 2015; 2(3):362-8; <http://dx.doi.org/10.1080/23328940.2015.1076591>
15. Matsuzaki K, et al. *Temperature* 2015; 2(3):418-25; <http://dx.doi.org/10.1080/23328940.2015.1044635>