

# Sunspot observation by the cooperation of amateur astronomers and researchers in Japan in early 20th century as early citizen science program

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**Abstract.** The development of astronomy has been developed by the cooperation of amateur astronomers and researchers. Sunspot observation is a good example of Extreme citizen science in early days. Issei YAMAMOTO (1889–1959), organized “Oriental Astronomical Association (OAA),” Yamamoto’s materials (now in Kwasan observatory) include solar observation data sent from many observers in Japan. From the viewpoint of today’s Citizen Science, collaborative observation of sunspot between researchers of solar physics and amateur astronomers in Japan has clearly a context of social mission rather than mere academic interest. From the viewpoint of science communication, we can see that Yamamoto’s call includes a social mission to promote astronomy in Japan, and that amateurs responded to Yamamoto’s call by participating in the observation network. It can be said that this collaboration have not only “cultural” aspect but also “civic” or “practical” aspect.

**Keywords.** history and philosophy of astronomy, sunspots

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## 1. Introduction

Citizen science, collaborative research between professional researchers and general public, is becoming more and more popular. Along with environmental science, history and biology, astronomy is one of the most popular fields of citizen science. Various researchers have pointed out the hierarchy of citizen science. Haklay (2013) categorized citizen science according to the depth of participation: crowdsourcing, distrusted intelligence, participatory science, and “extreme citizen science”. At the stage of extreme citizen science, participants of citizen science project do not only cooperate in collecting data, but also think together with researchers, identify problems, analyze data, and write papers. The collaboration between professional researchers and amateur observers in astronomical observation is one of the best examples of extreme citizen science. The discovery of supernovae, novae, and comets by amateur observers and detailed analysis by professional researchers has led to several papers with amateur astronomers as co-authors (for example, Abdo *et al.* 2010; Kawabata *et al.* 2010). It is important to examine the participants of Citizen Science to understand why they participate in the project in order to make future projects more useful. Ikkatai *et al.* (2020) investigated people’s willingness to participate in citizen science, focusing on their level of interest in science and technology in Japan, and pointed out that “Contribution,” “stimulation of

intellectual curiosity,” and “latest knowledge” were identified as motivating factors. Shen (1975) pointed out three categories of scientific literacy (practical literacy : knowledge for solving practical problems, Civic literacy: Understanding of scientific terms, concepts, and methods, and Cultural literacy: the ability to use scientific information as intellectual entertainment). It is useful to analyze the three categories of scientific literacy from the participants' behavior. The participants in professional-amateur joint observations in astronomy nowadays are clearly participating with cultural literacy. It is useful to look at the history of the establishment of the system to understand why it became this way. In this paper, I will examine how amateur astronomy was created in Japan, and consider the prospects for citizen science, from the viewpoint of scientific literacy.

## **2. Issei Yamamoto and Amateur Astronomers in Japan**

Issei Yamamoto was the first director of Kwasan Observatory of Kyoto University. Kwasan Observatory was open to the public from its inception in 1929, a pioneering move at that time. Staffs of Kwasan Observatory, researchers of astronomy, has been actively involved in science communication activities from the early stages of its opening, for example, by holding observing sessions for the public. In addition to public outreach, Yamamoto cultivated and interacted with amateur astronomers in Kwasan Observatory. These are Kwasan Observatory is said “sacred place for amateur astronomers in Japan.” In 1920, before the opening of Kwasan Observatory, Yamamoto organized “Oriented Asia Astronomical Society (OAA)”, an organization of amateur astronomers in Japan, and worked to foster amateur astronomers. In 1940, after retiring from Kyoto University, Yamamoto established a private observatory, which is now called Yamamoto Observatory. There are many records of his interactions with amateur astronomers at Yamamoto Observatory, which are now in the possession of Kwasan Observatory. Among them are sunspot records by amateur astronomers from all over Japan. Amateur astronomers sent their observation records to Yamamoto through the OAA, and Yamamoto and his colleagues compiled the records.

## **3. Sunspot Observation by Amateur in Japan in early 20th**

Reports on sunspot observations in the Yamamoto Observatory were archived, and the oldest data is in 1935. Reports of sunspot observation in 1935 were submitted in a format prepared in advance (Fig.1). Looking at the records collected in 1943, we can find not only formatted papers, but also scraps of notebooks, postcards, and letterheads. In addition to the observation rules, there are also personal letters from the observers to Yamamoto. Looking at these records, we can see that the observers were trying to make observations even under the WWII.

In the first issue of “The Heaven” (In Japanese, “Tenkai”), a member magazine of OAA, it was stated that in order to carry out continuous observations, not only the United States and Europe but also Asia needed to participate in the observations. A cooperative system is essential for continuous observations, and it must be organized (Yamamoto & Furukawa 1920). As for sunspot observations, it takes time to obtain sunspot data collected in Belgium at that time, so it is desirable to observe sunspots by oneself if it is possible. Yamamoto's comments (Yamamoto 1926) imply that the training of amateur astronomers was necessary for astronomical observation in Japan, and that there was an practical and civic aspect. This is in contrast to today's activities, which have a strong cultural aspect.

**SUN-SPOT OBSERVATIONS.** FOR JAN 1935

Instrument: 10 cm. Refractor Power: 73 Observer: 1 (No. \_\_\_\_\_)

Date	Time	Weather	Wind	Dir.	Bar.	Northern Hemisphere		Southern Hemisphere		Total	Remarks			No.
						Lat.	Lon.	Lat.	Lon.		K.	G.	U.	
1	12.0	B	C	C										
2	11.0	B	C	C										
3	11.0	B	C	C										
4	12.0	B	D	D										
5	12.0	B	C	C										
6	11.0	B	C	C										
7	12.0	B	C	C										
8	11.0	B	D	D										
9	11.0	B	C	C										
10	12.0	B	C	C										
11	11.0	B	C	C										
12	12.0	B	C	C										
13	11.0	B	C	C										
14	11.0	B	C	C										
15	11.0	B	C	C										
16	11.0	B	C	C										
17	12.0	B	C	C										
18	12.0	B	D	D										
19	12.0	B	D	D										
20	12.0	B	C	C										
21	12.0	B	C	C										
22	12.0	B	C	C										
23	12.0	B	C	C										
24	12.0	B	D	D										
25	11.0	B	C	C										
26	11.0	B	C	C										
27	11.0	B	C	C										
28	12.0	B	C	C										
29	11.0	B	C	C										
30	11.0	B	C	C										
31	11.0	B	C	C										

Figure 1. An example of sunspot observation record written in 1935.

#### 4. Archiving of historical observation records

Unraveling the history of pro-amateur collaboration in astronomy is a perfect example of extreme citizen science, therefore by using them we can think about the future of science communication and citizen science. The International Astronomical Union (IAU) has pointed out the importance of archiving historical observation records (IAU 2018). Historical observation records are not only useful for astronomy itself, but also for understanding the history of astronomy, the social theory of science and technology, and the history of science communication.

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