59. *Contribution to the Knowledge of Hydrogen Ion Concentration of the Lake Water in Japan.*

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In recent years an enormous data on the hydrogen ion concentration of water of a large number of lakes in Japan¹⁾ have been accumulated and the knowledge of this chemical property of lake water has made a great progress.

Skadowsky recognized distinct types of lakes characterized chiefly by the amounts of buffer substances and by the production of phytoplankton.²⁾ I have adopted the main idea of his opinion and classified the lake water into the following types:

	Primary Character Amount of Buffer	Secondary Character Amount of Phytoplankton
1	poor	{a poor b rich
2	rich (buffer: carbonate)	{a poor b rich
2'	(buffer: humate)	always poor

pH conditions of respective types are as follows:

	Circulation Period	Stagnation Period		Annual Range
		Upper Layer	Lower Layer	
1	6.0-7.5	{a 6.0-7.5 b 8.0-9.0	6.0-7.0	small biggest
2	7.0-8.5	{a 7.0-8.5 b 8.0-9.0	7.0-8.0	very small big
2'	always 4.0-6.0			very small

1) All of the determination were made by the colorimetric method of Clarke.

2) Verhandl. Intern. Limnol. Kongr. Bd. 3 (1926), 109-144.

Type	Name of Lake	Locality	Depth	Date	pH		Observer
					Sur-face	Bot-tom	
1 a'	Ōnuma-ike ¹⁾	Nagano	26 m	Aug. 1929	3.4	3.4	A. Tanaka
	Kutcharo-ko ¹⁾	Hokkaido	125	Aug. 1929	5.1	5.4	K. Sawa
	Inawashiro-ko ¹⁾	Fukushima	96	July 1930	5.3	5.5	S. Yoshimura
1 a	Hakuba-ô-ike ¹⁾	Nagano	13	Oct. 1927	5.3	5.3	A. Tanaka
	Ontake San-no-ike ¹⁾	Nagano	14	Aug. 1928	5.6	5.4	A. Tanaka
	Abashiri-ko	Hokkaido	17	June 1927	7.3	7.0	K. Sawa
	Akan-ko	Hokkaido	37	July 1927	7.5	7.0	K. Sawa
	Shikotsu-ko	Hokkaido	363	Aug. 1928	7.7	7.4	S. Yoshimura
	Kutara-ko	Hokkaido	146	Aug. 1928	7.1	7.1	S. Yoshimura
	Dôya-ko	Hokkaido	183	Aug. 1928	7.2	7.1	S. Yoshimura
	Ō-numa	Hokkaido	13	July 1928	7.1	6.9	S. Yoshimura
	Tazawa-ko	Akita	425	Aug. 1927	6.7	6.2	H. Tanakadate
	Hibara-ko	Fukushima	30	July 1930	6.8	6.0	S. Yoshimura
	Akimoto-ko	Fukushima	32	Aug. 1930	6.6	6.1	S. Yoshimura
	Chûzenji-ko	Tochigi	166	Aug. 1929	7.5	7.1	D. Miyaji
	Ashi-no-ko	Kanazawa	43	Sept. 1930	6.8	6.5	S. Yoshimura
	Motosu-ko	Yamanashi	133	July 1929	7.4	7.4	D. Miyaji
	Kawaguchi-ko	Yamanashi	15	July 1929	7.6	6.8	D. Miyaji
	Yamanaka-ko	Yamanashi	16	July 1929	7.6	6.8	D. Miyaji
	Aoki-ko	Nagano	58	Aug. 1928	7.1	6.5	S. Yoshimura
	Kizaki-ko	Nagano	29	Aug. 1928	7.2	6.5	S. Yoshimura
	Nojiri-ko	Nagano	38	July 1928	7.3	6.6	S. Yoshimura
	Biwa-ko	Shiga	95	Aug. 1930	7.2	6.8	S. Yoshimura
	Tane-ga-ike	Tottori	13	July 1929	6.7	6.3	S. Yoshimura
	Mi-ike	Miyazaki	92	Aug. 1929	7.5	6.5	S. Yoshimura
	Ikeda-ko	Kagoshima	233	Aug. 1929	7.3	7.1	S. Yoshimura
1 b	Tôro-ko	Hokkaido	7	Sept. 1928	8.8	6.8	K. Sawa
	Hangetsu-ko	Hokkaido	18	July 1928	9.0	6.1	S. Yoshimura
	Takasuka-numa	Saitama	6	Aug. 1928	8.7	7.0	S. Yoshimura
	Suwa-ko	Nagano	7	Aug. 1927	9.3		A. Tanaka
	Koyama-ike	Tottori	9	July 1929	8.8	7.3	S. Yoshimura
	Sumiyoshi-ike	Kagoshima	26	Aug. 1929	8.3	6.5	S. Yoshimura
	Unagi-ike	Kagoshima	56	Aug. 1929	8.0	6.8	S. Yoshimura
	Towada-ko	Akita	325	Nov. 1925	8.0	6.5	H. Tanakadate
2 a	(L. Nipigon) ³⁾	Canada	123	Aug. 1923	8.3	8.0	W. A. Clemens
	(Attersee) ⁴⁾	Austria	170	Oct. 1924	8.3	7.8	O. Haempel
2 b	(L. Mendota) ⁵⁾	Wisconsin	23	Aug. 1920	8.7	7.4	C. Juday
	(Victoria Nyanza) ⁶⁾	Africa	80	Sept. 1927	8.5	7.5	M. Graham
2'	Yashima-ike	Nagano	shallow		4.4		H. Nakano
	Mizoro-ike	Kyoto	3	Aug. 1928	4.1		S. Miki

(the shallow swamp or pond where water plants are growing are excluded from this table)

1) Polluted by the inflowing water containing mineral acids from the volcanic region (subtype 1 a').

2) Small pond in high mountain (about 2500 m), extremely poor in electrolyte.

3) Univ. Toronto Studies. Biol. Ser. **25** (1924), 1-14.

4) Intern. Rev. d. ges. Hydrob. u. Hydrogr. **15** (1926).

5) Trans. Amer. Microscopical Soc. (1924), 178-190.

6) Intern. Rev. d. ges. Hydrob. u. Hydrogr. **24** (1930), 328-357.

It is concluded from the above observations that pH of the lake water in Japan possesses striking features as follows :

1. Nearly all of our lakes lie in volcanic region and they belong to soft water type. The alkalinity is usually less than 20-30 expressed in mg CaCO_3 per liter. No lake of hard water having a considerable size and depth has not yet been discovered.

2. A great number of soft water lakes have a poor production of phytoplankton (oligotrophic lake) ; so the vertical range of pH during the stagnation is small. Some of the deep volcanic lakes have no difference of it even at the depth 100 meters or more !

3. The rapid changes of pH in eutrophic lakes is due to the weak buffer of the water. The pH at the surface becomes very strongly basic and react sometimes 9.0 or more.

4. Some of the lakes in volcanic regions are polluted by the water of the inflowing river in spite of their big capacity of water. Even Inawashiro-ko and Kutcharo-ko with surface extension of nearly 100 sqkm and maximum depth of more than 100 m, are entirely polluted by the inflowing acid water, and their production of phytoplankton is reduced by acidic reaction of water.

5. The lakes on high mountains have weak acidic reactions owing to the complete lack of buffer, for their contents of electrolyte are as poor as 5-10 mg per liter. A single equilibrium of carbon dioxide is held between the air and the water.