Distribution of Salmonella Types in East Asia

1. Distribution of Salmonella Types in the Chinese Continent during the Period from 1937 to 1944

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東亜におけるサルモネラ菌型の分布。1。1937年から1944年に至る間中国大陸におけるサルモネラ菌型の分布。青木義勇，長崎大学医学部細菌学教室

Introduction

The present first report involves (1) experiences in practice got by the group of researchers** represented by the author of this paper, (2) informations obtained in Central China while Y. Aoki was dispatched on additional duty to Hankow and Changsha as one of the heads of Epidemic and Endemic Diseases Prevention Section of Dōjin-Kai, a medical institution for Japanese residents and Chinese sufferers in China proper, (3) those not yet made public by the Epidemics Prevention and Water Supply Corps (EPWS Corps) of Japanese army, and (4) other date picked up from many papers in periodicals published in those days and thereafter in and out of our country. According to these collected data, the author is confident of having outlined a view of Salmonella types distribution originted from human materials in the Chinese continent, partially in southern parts around Singapore and in islands of the Pacific Ocean, during the China Affair and the following Pacific War.

Japanese domestic affairs concerning salmonellosis and their causing agents for about ten years after the war will be stated as the second report in the near future. The review of oversea current literature as well as those domestic one made public since then, will be spared for the next but one occasion in the form of the third report. On the 2nd of last April the author took the chair at the symposium "Salmonella and Shigella Types in East Asia" in the 37th General Meeting of Japan Bacteriological Society (Nagasaki), and was favored with good opportunities to receive instructive data by getting acquainted with some foreign scholars on the one hand, and to collect, read and view world literature on the other hand. Needless to say, those opportunities blessed the author with good occasion to write this serial reports and to prevent, at the same time, many unpublished bacteriological and epidemiological data in the war time and in the following postbellum confusion period from being scattered and lost.

Our personal experiences

The studies of our own were made using 3,629 strains of Salmonella which had been isolated from human sources in the area ranging from Korea to the basin of the Yangtze Kiang in China proper in the years 1937-1944 (R. Aoki, 1938 ; 1941 ; 1950 ; Kuwahata, 1942 ; 1943 ; Shibahara and Yamaguchi, 1948). Some of them were isolated at the juncture of our surveying tour, but the majority were received from municipal isolation hospitals (Korea and urban localities of Manchuria), Dōjin-Kai sanitary

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agencies (China), and Japanese military hospitals (Shanghai and boundary regions of Manchuria). It is quite sure that they were all free from strains of animal origin, for examples Salmonella strains taken directly from rats, dogs, pigs, poultry, etc., while there is no knowing regrecttably whether they were obtained from healthy carriers or patients. As for the isolation from the patients, without obtaining many strains from those at the epidemic occurrence, some few strains were obtained as representatives of them. Most of other strains are understood to have been obtained from sporadic cases.

In the days of R. AOKI's studies on Salmonella strains isolated in Korea (1938) and in the early days of KUWAHATA's studies, the routine typing was carried out by the "practical method" suggested by SHIMOJŌ and SODA in 1936 which had been devised to determine readily eleven common types of Salmonella in Japan including Formosa of those days (SHIMOJŌ, 1936; 1937 ; SODA, KUBOTA and TSUCHIMOCHI, 1936; KUBOTA, 1936). It consists of H agglutination tests with specific sera of *S. typhi*, *S. paratyphi A*, *S. paratyphi B*, *S. typhi-murium*, *S. cholerae-suis*, *S. enteritidis*, and *S. london*, of an unspecific serum prepared with the second phase culture of *S. cholerae-suis*, of biochemical tests for arabinose, xylose, dulcitol, inositol, and rhamnose, and of test for hydrogen sulfide. This method was applicable to all the strains isolated in Korea. But it gradually proved dissatisfactory to us in serological tests with the increase of strains to be classified, and finally were compelled to add four 0 factor sera designated (1,2), (6,7), 9, and 3; six specific H sera containing (f,g……), k, (g,p……), (g,q,u……), (g,q……), and (g,m,q……) factors ; and an unspecific serum (e,n,x) (KUWAHATA, 1943).

By this modification of the typing method, 3,619 out of 3,629 strains, or 99.8% could be identified to be of the following types : *S. typhi* 2,827, *S. paratyphi B* 369, *S. paratyphi A* 330, *S. cholerae-suis* 34, *S. sendai* 17, *S. typhi-murium* 10, *S. enteritidis* 9, *S. stanley* 5, *S. paratyphi C* 5, *S. blegdam* 4, *S. onarimon* 3, *S. thompson* 2, *S. dublin* 1, *S. derby* 1, *S. potsdam* 1, and *S. moskow* 1.

According to the author's principle in his arrangement of the types, in both the arrangement stated above and that of the results obtained by other researchers to be stated in a series in the following, *S. cholerae-suis var. kunzendorf* was not distinguished from *S. cholerae-suis* and *S. thompson var. berlin* was also involved in *S. thompson*. What is more, respective variants of *S. enteritidis* together with those called *danysz*, *chaco*, *essen*, etc., were arranged together simply in *S. enteritidis*. The unification of subtypes like this, however was not always applied to *S. typhi*, *S. paratyphi A* and *B*; the problem of biotypes in *S. typhi* advocated by SHIMOJŌ and some problems concerned with serological minus-variants of the both paratyphoid organisms will be specially discussed in the following chapter.

As seen in Table 1, *S. typhi* in each region is ranking first overwhelming other types. In Korea, 88.1% of strains tested, in Manchuria 79.1%, in North China 65.8%, and in Central China 41.2% were *S. typhi* respectively, while *S. patatyphi B* ranks second in Korea and Manchuria and *S. paratyphi A* similarly in North and Central China. The percentage of *S. typhi* becoming smaller from Korea down to the south of the continent, but on the contrary that of *S. paratyphi A* is remarkably seen becoming larger.

Apart from referring to assortment of the causing agents of paratyphoid, at least the number of typhoid and paratyphoid cases are available from the statistic made public, since, in our country, the cases of these two diseases are legally requested to be notified. The data of the cases covering Japan in 1935-1948, the data concerning former colonies of Japan down to 1940 and other data kept secret of the cases among the Japanese residents in Manchuria and China proper and those within the Japanese army during the wartime specially surveyed are shown altogether in Table 2. Only the statistics within the Japanese navy is limited to numeral of 1907-1937, as it was impossible to be obtained for the period of the wartime. There is a detailed paper of

Table 1. Classification of Salmonella types distributed in each region

Types*	Total (3,629)	Korea (802)	Manchuria (1,971)	North China (169)	Central China (687)
Typhi	2,827	705	1,559	111	452
Paratyphi B	369	87	192	15	75
Paratyphi A	330	4	165	29	132
Choleae-suis	34	1	26	5	2
Sendai	17	2	5	0	10
Typhi-murium	10	0	4	3	3
Enteritidis	9	1	4	4	0
Stanley	5	1	1	1	2
Paratyphi C	5	1	4	0	0
Blegdam	4	0	3	0	1
Onarimon	3	0	3	0	0
Thompson	2	0	0	1	1
Dublin	1	0	0	0	1
Derby	1	0	0	0	1
Potsdam	1	0	0	0	1
Moskow	1	0	1	0	0
undetermined	10	0	4	0	6

* Arranged in order of each total.

Table 2. The ratio of typhoid cases to paratyphoid

Region	Period	Typhoid	Paratyphoid	Ratio*
Japan proper	1935—48	591,037	102,082	5.8
Saghalien	1933—38	3,083	316	9.6
Japanese in :				
Manchuria	1931—36	4,172	1,094	3.6
Central China	1939—42	923	479	1.9
Korea	1925—40	24,814	3,410	7.3
Formosa	1936—40	3,650	241	15.1
South Sea Isl.	1933—37	83	63	1.4
Japanese army	1915—25	1,735	1,120	1.6
〃 inland corps	1940—44	1,790	639	2.8
〃 corps in Manchuria	1940—44	5,448	4,103	1.6
〃 corps in other localities	1940—44	10,747	14,136	0.8
Japanese navy	1907—37	2,329	4,119	0.4

* The number shows each ratio of the number of typhoid cases to that of paratyphoid, regarding the latter number each as the unit.

Y. AOKI and KUWAHATA (1943) as to these statical observations, including a matter of classification of paratyphoid. Comparing the ratio shown in Table 2 with one another, rather a comparatively large number of cases of paratyphoid is seen among the Japanese residents in the South Sea Archipelago, Central China and in the army. Especially in the navy, though with its prewar statistics, the ratio is stated 0.4, that is to say a number of cases of paratyphoid it twice

and a half as many at that of typhoid. This is of course probable because of their more frequent opportunities of going overseas, and it is certainly conceivable that higher ratios of the cases of paratyphoid are to be seen within the army at the fronts other than those in Manchuria. To sum up, it is obviously seen in Table 1 and 2 how the cases of paratyphoid of type A are growing larger in number than those of typhoid with latitude coming down to the south.

In the following, those other types than *S. typhi*, *S. paratyphi A* and *B* are called "the other Salmonella types". The type ranking top among the others was *S. choleraesuis* which was claimed to cause infections of human beings, being carried by pigs in healthy state. This is unanimously stated in all the reports on Salmonella type distribution in Chinese continent, especially the mass occurrence in Manchuria has been reported by KITANO (1942), HAMANO and KOIKE (1942), YAMASHITA, OGATA and MORITA (1943), YAMADA (1943), that in Wuhu, Central China, by SHŌJI (1943) and that in troops stationing around Canton in South China (SUGITO, 1943). It has been also emphasized by HIROKI and by HAMANO which will be mentioned later on. It is a matter of common talk among these authors that clinical symptoms of the disease due to this Salmonella type were much varied, being occasionally typhoid or paratyphoid-like, dysentery-like or food-poisoning-like. As to *S. paratyphi C* belonging to group C together with the type stated here, there revealed a few cases in the research work of the author's group, where YAMADE reported that 4 patients died being infected with this *S. paratyphi C*, all of them developing eruptive typhus-like symptoms; and HAMANO (1951; 1956) reported that they developed multiform symptoms with no uniformity, similar to *S. cholerae-suis* when 89 strains of this type were isolated in Dairen, Tunghua and Hopei Province from 1942 on.

As to *S. sendai*, 17 strains of them were detected and it is to be noticed that comparatively many of them were isolated in Central China. It is generally said that rats are carriers of *S. typhi-murium* and *S. enteritidis*, and that foods contaminated with their excrements give rise food-poisoning. However, detection of these two types were rather few in the research of our own. Other Salmonella types, which are almost common and few in number, will be illustrated in a latter chapter with general consideration. However, isolation of 3 strains of *S. onarimon* is of comparatively rarity, and the author should like to make a remark. This type (antigen formula 1, 9, 12 : b - 1, 2) was discovered by KISHIDA (1940) in Tokyo first, and the second case reported before long by TSURUMI and ANZAI (1940) in the same City. Though one strain was reported in Manchuria by HIROKI, AMAGA and NAGASAWA (1944) and two strains were isolated and reported by HAYAKAWA and SEN (1944), there are no isolation reports as far as the author made researches. HAYAKAWA and others obtained these strains from one soldier with paratyphoid-like symptoms and another soldier with dysentery-like symptoms who had been both taken to the army hospital in Singapore from some district of Burma. The isolation and examination report by one of the co-workers has already been given full perticulars in another English paper of R. AOKI (1949).

Biotypes and variants of the three main types

SHIMOJŌ of the Central Research Institute, the former Colonial Government of Taiwan, Japan, classified first *S. typhi* into eight biotypes (No. 1-8) according to the acid formation in peptone water containing xylose and to the colony size on agar medium and gelatin medium (SHIMOJŌ, 1936), and then adding more types of No. 9-12 basing on SODA's studies (1936) which were considered to correspond to the known special type of typhoid bacillus called by JACOBSON (1910) "*Bacterium typhi mutabile*". As for the keys to this expended classification method, Endo agar, agar medium prepared with Witte peptone and that prepared with home-made Teruuchi peptone were added for use. Though this method is out of practice at present, it made a good topic of Japanese bacteriologists

Table 3. Biotypes of S.typhi by Shimojō's method

Region	Author	Year*	Total	Results of typing						
				Type 1	2	3	4	5	6	the other types
Japanese mainland	Ochiai	1940	405	305	0	1	37	39	0	23
	H. Ogawa	1941	400	281	13	14	11	75	3	3
Korea	Ishihara	1937	102	47	3	6	22	21	0	3
	R. Aoki	1939	100	43	3	4	1	33	10	6
	Ogino et al.	1940	1,111	439	33	114	85	395	45	0
Cantral China	T.Ogawa	1942	327	267	2	10	1	47	0	0
	Shibahara-Yamaguchi**	1948	69	42	1	0	5	20	0	1
	Suzuki et al.	1942	166							
	Iguma	1943	89	64	4	3	0	7	0	1

* Year of publication. ** practised in 1942 in fact.

in those days. According to Kubota, who was one of co-workers of Shimojō and Soda at that time and had stayed to the time of closing of this institutions, the number of *S. typhi* strains collected and examined for many years came to 5,825 in total, namely Taiwan 4,752, Canton 17, Siam 26, Australia 36, Korea 586, and the Japanese mainland 407. The results of this typing was illustrated roughly in the following percentages : Type 1 50%, 5 20%, 2 15%, 6 10%, 4 3%, 3, 7, 8, 9, 10 and 11 each 1%. These data were presented by Kubota in the last symposium(Kubota, 1964).

There are some data obtained by bacteriologists except Shimojō and a party concerned. The results of typing by Ochiai and Naito (1940), H. Ogawa (1941), Ishihara (1937), R. Aoki (1939) Ogino, Watanabe and Kamiya (1940), T. Ogawa (1942), Shibahara and Yamaguchi (1948), Suzuki and Mitani (1943), and Iguma (1943) are as shown by regional groups in Table 3. As seen in this table, Type 1 ranks top in number and comes next Type 5, while the percentages of occurrence of the other types, except only the results of Ishihara at Seoul in Korea concerning Type 4, are possibly remarkably small. With reference to the studies of Shimojō and bis co-workers and successors in Taiwan, the author is of the opinion that the results of typing of *S. typhi* by biological means made no provincialities ; it came to light also that there is no chronological difference in appearance of these types.

In this typing method of Shimojō, xylose reaction of *S. typhi* is considered as one key, while on the other hand, Bommer (1947) in Germany also grouped this organism into three types by each xylose reaction (acid formation within 24 hours, delayed acid formation or no formation), and Jude et Nicolle (1949) in France, collecting 280 *S. typhi* strains from France proper, Algérie, Maroc, Tunisie, Indochine, A. O. F. (Daker), and Nouméa, established biotypes by the method of Kristensen (1938) in accordance with xylose and arabinose reactions and compared the results of each district with each other, but both of them are not with the result worthy of particular description. Besides some researchers made classification serologically in accordance with the presence of Vi-antigen, which also does not confirm the regional differences. As widely accepted at present, the typing in accordance with Vi-phage as the ideal method of confirming the local differences are being investigated the world over and its results being examined.

It is definitely stated in the current Kauffmann-White-Schema (revised in 1961 ; cf. Edwards and Ewing, 1962) that in the type *S. paratyphi A* (antigen formula 1, 2, 12 : a -),there is *var. durazzo* (2, 12 : a -) as its 0 minus-variant, while likewise in the type *S. paratyphi B* (1, 4, 5, 12 : b - 1,2). As for the literature which surveyed natural occurrence of these two variants and which referred to their frequencies under the confirmations of

Table 4. Occurrence of O antigen minus-variants of S. paratyphi A and B

	Author	Origin or gegion	Total	Typical strains	Variant	Percentage of variant
S. paratyphi A var. durazzo	Abe (1942)	Japanese navy	318	308	10	3.1
	Monji (1943)	Japanese mainland	55	54	1	1.9
		Manchuria	57	49	8	16.5
		North and Central China	133	123	10	7.5
	R. Aoki (1948)	Manchuria	85	71	14	16.7
	Nagaki (1943)	North China	76	75	1	1.4
	Hayakawa et al. (1944)	Southern region	770*	762	8	1.1
S. paratyphi B var. odense	R. Aoki (1938)	Korea	87	78	9	11.5
	(1941)	Manchuria	23	18	5	27.8
	(1948)	Manchuria	65	65	0	0
	Yamada (1942)	Manchuria	124	120	4	3.2
	T. Itō (1943)	Manchuria	226	223	3	1.4
	Nagaki (1943)	North China	45	45	0	0
	Sh. Itō et al. (1944)	Japanese navy	75*	63	0	0
	Hayakawa et al. (1944)	Southern region	189**	64	125	195.0

* Five strains with an appearance of R-variant in the case of S. paratyphi A and 3 strains of the same variant in S. paratyphi B were detectable in addition to them above in the table. There could be found among them several strains of S. paratyphi B var. java in the studies by Hayakawa and others. ** Twelve strains var. java also had been found included among the strains examined. As to this variant the author (Y.Aoki) will write once again later on in the present paper.

their existence, a considerable number of papers were available in Japan of those days.

As shown in the upper half of Table 4, *S. paratyphi A var. durazzo* was known detectable in percentages from about 1 to about 17 by all the representative reports of the day. Beside them mentioned in the table, there are, in fact, the papers by OGASAWARA and SHIMIZU(1940)of Nagoya Univesity and of RYŪ (1941) of Manchurian Medical College. The former, however, had used only a few laboratory-strains, and as to the latter's work, it is a matter of great regret that Ryū had used a diagnostic factor serum with little effect, while a large number of isolated strains had been available in Manchuria, so that their data were excluded from our reference.

According to RYŪ 186 strains out of 188 strains were those of this type of variant, *var. durazzo*. When the percentage of *S. paratyphi A var. durazzo* in Manchuria is compared with that in other regions in the corresponding part of the table, the author feels that this variant is somewhat predominant in Manchuria, which would be further confirmed provided RYŪ's work is to be trusted.

Of geographical distribution of *S. paratyphi B var. odense* the author cannot say also anything definite on the question. The results shown in the lower part of Table 4 appear extremely incomplete, while in the work of R. AOKI in the northern boundarries of Manchuria, of NAGAKI in Honan Province in North China and of SH. ITŌ, KUSAKASHI and MOTOYAMA (1944) with the strains collected from the navy in various bases and operation centers, the detection of this variant

in a complete failure, but it was detectable, irrespective of frequency, in others' work, especially it was reported by Hayakawa and others in Singapore that the number of this variant were twice that of the typical strains. The affair is here extremely complicated, as Hayakawa and others have declared in their paper that the greater part of *S. paratyphi B* strains had been isolated from soldiers directly carried from the Japanese mainland or Taiwan.

After all, consideration of geographical distribution of a certain biotype or serological variant in so-called three main Salmonella types is unauthentic. This task is of extreme difficulty, the author thinks. The problems of standardization of the method inclusive of suitability of the materials for diagnosis will be somehow solved. But it is an unavoidable trouble that the party concerned preserves the strains for examination just in the state as have been isolated from infected materials. Of the statement in this chapter, what can be said with certainly is that the majority of *S. typhi* come under the organism, which is readily xylose-fermentative and well-growing type on every isolation medium, namely, the first type of Shimojō, of Kristensen or of Bommer.

Studies of Hiroki and of Hamano

In the Department of Microbiology, Manchurian Medical College in Mukden (Fengtien), studies on Salmonella were going on from the time of Prof. Kitano, and particularly Prof. Hiroki, a successor to Kitano, devoted himself to the studies on the subject. Kitano (1942) reported of the detection and typing results of 484 Salmonella strains originated from men and animals in summary with the cooperation of Hiroki, Yamashita and Kumanishi. Hiroki returned home to Japan in a comparatively short time after the war and got his post in Kagoshima Medical College, and at the 49th General Meeting of the Kyushu District Medical Association opened in 1949 in Nagasaki, he reported, in his special speech, of the classification of 622 strains isolated in Manchuria, 1,019 strains

Table 5. Salmonella types reported by Hiroki*

Types**	Total (1,641)	Manchuria (622)	the other regions (1,019)
Paratyphi A	820	307	513
Paratyphi B	514	207	307
Cholerae-suis	113	59	54
Blegdam	62	14	48
Enteritidis	38	6	32
Typhi-murium	28	13	15
Paratyphi C	25	3	22
Senftenberg	18	0	18
Sendai	5	5	0
Stanley	4	0	4
Onarimon#	4	4	0
Dublin	3	0	3
Derby	2	2	0
Thompson	2	0	2
Potsdam	1	0	1
(failed to note)	2	2	0

* The memorandum taken by Y. Aoki from the special lecture.
** S. typhi is ruled out. # Three strains reported by R. Aoki are supposed to have been taken in.

in sections in China other than Manchuria, presumably chiefly in Hopei Province, of Salmonella other than *S. typhi*. This table of classification of him is as shown in Table 5. HIROKI tried the isolation of Salmonella, in Manchuria, with the cooperation of OGATA, YAMASHITA, ENDO and the others, from rats, pet fowls, cattles in the slaughter house, etc., and they obtained a considerably large number of strains of several types.

But Salmonella types thus obtained characteristic of animals, especially those belonging to the rare types, are not shown in Table 5, so the data put up in this table are conceived exclusively confined to Salmonella strain originated from men.

In April this year, 15 years since, on the occasion of the symposium already mentioned in "introduction" of this paper, HIROKI made public his research results in outline which he obtained in the years gone by. According to him, the collection of strains extended to the whole area of China and covered the period from 1940 to 1950, supposedly inclusive of some strains isolated after the war, and the number of strians collected by him amounts to 3,143 of 26 types. Conclusions of his speech : (1) the frequency of isolation of each type is the order of *S. typhi*, *S. paratyphi A*, *S. paratyphi B*, *S. cholerae-suis*, *S. blegdam*, *S. paratyphi C*, *S. typhi-murium*, *S. sendai*, and *S. meleagridis*, other types being very few ; (2) the fact that *S. paratyphi A* can be isolated in higher frequencies than *S. paratyphi B* in China is the matter conspicuously different from that in Japan ; (3) the high frequency of human infection with *S. cholerae-suis* and *S. blegdam* is noteworthy ; (4) as the isolation frequency of *S. sendai* in China is rather high, this type can not be hastily concluded peculiar to Japan ; (5) *S. meleagridis* has been flequently isolated in China, while it is conceived to be rare in Japan as well as Europe, and the fact that it has been isolated from only carriers is of great interest, and (6) in China, *S. cholerae-suis*, *S. blegdam*, *S. enteritidis*, *S. typhi-murium* are occasionally exhibiting clinical signs which is of quite surprising interest (HIROKI, 1964).

HAMANO was working at the Dairen Health Institute for many years engaging in the study and preparation of diagnostic materials for infectious diseases, and after the war, he was asked to remain at the Institute taken over and reorganized by the Chinese Government, without being admitted to be repartriated longest of all his colleagues, which is to be known by the fact that his own paper in Chinese was published in 1951 from the Institute. He also produced the classification table of Salmonella types relating to human diseases and made it public (HAMANO, 1951; 1956) as quoted in Table 6. In this table, *S. typhi*, *S. paratyphi A* and *B* are not enumerated with figures as these types breaking out universally, while other 1,097 strains in all are shown deviding into four regions with the origin of each type and with the name of individual disease.

As to the data as the foundation of this table, he states that they were composed of reports and literature during the period from 1911 to 1950 and his own research results. The type ranking top among other Salmonella exclusive of *S. typhi*, *S. paratyphi A* and *B*, is also *S. cholerae-suis* amounting to 351 strains, and the number of strains amounts to 475, namely 44% of all the strains, if 124 strains of *S. paratyphi C* which has a close relation with *S. cholerae-suis* considering from the point of antigenic structure, epidemiological and clinical character are included. And next ranks in the order of *S. typhi-murium* 290 (27%), *S. blegdam* 131 (12%), *S. enteritidis* 90 (8.3%), and *S. sendai* 63 (5.3%).

In Changchun, YAMADA was working at the different organization, and he engaged in the studies on Salmonella and other entero-pathogenic bacteria and published several valuable reports (YAMADA, 1943 ; KAMIKO and YAMADA, 1943). MOCHIZUKI and NAGASAWA (1942) in the Isolation Hospital in Mukden reported 175 paratyphoid cases in which the causing agents divided into three types as follows : *S. paratyphi A* 108, *S. paratyphi B* 36, and *S. paratyphi C* 31.

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Table 6. Salmonella types reported by Hamano*

Types	Total (1097)	Lushun-Dairen (37)	Manchuria (287)	Northern, eastern and middle-south China (674)	Taiwan (99)	Origin of the strains (a.g.e. = acute gastroenteritis)
Cholerae-suis	351	10	203	131	7	typhoid-like, icterus, a.g.e.
Typhi-murium	290	2	6	239	43	a.g.e., icterus, fever
Blegdam	131	2	6	123	0	typhoid-like, meningitis, septicemia, dysentery-like, carrier
Paratyphi C	124	20	45	56	3	paratyphoid, dysentery-like, a.g.e., typhus-like
Enteritidis	95	1	11	63	20	a.g.e., icterus, meningitis, typhoid-like, carrier
Sendai	63	0	3	48	12	typhoid-like, carrier
Derby	17	0	2	4	11	a.g.e., dysentery-like, carrier
Stanley	5	0	0	4	1	a.g.e., fever
Anatum	4	2	0	2	0	icterus, a.g.e.
Thompson	3	0	1	2	0	a.g.e., fever
Meleagridis	3	0	3	0	0	carrier
Essen	1	0	1	0	0	a patient with laryngalgia and dysphagia
Typhi-suis	1	0	1	0	0	carrier
Potsdam	1	0	0	1	0	uncertain
Montevideo	1	0	1	0	0	typhoid-like
Newport	1	0	0	0	1	blood of a child suffering from bronchitis
Bovis-morbificance	1	0	1	0	0	a.g.e.
Onarimon	1	0	1	0	0	typhoid-like
London	1	0	0	0	1	carrier
Zanzibar	1	0	1	0	0	a.g.e.
Senftenberg	1	0	1	0	0	a.g.e.
Aberdeen	1	0	0	1	0	a.g.e.

* S. typhi, S. paratyphi A and B, which are ubiquitously observable, are excluded. And here the author re-classified them in the order of the number of isolated strains thereof, while the original table was classified in the different groups basing on the somatic antigens.

tious Diseases, Tokyo University, examined 213 patients when enteritis broke out among colonists in North Manchuria in July 1940, and isolated *S. cholerae-suis* 5, *S. typhi* 2, *S. enteritidis* 2, *S. paratyphi B* 1, and *S. zanzibar* 1 (Kojima et al., 1940).

North and Central China

The author believes basing on his observations performed that(1) *S. typhi* ranks top so far as he has investigated, (2) *S. paratyphi A* is growing larger in number than *S. paratyphi B* with latitude coming down to the south, and (3) what is raning top "the other Salmonella types", namely

the type standing No. 4, is *S. cholerae-suis* in any region. And the last finding expressly emphasized when *S. paratyphi C* is added to *S. cholerae-suis* in the sense of the same C-group organisms.

Comparing now the Salmonella types ranking fifth and below among the data shown in Table 1 (the author's), Table 5 (HIROKI) and Table 6 (HAMANO), it is noteworthy that *S. blegdam*, *S. typhi-murium* and *S. enteritidis*, which are not much to be isolated in Manchuria, have been isolated with comparatively high frequencies in China and other provinces. Furthermore it can be said that *S. se dai* should be added to thee types making a reference to HIROKI's opinion stated in the latest symposium. However, judging from the scope of working of HIROKI and HAMANO in those times, it may be understood that the scope is extending to only four Provinces of North China, namely Hopei, Hanan, Shantung, and Shansi Province, and their data have not been obtained enough from Yangtze Kiang valley and so-called Shanghai-Nanking area. Such being the case, the Salmonella situation in North and Central China is to be stated in the following with reference to the data available from the papers and informations of other institutes.

The statistics on Salmonella types in Chinese continent covering the period from 1937 to 1944 seen from Table 7, in which the data made already put into Table 1,5 and 6 have been excluded. As to the situation in North China the occurrence and frequencies of each Salmonella type is a mere repetition of what the author has known from the report of HIROKI and of HAMANO. There are two trustworthy classification results obtained by NAGAKI and UMEMOTO in EPWS Corps using numbers of strains. UMEMOTO, who was stationed at Peking, collected 842 strains from military hospitals and EPWS Corps attached to task forces in the mentioned northern four provinces in China, and classified "the other Salmonella types" into *S. blegdam* 20, *S. cholerae-suis* 13, *S. paratyphi C* 12, *S. enteritidis* 6, *S. typhi-murium* 4, *S. sendai* 2, and *S. dublin* 1. NAGAKI was in the survice of the stationing at Chengchow or Kaifeng in the banks of Hwang Ho, the author supposes. The strains isolated in and around Suchow may have been contained in his test-strains, judging from the jurisdiction of operation unit.

In addition to these, it is worth mentioning that from Peiping Union Medical College some instructive reports have been presented by Chinese scientists for asserting the existence of *S. enteritidis* and the possibility of its invasion by a parenteral route (LIU, Z'A and CHUNG, 1937 ; LIU, 1938 ; CHUNG and CHANG, 1939) . It is a matter of great importance from a clinical and epidemiological standpoint that relapsing fever patients complicating Salmonella infection had taken a turn for the worse, and that body lice obtained from the patients harbored *S. enteritidis* as well as Borrelia, a causing agent of relapsing fever.

As regards them in North China, in addition to the above, there is the report by HUANG et al. (1937) on treating 17 cases of systemic infection of *S. enteritidis* who were all beggars, 9 out of 17 having been complicated with relapsing fever and 2 with meningitis, and ultimately 10 of them died.

In the same meaning it is a matter of being respected that the branch of the Pasteur Institute in Shanghai continued its research work, keeping aloof from the war disasters and even in the time the China warfare being expanded to the inside of China, and left many useful reports. Its collection of strains to be tested was limited in and around Shanghai, as a matter of course, and the number of strains was not so large, only the case reporting being its main task. However, it is to be highly evaluated that the institute engaged in detailed clinical observations as to the patients in cooperation with missionary hospitals conducting to the solution of pathogenicity of the main Salmonella species existing in this district. The representative French researcher FOURNIER reported of cases of septiemia due to *S. cholerae-suis* in 1939 and that due to *S. enteritidis* in 1942, both in Shanghai ; and in 1949, 1950 and 1951, through serological typing of *S. enteritidis*, he reported under joint signature of Chinese doctors of many

Table 7. Salmonella types in Chinese proper
(The data recorded in Table 1, 5 and 6 excepted)

Region	Year*	Informant	Total of strains	Results of typing**			
				Typhi	Para-A	Para-B	the other Salmonella
North China : Tsingtao	1938—39 (1940)	Dōjin-Kai	46	31	14	1	
Tsingtao	1942—43 (1943)	Ogawa-Satō					Cs 4, Bd 3, Tm 1
Tientsin	(1945)	Murakami et al.	110	47	16	38	Para-C 2, Et 2, Tm 2, Sd 2, Cs 1
Shihkiachwang	1941—42 (1943)	Nakashima					Para-C 4
Honan Prov.	1939—40 (1943)	Nagaki	250	106	77	46	Cs 13, Et 7, Bd 1
Every part	1939—40 (1944)	Umemoto	842	424	230	130	Bd 20, Cs 13, Para-C 12, Et 6, Tm 4, Sd 2, Dublin 1
Central China : Wuhan	1938 (1942)	M. Itō	148				Et 62, C-group 12
Wuhan	1938—40 (1941)	Mizokami	68				Bd 50, Et 18
Wuchang	(1941)	Ishiyama	401	169	194	11	Et-group 20, C-group 7
Hankow	1940—43	Dōjin-Kai	756	122	290	222	Et-group 90, C-group 32
Hangchow			13		7	5	C-group 1
Suchow			20		2	12	undetermined 6
Nanking			114		82	29	undetermined 3
Wuhu			67		58	8	C-group 1
Kingkiang			26		15	6	undetermined 5
Nanchang			7		5	2	
Anhwei, Kingsu and Cheking Prov.	(1943)	Iguma	176	84	88	0	Et 3, Para-C 1
Wuhu	1941 (1942)	Shōji					Cs 80
South China : Canton	1939 (1940)	Kubota	43	17	23	0	Cs 2, Sd 1
Every part	1939—41 (1942)	Satō					Sd 33
Canton, Nanning	1939—41 (1944)	Satō					Bd 85, Et 72
Canton	1940—41 (1943)	Sugito	566	367	129	0	Para-C 47, Et 23
Canton	1941 (1943)	Mizokami et al.					Tm 122
Every part	1940—42 (1943)	Komori	162	50	45	13	Bd 19, Cs 12, Et 11, Para-C 7, Sd 4, Stanley 1

* Year of actual working (publication year is parenthesized). ** Abbreviations of the other Salmonella types : Cs····· Cholerae-suis, Et····· Enteritidis, Tm····· Typhi-murium, Bd·····Blegdam, Sd·····Sendai.

infection cases due to *S. blegdam*. And they summed up the types of Salmonella and clinical symptoms caused by these organisms (FOUNIER, 1949). It is a great regret for us Japanese bacteriologists and researchers of infectious diseases to have had no opportunity to read there informations in original papers and especially the monograph published by FOURNIER under joint authorship with RAYNAL (RAYNAL et FOURNIER, 1945; 1947).

FOURNIER attached most importance to *S. blegdam* as the causing agent of epidemics of salmonellosis in Shanghai area (typhoid and paratyphoid being excluded), and states in summary as follows: *S. blegdam* is closely related to *S. enteritidis*, if not a variant of this organism. In the Far East it occurs frequently than *S. enteritidis*. In man it causes severe septic conditions, often secondary to the infections and frequently complicated by suppurations, especially in young inividuals. The organisms has been isolated from rats and small rodents in Shanghai; the animal infection is always a septic type.

What first surprised the Sanitary Department of the Japanese Central China Army was the fact that undernutrition has brocken out by thousands on the one hand (YOSHIKI, 1940), and that many soldiers contracted a febrile disease which turned out before long to have been due to mainly *S. enteritidis* or an organism of this kind (*S. blegdam*) on the other hand, in the time of the Japanese attack towards Woochang and Hankow (Wuhan) in the autumn of 1938. MIZOGAMI (1941) isolated these causing agents from 37 cases of febrile patients, 2 cases of healthy persons, and 1 case from a patient with cholera-like symptoms immediately after the termination of this local war, in Hankow. He could obtain scores of strains in addition and classify them as follows: *S. blegdam* 50, *S. enteritidis var. chaco* 16, and ditto *var. moscow* 2 (in Table 7 recorded the latter two simply as *S. enteritidis* 18).

M. ITŌ (1943) engaged at the military hospital of Nangking Operation Base in the treatment of a large number of febrile patients sent back from the field of Wuhan operation and obtained 148 strains belonging to Salmonella. 62 strains of them were identified to be *S. enteritidis*, 58 strains of which were those obtained by blood culture. Besides them, there were 12 strains belonging to C-group of Salmonella. According to him, no bacterial cultures of this kind having been isolated from the patients back from other field, the chief causes of outbreak of this disease are considered to have been due to those facts: comparatively dense distribution of bacterial species of this kind in the Wuhan district; severe shortage of provisions and physical and mental rest on account of a forced march and furious battles and consequenlty indisposition of health conditions; complication with other diseases in addition; ultimately lowering of natural resistance against bacterial invasion.

It was an undisputed fact that in Wuhan operation a large number of salmonellosis due to *S. enteritidis* or *S. blegdam* as well as the mentioned undernutrition occurred and these affair seriously lowered the war potential. Nevertheless, the papers about them reported by Chinese scholars in Peiping or studies by FOURNIER and others in Shanghai are not to be found quoted in those reports by Japanese army surgeons. It could not be helped as the latter's studies were not made public at that time, but the reports by LIE (1937) and HUANG et al. (1937) should naturally have been referred to for notices and warnings given to surgeons on the front.

It is a matter of much interest that, during the period from 1940 and on, when occupation of Wuhan and its neighboring areas has reached a stage where various kinds of supply especially food situation turned better in the Japanese army stationing there, isolation rate of *S. enteritidis* or of *S. blegdam* inclined decreasing, while *S. paratyphi A* was mainly detectable and occasionally a small number of C-group organisms were isolated. This is to be well accepted through Table 7 indicating investigation results by the Epidemic and Endemic Diseases Prevention Section of Dōjin-Kai in Hankow and through IGUMA's report (1943). IGUMA, at the Military Medical College in Tokyo,

contrived classification with accurate serological biological methods of 176 strains sent from the stationing corps in three provinces along the lower reaches of Yangtze Kiang and obtained following results: S. *paratyphi A* 88, *S. typhi* 84, *S. enteritidis* 3, and S. *paratyphi C* 1. The results of KUWAHATA (1942) using 412 strains collected in Shanghai and Nangking area in 1940-41, 169 strains in Wuhan in 1941, and those of SHIBAHARA and YAMAGUCHI (1948) as to 106 strains obtained in Wuhan in 1942 are also other data which prove this consideration to be rational. Their classification figures shown in rightmost space of Table 1 have been made up of these data. To sum up the author's opinion, in rather peaceful periods the Salmonella situation had no greater difference even in Central China than that in North China.

This peaceful time was temporal. In June 1944, the military operation against Hunan Province was opened, marching rapidly along bad roads crossing over mountain between Yochow and Changsha, partly extending farther towards Shaoyang and Hengyang and occupied Changsha in one month or so. In this period with fierces air raids by Chinese and American Air Forces against supply lines, the supply could not be kept on satisfactorily and with the addition of the consumption of physical strengh due to the summer heat, there broke out a large number of sick and wounded showing a variety of clinical signs.

The author, as one of civilian doctors taking several assistants, technicians and nurces with him, went to the front with the reduction forces. Possible medical treatments were applied to the soldiers fell down by the roadside. We obtained examination materials as fas as possible at this time, made cultivation and arrived at Hsinsih on July 9th. The party engaged without delay in detecting causing agents and in sero-diagnosis at the field hospital laboratory there. But unfortunetely one technician was seriously injured and all of the outfit of bacteriological examination including test-materials were lost by the air raid and by the fire in succession on the next day. After arriving at Changsha, the author and others were obliged to engage in traveling medical treatment of Chinese refugees, which was of quite other job to him, in and around Changsha down to December 1944.

A considerable number of salmonellosis can be imagined to have been detectable among those sick and wounded soldiers during this operation too, but the scientific evidence to support it could not be entirely acquired.

Salmonella types in South China

What was perfromed first in Canton was that by KUBOTA (1940). In 1939 he was despatched from Taiwan to Canton and isolated 43 strains of Salmonella, and classified them into *S. paratyphii A* 23, *S. typhi* 17, *S. cholerae-suis* 2, and *S. sendai* 1. SUGITO (1943), who engaged chiefly in statistical and clinical observation of typhoid and paratyphoid at an army hospital in Canton during 1940-1941, classified 566 patients into 367 cases of typhoid fever, 129 paratyphoid of A-type, 47 of C-type and 23 cases of salmonellosis due to Enteritidis group organisms. It is noteworthy that the paratyphoid of B-type was not seen at all in his report together with that of KUBOT 's, though SUGITO's description as regards bacteriological findings was too simple and it could not fully convince KOJIMA (1944) of his diagnosis. KOMORI of the Army Medical College, Tokyo, classified 162 strains of Salmonella sent from each corps and hospitals stationing in South China into *S. typhi* 50, *S. paratyphi A* 45, *S. blegdam* 19, *S. paratyphi B* 18, *S. cholerae-suis* 12, *S. enteritidis* 11, *S. paratyphi C* 7, *S. sendai* 4, and *S. stanley* 1. His classification result is rich in variety compared with that of the other two informers above. The result like this might well be due to the fact that typical, special or unidentifiable ones are likely to be chosen when specimens are sent from the front to the diagnosis center.

Judging from the three reports above, it might be positively conbinced that among three main types in South China, *S. paratyphi B* was almost nought or scarce, while *S. paratyphi C* or *S. blegdam* was ranking third. However, SUGITO's diagnosis

of *S. paratyphi C* and Enteritidis group organisms being considered performed bacteriologically with little justification, as stated before, there is possisibility of inclusion of *S. cholerae-suis* in the former and of *S. blegbam* in the latter group, therefore it may safely be said that the type ranking third should be *S. cholerae-suis*, *S. blegdam* or *S. enteritidis*.

The researchers who studied bacteriologically and epidemiologically exclusively only on the Enteritidis group on the one hand, and on *S. sendai* on the other hand was SATO (1942 ; 1944). He managed, from May 1939 on in Kwangtun and Kwagsi Provinces inclusive of northern part of French Indo-China, and classified 157 strains of Enteritidis group into *S. enteritidis* 72 and *S. blegdam* 85. According to him most of the strains were obtained by blood culture mostly from patients manifesting typhoid-like and rarely dysentery-like symptoms or jaundice. Next, SATO's report as to 33 strains of *S. sendai* collected from every corner of South China gives an impression on the auther that this type was widely but comparatively scarcely distributed in Chinese continent in general ; it appeared sporadically for the most part, but there was a case of small-scale mass outbreak in a corps. MIZOGAMI et al. (1943) reported also outbreaks of food-poisoning due to S. *typhi-murium* twice in corps sationing in Canton in March and in July, 1941. Both SATO and MIZOGAMI practiced their detection from normal carriers other than patients and exmination on Salmonella organisms isolated from rats, ducks, pigs, etc. It is greatly worth notice that *S. cholerae-suis* was isolated from 53 among 676 pigs (approximately 8%), while the carrying rate was considerably low in rate among rats and ducks.

To sum up again, in South China, *S. paratyphi B* was extremely scarce and each of *S. cholerae-suis*, *S. blegdam* or *S. enteritidis* was ranking third according to the local conditions including military affairs, and the author has a feeling that this tendency became significant as the war came near its end.

Another problem becomes here the topic. It is a matter of interest that KOMORI isolated 4 strains of *S. paratyphi B var. java* mixing among 13 strains of *S. paratyphi B* sent from Canton. This organism, as stated in the footnote of Table 4, was detected by Sh. ITŌ, KUSAKASHI and MOTOYAMA (1944) of the navy from sailors onboard warships and from those of the bases, and it was also isolated in several number of strains by HAYAKAWA and SEN (1944) in Singapore. It was first isolated by De MOOR, in Java in 1935, from a case of acute gastroenteritis and was named as above by KRISTENSEN und KAUFFMANN (1937). Later on down to 1958, it was not distictively registered in Kauffmann-White-Schema, but it has been officially registered as an independent type named *S. java* in the current schema, which was revised in 1961 (EDWARDS and EWING, 1962). Its antigen formula is 1, 4, 5 :b - (1, 2), which is quite the same with *S. paratyphi B* excepting the point of carrying parentheses in the second phase.

Appendix : On Salmonella types in Taiwan (KUBOTA. 1964).

The classification of 5, 054 Salmonella strains worked out by the Hygenic Laboratory, Central Institute, Taiwan Government (it was abolished at the war-end) during the period from 1929 to 1940 is as follows : *S.typhi* 4, 753, *S. paratyphi A* 178 *S. typhi-murium* 34, *S. sendai* 30, *S. cholerae-suis* 17, *S. paratyphi B* 13, *S. derby* 11, *S. enteritidis* 9, *S.paratyphi C* 6, *S. stanley* 1, and *S. senftenberg* 1, aud *S. london* 1. They were all of human origin.

Studies of Hayakawa and of Fujino

The only previous report in those days as regards Salmonella types in the southern occupied area by the Japanese army was so far DeMOOR's work (1935) in Djakarta, Java, in which he had classified 72 Salmonella strains isolated here into *S. typhi-murium* 22, *S. cholerae-suis* 9, *S. newport* 9, *enteritidis* 8, *S. paratyphi B.* 7, *S. derby* 5, *S. stanley* 2, *S. hvittingfoss* 2 and 8 other indistinct strains.

The EPWS Corps of the Japanese South Army was established in the quaratine station when Singapore was occupied by Japanese Army early

in 1942, and it was one of its main tasks to examine all sorts of infectious agents isolated from the patients and carriers at the time of medical inspection and examination, to diagnose diseases using patients' materials and to identify isolated strains sent from hospitals in bases and front lines. Hayakawa (Hayakawa et al, 1944 ; Hayakawa and Sen, 1944 ; 1945) particularlly interested in Salmonella and favored with capable men, especially a native W. K. Sen, M. B. under his charge, could manage during the period of April 1943 - March 1945 to classify 1,210 Salmonella strains collected from Java, Indo-China, Siam, Malaya, Philippines, Sumatra and Taiwan as shown in the following : *S. paratyphi A* 775, *S. paratyphi B.* 192, *S. typhi* 178. *S. paratyphi C* 23, *S. oslo* 11, *S. sendai* 7, *S. enteritidis* 6 *S. cholerae-suis* 3, *S. onarimon* 2, *S. stanley* 1, *S. chester* 1, *S. bareilly* 1, *S. moscow* 1, *S. blegdam* 1, *S. london* 1, *S. poona* 1, *S. hvittingfoss* 1, and as new type strains S. naungkangyi 2, S. tikusi 2 and S. shonan 1.

What ranks top is S. *paratyphi A* occupying 64.05% of all the strains and the second is *S. paratyphi B* (occupying 15.87%) and the third is *S. typhi* (14.71%), the top being far higher of the two following it. As already noted in the chapter "O antigen minus-variant", the majority of *S. paratyphi B* strains is those isolated from patients or carriers who directly moved there from the Japan proper and Taiwan, which distincly showed that this type was not so much native in the south area. In reality what is to be regarded as most important, similarly in Central and South China, is *S. paratyphi A* and next comes *S. typhi*, while *S. paratyphi C* though ranking fourth is less than in the Chinese mainland including Manchuria and *S. cholerae-suis*, being only 3 strains (0.25%), is quite out of the question. Thus it has been disclosed by the studies of Hayakawa and others that not only with a large difference in frequencies of those types ranking the first to the fourth but also in the order and frequencies ranking the fifth and below than those in other areas. That different consideration should naturally paid to preventive measures of salmonellosis, vaccine and sets of diagnostic sera for this kind of diseases, was another conclusion of this work.

Of the results of Hayakawa and Sen (1944; 1945), what has been once reported as new types of Salmonella are (1) S. naungkangyi (1, 9, : g, w -) isolated by Fujino and others (Fujino et al., 1944 ; Fujino, Kimura and Takaki, 1948) in northern Burma, (2) S. tikusi (1, 3, 19, 25 : g, s -), and (3) S. shonan (6, 7 : k - e, n, x) isolated by Hayakawa and Sen (antigen formulae in parentheses being the originals roported by the authors at that time). After the war, these three specimens were sent to the Salmonella Reference Laboratory, England through the good favor of Col. Stuart-Harris, dispatched officer from the National Institute in England, to the Vaccine and Serum Institute, King George VII Medical College, Singapore where Hayakawa was then being asked to work. At the mentioned Laboratory the S. naungkangyi was identified as *S. blegdam.* Only S. shonan was determined as a new type, and sent to P. R. Edwards, U. S. A. after receiving Joan Tayler's approval, where today its name has been converted to *S. singapore* and has immediately been registered in Kauff mann-White-Schema (Hayakawa, 1946). As to S. tikusi, its subsequent examination results are not known, but as it can simply be considered as a variant of *S. senftenberg* (1, 3, 19 : g, s, t, -) it is conceivable that the Salmonella Center held the same view.

In the current Kauffmann-White-Schema(1961) we can find *S. singapore* as one of new types discovered by Japanese during the war time inclusive of *S. onarimon* discovered by Kishida (1940) in Tokyo. Thus the number of Salmonella types discovered by Japanese came up to five in addition to those three types already registered, i. e. *S. sendai*, *S. mikawashima* and *S. narashino*, and at present came up to seven including *S. mivazaki* and *S. nagoya* discovered and officially recognized later on.

S. singapore was isolated by KASAHARA, a health officer, in a certain army hospital in Singapore from one soldier's feces. The patient was attacked suddenly with fever of 38.7°C complaining of an abdominal pain with watery diarrhoea of four-times in the day on December 6, 1943, and on the following day, only his high fever remained, but it gradually came down to the normal temperature on the third day, and it was not long before he completely recovered.

That HAYAKAWA and others could isolate 11 strains of *S. oslo* and one *S. chester*, *S. bareilly*, *S. poona* and *S. hivittingfoss* each, is of a great significance, though they were extremely few excepting *S. oslo*. Of them above, *S. bareilly* and *S. poona* were first detected is India, while others are those existing is Europe. It is thus conceivable that Salmonella affairs of the world are subject to the transfer of population.

FUJINO of Osaka University was working at that time as a low-grade medical officer at one detached corps of the EPWS Corps in Maymyo near Mandalay, Burma. The classification of Salmonella strains obtained by blood culture by him with his men November 1944 at the hospital there is : *S. paratyphi A* 54, *S.* nanngkangyi (in reality, *S. blegdam* as stated before) 16, *S. bareilly* 12, *S. worthington* 9, *S. typhi* 7, and 6 strains of S. maymyo (18 : y, m, n -) tentatively named by him (FUJINO, KIMURA and TAKAKI, 1948). And on another occasion various types of Salmonella were isolated by blood culture from 17 patients hospitalized who were tentatively diagnosed "war malaria", being sent back from the front at the time of Imphal operation. And else 2 strains of *Staphylococcus aureus* and one strain of *Alkaligenes fecalis* were isolated (FUJINO et al., 1944). It was to be obviously accepted that a considerably large part of diseases with undetermined causes should be due to Salmonella, in such an occasion as of the tragic defeat in Imphal. Just like in Wuhan operation and in Hunan operation in Central China, when physical defence is extremely lowered on account of utmost shortage of food supply, extreme exhaustion and of complication with other diseases, etc., it might well be said that Salmonella types which possess not so much pathogenicity in usual times for man are able to cause serious systemic infection.

As to other continental regions than those above, no reports concerned in Indo-China during the war time have so far been found at all.

After the war, one report was available being issued by JUDE et LEMINOR (1948) of the Branch Office in Saigon, the Pasteur Institute.

According to this report, 27 strains out of 42 strains isolated were *S. typhi* and the others were .*S paratyphi A. S. choleraesuis* and *S blegdam*.

Islands of the Pacific

In this section no systematic study has been done by Japanese excepting the report of HAYAKAWA and others which deals with a few strains collected from Java, Sumatra and the Philippines, of ABE (1942), and of Sh. ITŌ KUSAKASHI and MOTOYAMA (1944) at the Naval Medical College in Tokyo. The detection and study was presumably done to some degrees, but, the author thinks, it was denied the researchers the results on paper. On the other hand, there are some reports in the American army field research institutions, for examples report as to Salmonella affairs in the Mediterranean Theater, especially in Italy, by the 15th Medical General Laboratory (BRUNER and JOYCE, 1947) and that in the islands of the Pacific (Hawaii, Mariana, Guadalcanal, Iwōjima) by the 18th M. G. Laboratory (LINDBERG and BAYLISS, 1946), the latter being of greater value. Besides them above, CARLQUIST (1947) medtioned briefly S. chiba, S. nipponbashi, S. yodobashi, S. kanda, S. taihoku, *S. singapore*, S. iwō-jima, S. oahu, S. saipan as reported Salmonellas from the Pacific, but, as mentioned already, the only one officially registered type was *S. singapore*.

There are reports available else as to the

Table 8. Salmonella types ranking from the first to the tenth encounted by the 15th and 18th Medical General Laboratory, U. S. Army

Organization (Location and period)		The 15th M G L in Naples, Italy 1944-45			The 18th M G L in the Pacific area 1944-45		
Total		32 types, 1,007 strains*			31 types, 202 strains**		
Ranking of occurrence	1	Typhi	300	30.0 %	Oranienburg	55	26.2 %
	2	Oranienburg	187	18.7 %	Typhi-murium	27	13.7 %
	3	Montevideo	119	11.9 %	Anatum	23	11.4 %
	4	Paratyphi B	98	9.8 %	Montevideo	22	10.9 %
	5	Tennessee	58	5.8 %	Typhi	9	4.5 %
	6	Typhi-murium	51	5.1 %	Paratyphi A	8	3.9 %
	7	Meleagridis	44	4.4 %	Enteritidis	7	3.5 %
	8	Napoli	31	3.1 %	Newport	6	3.0 %
	9	Give	21	2.1 %	Litchfield	5	2.5 %
	10	Cholerae-suis	20	2.0 %	Weltevreden	4	2.0 %
The remainder		22 types, 78 strains (7.8%)			21 types, 36 strains (17.8%)		

* Number of isolated and examined strains, not of cases.
** Strains of animal origin excluded.

existence of *S. blegdam* in the Philippines by Kunsell and Stevens (1946) and in New-Guinea (Jones and Fenner, 1947). However the author has no opportunity of reading the report of Dick (1946) as to enteric group fevers in the Middle East Forces and a serial reports on the occurrence of Salmonella types in Australia and Queensland (Atkinson and Woodroofe, 1944 ; Atkinson, Woodroofe and Macbeth, 1944 ; 1947 ; 1949 ; Mackerras and Mackerras, 1949).

The reports by the 15th and 18th Medical General Laboratory were summed up by the author as shown in Table 8. In this table, predominancy of *S. oranienburg*, *S. montevideo*, etc. are remarkable, though *S. typhi* ranks top in Italy in 30 per cent, it ranks fifth (9%) in the Pacific. *S. paratyphi A*, most significant all over Chinese continent, is ranking below tenth in Italy and sixth even in the Pacific. On the other hand, though not indicated in this table, comparing 155 United States soldiers with 20 prisoners of war, either Japanese or Koreans, *S. oranienburg* and *S. montevideo* were detectable exclusively from American soldiers, while *S. typhi* were detectable from only two cases among 155 soldiers and it was detectable from 4 cases among 20 prisoners. And only one strain of *S. paratyphi B* was detectable from the whole of the former, while it was possible in more number from the latter.

In 1950 Dunlop in the Pasteur Institute, Bandung, Indonesia, reported on his isolation of *S. sendai* from eight patients showing distinct typhoidal symptoms. This type of Salmonella is considered to be widely but not so densely distributed in East Asia. The author cannot say anything definite on the question whether this is a type indigenous to the soil of Indonesia or not.

Summary

Every one believe in our land that the celebrated "Hamamatsu Incident" found an

occasion to promote in general the study of salmonellosis as the problem of public health, and of Salmonella types related to diseases of this kind. There occurred at a certain middle school in Hamamatsu City, Shizuoka Prefecture, food-poisoning amounting thausands (according to the offical statistics, 2,201 persons suffered from it within a definite of time, among them 45 persons died) among pupils and members of their families all at once from the very night to the next day, a sport day, May 10, 1936. It was referable to rice-cakes suffered with redbeam-jam (Daifukumochi) which had been degraded by contamination of *S. entertidis*, and the cases were reported one after another from the pupils, home and other places, owing to the fact the school authorities allowed the pupils to take the cakes home as present on the one hand, and that the confectionary at where the cakes were made kept them for sale on the other hand (MURASHIMA, KITAHAMA and HARA, 1936; IDE, 1936 ; KOJIMA et al., 1937). It brought a panic to the standing regiment here, too. It happened to be a leave day for a certain circle of soldiers off duty ; some of them bought the cakes at the confectionary above, ate them there or in other places, and were attacked by food-poisoning of the same type. The Institute for Infectious Diseases attached to Tokyo University, the Sanitary Division of the Ministry of Home Affairs, and the Army Medical College in Tokyo attached great importance to this case and dispatched a respective group of capable research workers. A wide rumor in circulation about the source of this incident, might have authorities to make an exhaustive investigation and study. To the best of the author's belief, in any case, many specialists in Salmonella study appeared one after another taking this opportunity, especially among Japanese Surgeon Corps, from that time on.

This "Hamamatsu Incident" reminds the author of his description in the text as to an origin of mass outbreak of *S. enteritidis* or *S. blegdam* septicemia amog Japanese soldiers, in which he gave special weight to lowering of systemic resistance in the host as the results of consumption of physical strength. We cannot possibly explain the affairs of Hamamatsu in that light, but this much be certain, that the disease in Hamamatsu belongs to the typical gastrointestinal form of salmonellosis from clinical and epidemiological points of view, and it is well known that blood culture was not successful as far as the cases examined by KOJIMA and his co-workers. In addition, it deserves full consideration, every one of the persons concerned believes, that Hamamatsu Insident was ascribable to oral infection with the organisms of a pretty extensive dose, accordingly there were some patients of secondary infection as the unusually case of food-poisoning of this kind.

It is a established theory at present that all infection phenomena occur under control of the "host-parasite-relationship". To the comparison of the explanation of the cases in Hamamatsu and on battlefield each other, this relationship should be applicable, of course. To author's regret, but he is unable to have his further discussion in this paper.

The recollection of late Prof. Saburo KOJIMA (1888-1962), who was taking charge of the 4th Laboratory in the Institute for Infectious Diseases mentiotioned above in those days and after the war he was appointed the director of the National Institute of Health of the Welfare Ministry as his last but very responsible position, is always sticking to the minds of all Salmonella researchers in Japan. He took for a leadership in Salmonella study of army circles or of non-military bacteriologists in our country, keeping contact constantly, though interrupted at one time, with International Salmonella Centre, Copenhagen.

In 1940 a notable book "The Causative Organisms of Food-Poisoning" was pudlished under joint authorship with Sadayoshi HATTA, and in the last stage of the war (May, 1944) a review "Recent Studies on Salmoella in East Asia" written by KOJIMA appeared in the Japanese Journal of Bacteriology, in which all important

studies of Japanese researchers up to that time have concisely been introduced.

The present report of Y. AOKI has in the main points common with KOJIMA's review, but it can be said that the former is characteristic of the following points : (1) written in English, while the papers in those days were written all in Japanese, of course without abstracts of foreign texts, (2) inclusion of unpublished data of the EPWS Corps of the Japanese army and of Dōjin-Kai, on the one hand, and of oversea literatures which came to hand after the war, on the other hand, (3) reference to special cases, for example, the mass outbreak of septicemia due to *S. enteritidis* or *S. blegdam* at the time of desperates or the defeat, which could not be concretely explained in those days.

The data mainly available for this report were the results obtained by systematic studies of HIROKI, HAMANO, NAGAKI, UMEMOTO, IGUMA, KOMORI, HAYAKAWA and of the author including his co-workers. In addition a number of reports recorded in Table 7 were served as reference as occasion called for. It can naturally be considered that among these data, especially those dealt with salmonellosis occurring in the same area and at the same time there were something duplicated. But, as it was almost impossible to trace each of the strains used by them further to its origin, the author asks the reader's excuse for his handling of the data in this way.

The conditions of Salmonella types and distributions of them in East Asia in the period corresponding to the Japan-China Incident and the following Pacific War were observed from a birds-eye view of these data. The main results of observations can be expressed as follows :

(1) *S. typhi*, *S. paratyphi A*, *S. enteritidis*, *S. bleg dam*, *S. cholerae-suis*, *S. paratyphi C*, and *S. sendai* were Salmonella types existing any where in the occupied areas by the Japanese army in those days. In addition, besides. *S. paratyphi B*, following types were found, though in a small numfer or alone : *S. java*, *S. stanley*, *S. chester*, *S. derby*, *S. oslo*, *S. typhi-suis*, *S. montevideo*, *S. singapore*, *S. potsdam*, *S. bareilly*, *S newport*, *S. bovis-morbificance*, *S. zanzibar*, *S. dublin*, *S. moscow*, *S. anatum*, *S. meleagridis*, *S. zanzibar*, *S. aberdeen*, *S. poona*, *S. washington*, and *S. senftenberg*.

(2) *S. paratyphi B*, one of the common types in Japan, Korea, Manchuria and North China, could scarcely be found in and around Canton. This type was comparatively few in Central China, very few in Taiwan. And the majority of this type of strains found in Singapore by HAYAKAWA and SEN was said to be the organisms originated from soldiers who directly moved here from Japanese mainland or Taiwan.

(3) *S. paratyphi A* was growing larger in number with the latitude coming down to the south. It was close to *S. typhi* in the percentage or ranked top sometimes in the sourthern areas. The superiority of *S. paratyphi A* in lands beyond the sea could also be known from the statistics of the Japanese navy.

(4) *S. typhi* was a type of importance as usual. The epidemiological significance of typing of this organism by SHIMOJŌ's method was investigated by some researchers, but there was no clear evidence for the distribution of a definite biotype in a certain region. As to differences in their geographical distributions of *S. paratyphi A var. durazzo* and *S. paratyphi B var. odense* from their original serotypes respectively, the results were not satisfactory enough to arrive at the conclusion.

(5) As to *S. paratyphi B var. java*, another kind of variant, it leaves room for consideration. It was detectable only by the workers of the Japanese army and by HAYAKAWA and SEN in Singapore, though small in number. in Java, as everybody knows, it was found by DE MOOR in 1935, and it is noteworthy that this organism has been registered in the revised Kauffmann-White-Schema (1961) as a type separated from *S. paratyphi B*.

(6) *S. cholerae-suis*, *S. paratyphi C* and *S. sendai* had been distributed in all areas surveyed in this study, but in lower rates than *S. typhi*, *S. paratyphi A* and *B* respectively in the north of Chinese continent, and than *S. typhi* and *S. paratyphi A* in the south.

(7) *S. enteritidis* and *S. blegdam* were likewise. But it must be emphasized that they could have caused severe septicemia among remnants of defeated Japanese soldiers or those tired out in marching or in action, for example. The disease of the same type has been reported also by Chinese and French researchers in Peiping and Shanghai among the poor and patients with a complication of relapsing fever, etc. As to the infection mechanism of Salmonella of this kind, the "host-parasite-relationship" must be fully considered.

(8) It can be considered that there is a wide difference between Salmonella affairs in the peace time and in the war time. The main controlling types of this fluctuation attributed to *S. paratyphi B*, *S. enteritidis* and *S. blegdam* as far as East Asia concerned, the author thinks. *S. typhi* *S. paratyphi A*, *S. cholerae-suis*, etc. are believed to form the basis of the geographical distribution of Salmonella in that place and exercise only a slight influence upon it.

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In concluding this paper, the author expresses here his gratitude to Dr. Oscar FELSENFELD, Walter Reed Army Institute of Research, Washington, for his cordial donation, in 1952, to this department, Nagasaki University of a large number of books, a great many back numbers of journals and reprints on Salmonlla and Shigella when the department was extremely short of literatures as they had been all together victimized by the atomic bombardment. As stated in the body of the paper, this paper is the summary of the collection of the fruits of efforts made by either military surgeons who were busy themselves in the north or in the south, or by resarchers engaed in their work in the home land panting in an extreme shortage of commodities during the war time. Among the anthors enumerated in the list of literature referred to by the author, a considerably large number of them might have been numbered among the dead as Dr. Yoshio SHIBAHARA, professor of bacteriology, Kagoshima Medical College. The author expresses his condolence with those deceased scholars as well as with Prof. Tatsuo NAITO, his respected teacher, who, for one, was an A-bomb victim at Nagasaki, and with Prof. Saburo KOJIMA, a pioneer and leader of the study on Salmonella in this country, who died in the year before last.

References

1) **Abe, I.** ; Studies on S. paratyphi A var. durazzo (in Japanese). J. Jap. Assoc. Naval Surgeon **31** : 335-373 ; 497-508 ; 509-514, 1942.

2) **Aoki, R.** : Prevalent types of paratyphoid germs in Korea (in Japanese). J. Nagasaki Med. Assoc. **16** : 2611-2638, 1938.

3) **Aoki, R.** : Antigen-analytic study of S. typhi classified into various types by Shimojō's method (in Japanese). J. Taikyū Med. College **1** : 36-49, 1939.

4) **Aoki, R.** : Types of paratyphoid group Salmonella isolated in Kungshuling (in Japanese). J. Jap. Army Surgeon Corps **340** : 1292-1304, 1941.

5) **Aoki, R.** : Isolatoin of S. onarimon from cases with symptoms resembling paratyphoid in Manchuria. Kitasato Arch. Exp. Med. **22** : 33-38, 1949.

6) **Aoki, R.** : Studies on paratyphoid group germs isolated in the boundary regions of Manchuria (in Japanese). Nisshin Igaku **37** : 138-144, 1950.

7) **Aoki, Y.** and **Kuwahata, M.** : Comparative observations on typhoid/paratyphoid rate and paratyphoid, A/B rate in various parts of Chinese continent (in Japanese). Nisshin Igaku **32** : 214-219, 1943.

8) **Atkinson, N.** and **Woodroofe, G. M.** : The occurrence of Salmonella types in Australia. 1. Australian J. Exp. Biol. Sci. **22** : 51-55, 1944.

9) **Atkinson, N., Woodroofe, G. M.,** and

Macbeth, A. M. : The occurrence of Salmonella types in Australia. 2, 3, 4. Australian J. Exp. Biol. Med. Sci. **22** : 201-204, 1944; **25** : 25-31, 1947 ; **27** : 375-383, 1949.

10) **Bommer, G.** : Zur Typenbestimmung der Typhusbazillen nach ihrem Xylose-vergärungsvermögen. Z. Hyg. **127** : 410-413, 1947.

11) **Bruner, D. W.** and **Joyce, B. J.** : Salmonella types encountered by the 15th Medical General Laboratory. Amer. J. Hyg. **45** : 19-24, 1947.

12) **Carlquist, P. R.** : Reported salmonellas from the Pacific 1941-1946. J. Bacteriol. **54** : 265, 1947.

13) **Chung, H. L.** and **Chang, F. C.** : Relapsing Fever. Clinical and statistical study of 337 cases. Chinese Med. J. **55** : 6-33, 1939.

14) **Dick, J. C.** : Laboratory findings in enteric group fevers in the Middle East Forces. J. Hyg. **44** : 430-436, 1946.

15) **Dunlop, S. J. C.** : A new strain of Salmonella in man found in Indonesia. Documenta Neerlandica et Indonesia der Morbis Tropicis **2** : 21-22, 1950.

16) **Edawrds, P. R.** and **Ewing, W. H.** : Identification of Enterobacteriaceae. 2nd ed. 1962. Burgers Publishing Co. Minneapolis.

17) **Fournier, J.** : L'infection a Salmonella blegdam. Identification du germe ; son incidence a Changhai et en extréme-orient ; aspect clinique. Ann. Inst. Pasteur **77** : 269-276, 1949.

18) **Fournier, J., Sung, C., Koang, N. K.**, and **Velliot, G.** : Salmonella blegdam infection in the Far East, with especial reference to the thirteen cases seen in Shanghai. Chinese Med. J. **68** : 63-70, 1950.

19) **Fujino, T., Ōhara, Sh., Hori, H., Ishikawa, T., Sugimoto, N., Kumagaya, K., Saizawa, K.**, and **Nakagawa, S.** : Speciality of salmonellosis in North Burma, viewed in the light of antigenic structure (in Japanese). Pamphlet (Meimyo, Nov., 1944).

20) **Fujino, T., Kimura, R.** and **Takaki, T.** : Consideration in diagnosis of febrile diseases of unknown origin (in Japanese). Nihon Rinshō **6** : 404-408, 1948.

21) **Hamano, M.** and **Koike, H.** : S. paratyphi C (possessing Vi antigen) isolated from a patient manifesting severe dysentery-like symptoms (in Japanese). Nihon Igaku **3301** : 2042-2045, 1942.

22) **Hamano, M.** : Epidemiological state of Salmonella in China (in Chinese). Bull. Dairen Health Inst. **1** : 78-79, 1951.

23) **Hamano, M.** : Salmonellosis in China with special reference to those due to C-group organisms (in Japanese). Eisei Kensa **5** : 127-131, 1956.

24) **Hayakawa, K., Kasahara, K., Ichikawa, R., Yoshii, S.**, and **Sen, N. K.** : Taxonomical studies of bacterial strains isolated from so-called salmonellosis in southern districts. 1. (in Japanese). Reports from Inf. Dis. Prev. Water Supply Corps, Japanese southern army. Series C No. 90, 1944.

25) **Hayakawa, K.** and **Sen, N. K.** : The same theme and subtitle. 2. Ditto No. 117, 1944.

26) **Hayakawa, K,** and **Sen, N. K.** : Te same theme. 3. A new Salmonella species, S. shonan. Ditto No. 118, 1945.

27) **Hayakawa, K.**, and **Sen, N. K.** : The same theme. 4. A new Salmonella species, S. tikusi. Ditto No. 119, 1945.

28) **Hayakawa, K.** : Introduction of recent studies on Salmonella (in Japanese). Jap. J. Publ. Health **1** : 247-254, 1946.

29) **Hiroki, H., Amaga, T.** and **Nagasawa, M.** Salmonella onarimon (Kishida) isolated in Manchuria with a contribution to its antigen structure (in Japanese). Nihon Igaku **3371** : 405, 1944.

30) **Hiroki, H.** : Various problems in study of Salmonlla in East Asia, with special reference to the state of clinical affairs. Special lecture in the 49th General Meeting of Kyūshū Medical Association (Nagasaki, 1949).

31) **Hiroki, H,** : Additional speech at the symposium "Salmorella and Shigella Types in East Asia". 1964.

32) **Huang, C. H., Chang, H. C.** and **Lieu, V. T.** : Salmonella infection. Chinese Med. J. **52** : 345-366, 1937.

33) **Ide, M.** : On tne causative organisms of "Daifukumochi Poisoning Incident" in Hamamatsu City (in Japanese). Tokyo Iji Shinshi **2990** : 1977-1981, 1936.

34) **Iguma, K.** : S. typhi and S. paratyphi A isolated in North China (an appendix : S. enteritidis and S. paratyphi C) (in Japanese). J. Jap. Army Surgeon Corps **365** : 1173-1188, 1943.

35) **Ishihara, T.** : Type classification of S. typhi in Seoul (in Japanese). J. Korean Med. Assoc. **27** : 1415-1424, 1937.

36) **Ishiyama, K.** : Statistical observation of paratyphoid of type A in Central China (in Japanese). J. Jap. Army Surgeon Corps **334** : 345-358, 1941.

37) **Itō, M.** : An addition to the lecture of Kumanishi, T. J. Jap. Assoc. Naval Surgeon **31** : 1069. 1943

38) **Itō, Sh., Kusakashi, J.** and **Motoyama, Sh.** : Studies on S. paratyphi B isolated from navy personnel in the Pacific War. 3rd Report (in Japanese). J. Jap. Assoc. Naval Surgeon **33** : 150-156, 1944.

39) **Itō, T.** : Taxonomical study of S. paratyphi B in Manchuria (in Japanese). Manchurian Med. J. **39** : 111-140, 1943.

40) **Jacobsen, K. A.** : Mitteilungen über einen variablen Typhusstamm (Bacterium typhi mutabile), sowie über eine eigentümliche hemmende Wirkung des gewöhnlichen Agar, verursacht durch Autoklavierung. Zbl. Bakter. I Orig. **56** : 208-216, 1910.

41) **Jones, H. I.** and **Fenner, F.** : Infection with S. blegdam amongst natives of New-Guinea. Med. J. Australia : **2** : 356, 1947.

42) **Jude, A.** et **Le Minor, L.** : Salmonella isolées en Indochine an cours d'affections typho-paratyphoidiques. Bull. Soc. Path. Exot. **41** : 129-133, 1948.

43) **Jude, A.** et **Nicolle, P.** : Determination des types bactériophagiques et caractères biochemiques de souches de S. typhi. Ann. Inst. Pasteur **77** : 550-560, 1949.

44) **Kamiko, K.** and **Yamada, Sh.** : Clinical observations and bacteriological finding of an outbreak of food-poisoning due to S. enteritidis in Hsinking (in Japanese). J. Jap. Assoc. Inf. Dis. **18** : 42-53, 1943.

45) **Kishida, A.** : A new Salmonella type (Salmonella onarimon). Kitasato Arch. Exp. Med. **17** : 1-7, 1940.

46) **Kitano, M.** : Infectious diseases of men and animals in Manchuria and Mongolia (in Japanese). Manchurian Med. J. **36** : 279-302, 1942.

47) **Kojima, S., Nakagome, W., Hatta, S., Ōhashi, K., Akiba, T., Kitahama, Sh., Matsubashi, T.,** and **Nakamura, J.** : On the causative organisms of food-poisoning (in Japanese). J. Jap. Assoc. Inf. Dis. **12** : 1-54, 1937.

48) **Kojima, T., Ōhashi, K., Itō, Sh.,** and **Ōzono, T.** : Etiological study on dysentery and enteritis in colonists in northern Manchuria (in Japanese). Jap. J. Exp. Med. **24** : 1445-1455, 1940.

49) **Kojima, S.** and **Hatta, S.** : Causing agents of food-poisoning (in Japanese). Kanehara, Tokyo. 1940.

50) **Kojima, S.** : Recent studies on Salmonella in East Asia (in Japanese). Jap. J. Bacteiol. **1** : 127-153, 1944.

51) **Komori, R.** : cf. Kojima, 1944.

52) **Kristensen, M.** und **Kauffmann, F.** : Bakteriologische and klinische Erfahrungen über Infektionen mit d-weinsäurevergärenden Paratyphus B-Bazillen. Z. Hyg. **120** : 149-154, 1937.

53) **Kristensen, M.** : cf. Jude et Nicolle, 1949.

54) **Kubota, K.** : Food-poisoning cases due to Salmonella in Formosa (in Japanese). Tokyo Iji Shinshi **2997** : 2416-2420, 1936.

55) **Kubota, K.** : Salmonella group isolated in Canton City, South China (in Japanese). J. Taiwan Med. Assoc. **39** : 1538-1548, 1940.

56) **Kubota. K.** : Additional speech at the symposium "Salmonella and Shigella Types in East Asia". 1964.

57) **Kussell, B.** and **Stevens, B.** : The occurrence of S. blegdam in the Philippins. J. Bacteriol. **52** : 146-147, 1946.

58) **Kuwahata, M.** : Studies on paratyphoid group organisms isolated in Chinese continent. 1. Type classification of strains isolated in Manchuria and Shanghai in 1940 (in Japanese). J. Nagasaki Med. Assoc. **20** : 479- 492, 1942.

59) **Kuwahata, M.** : Studien über Paratyphus-Enteritis-Erreger, welche auf dem Chinesischen Festland und in Mandschukao herausgezüchtet wurden. 1. Typenteilung der in Jahre 1940 in Mandschukao und in Shanghai gewonnenen Stämmen. Jap. J. Med. Sci. Bacter. **2** : 221-232, 1942.

60) **Kuwahata, M.** : Studies on paratyphoid group organisms isolated in Chinese continent. 2. Type classification of strains isolated in Middle China and North China in 1941 (in Japanese). J. Nagasaki Med. Assoc. **20** : 835-849, 1942.

61) **Kuwahata, M.** : Studies on paratyphoid group organisms isolathd in Chinese continent. 3. Type classification of strains isolated in Manchuria in 1941 and a summary of distribution state of Salmonella in Chinese continent (in Japanese). J. Nagasaki Med. Assoc. **20** : 2278-2292, 1943.

62) **Kuwahata. M.** : Studies on paratyphoid group organisms isolated in Chinese continent. 4. Stability of various properties of Salmonella which play weighty role in classification of these organisms (in Japanese). J. Nagasaki Med. Assoc. **21** : 795-806, 1943.

63) **Lie, P. Y., Zia, S. H.,** and **Chung, H. L.** : Salmonella enteritidis infection by a parenteral route. Proc. Soc. Exp. Biol. Med. **27** : 17-18, 1937.

64) **Lie, P. Y.** : Serological typing of Salmonella enteritidis isolated in Peiping. Chinese Med. J. Suppl **2** : 272-289, 1938.

65) **Lindberg, R. B.** and **Bayliss, M.** : Salmonella types of the Pacific Area. J. Inf. Dis. **76** : 91 -95, 1946.

66) **Mackerras, M. J.** and **Mackerras, I. M.** : Salmonella infections in Queensland. Australian J. Exp. Biol. Med. Sci. **27** : 163-171, 1949.

67) **Mizogami, S.** : Gartner's enteritis bacillus isolated in and around Wuchang and Hankow (in Japanese). J. Jap. Army Surgeon Corps **340** : 1265-1279, 1941.

68) **Mizogami, S., Sato, T., Shimada, K., Hatagami, R.,** and **Kajikawa, N.** : Food-poisoning due to S. typhi-murium which occurred frequently in troops stationing in Canton, and bacteriological studies on the isolated strains (in Japanese). J. Jap. Army Surgeon Corps **357** : 161-168, 1943.

69) **Mochizuki, N.** and **Nagasawa, S.** : Paratyphoid in Mukden (Fengtien) (in Japanese). J. Jap. Assoc. Inf. Dis. **16** : 692-694, 1942.

70) **Monji, I.** : Studies on O antigen minus-variants of S. paratyphi A and B. 1st Report (in Japanese). J. Nagasaki Med. Assoc. **20** : 2310-2324, 1943.

71) **De Moor, C. E.** : cf. Hayakawa (Salmonellosen in Batavia, in het bijzonder de diagnostik van het de infectie. G. T. V. N. I Dl., 75).

72) **Murakami, S., Mishima, T.** and **Murae, M.** : Type classification of Salmonella in and around Tientsin (in Japanese). Dōjin-Kai Med. J. **19** : 3-4, 1945.

73) **Murashima, T., Kitahama, Sh.,** and **Hara, F.** : Food-poisoning occurred suddenly in Hamamatsu City, May, 1936 (in Japanese). Ikaijihō **2182** : 1266; **2183** : 1318, 1936.

74) **Nagaki, D.** : Salmonella group organisms in Honan Province, North China (in Japanese). Saikingaku Zasshi **567** : 202-209, 1943.

75) **Ochiai, K.** and **Naitō, Sh.** : Trpe of S. typhi in Nagoya City (in Japanese). Tokyo Iji Shinshi **3165** : 3110-3114, 1940.

76) **Ogasawara, K.** and **Shimizu, K.** : Biological properties of S. paratyphi A ; Relationship between colony formation and antigen structure in cultures on absorption agar (in Japanese). J. Nagoya Med. Assoc. 51 : 531-537, 1490.

77) **Ogawa, H.** : Type of S. typhi in Osaka

City and its clinical observation. (in Japanese). J. Jap. Assoc. Inf. Dis. **15** : 863-866, 1941.

78) **Ogawa, T.** : Studies on types of S. typhi in Central China (in Japanese). Jap. J. Exp. Med. **26** : 334-341, 1942.

79) **Ogino, M., Watanabe, Ch.** and **Kamaya, M.** : Types of S. typhi isolated in Seoul during the past five years, and epidemiological consideration of the results (in Japanese). J. Korean Med. Assoc. **30** : 1643-1651, 1940.

80) **Raynal, J. H.** et **Fournier, J.** : Les Salmonelles á Changhai. Monographie de l' Institute Pasteur de Changhai. Changhai, 1945.

81) **Raynal, J. H.** et **Fournier, J.** : Les salmonelles à Changhai. Méd. Trop. **7** : 199-237, 1947.

82) **Ryū, G.** : Experimental study on S. paratyphi A in Manchuria (in Japanese). Manchurian Med. J. : **35** : 1009-1036, 1941.

83) **Satō, T.** : Salmonella sendai in South China (in Japanese). J. Jap. Surgeon Corps **345** : 243-250, 1942.

84) **Satō, T.** : Gartner's enteritis bacillus isolated in South China (in Japanese). J. Jap. Army Surgeon Corps **369** : 184-192, 1944.

85) **Shibahara, Y.** and **Yamaguchi, I.** : Salmonella types in Hankow district, especially results of typing of S.typhi by Shimojō's method (in Japanese). Igaku to Seibutsugaku **12** : 141-143, 1948.

86) **Shimojō, K.** : Lecture on paratyphoid in the present day (Lecture on Salmonella group) (in Japanese). J. Jap. Assoc. Inf. Dis. **10** : 220-233, 1936.

87) **Shimojō, K.** ; Paratyphoid (in Japanese). J. Jap. Assoc. Inf. Dis. **10** : 1031-1051, 1936.

88) **Shimojō, K.** : Lecture on paratyphoid in the present day (Lecture on Salmonella group) (in Japanese). J. Jap. Assoc. Inf. Dis. **11** : 1378-1392, 1937.

89) **Shōji, S.** : Cases of food-poisoning due to S. cholerae-suis in a certain place in Central China (in Japanese). J. Jap. Army Surgeon Corps **348** : 690-698, 1942.

90) **Soda, T.** : Studies on Bacterium typhi mutabile (Jacobsen) (in Japanese). J. Jap. Assoc. Inf. Dis. **9** : 1143-1173, 1935 ; **10** : 719-764, 1936 ; **11** ; 141-191, 1936.

91) **Soda, Ch., Kubota, K.** and **Tsuchimochi, K.** : Unusual Salmonella types (S. orient, S. stanley and S. london) found by our practical typing method (in Japanese). Tokyo Iji Shinshi **2987** : 1745-1750, 1936.

92) **Sugito, K.** : Statistical and clinical observations of paratyphoid fever of type C around Canton (in Japanese). J. Jap. Army Surgeon Corps **357** : 169-177, 1943.

93) **Suzuki, Y.** and **Mitani, H.** : Type classification of S. typhi in North China (in Japanese). Dōjin-Kai Igaku Zasshi **17** : 769-773, 1943.

94) **Tsurumi, H.** and **Anzai, H.** : Clinical and bacteriological researches on the diseases caused by S. onarimon. Kitasato Arch. Exp. Med. **17** : 106-114, 1940.

95) **Yamade, Sh.** : Biological and serological properties of S. paratyphi B isolated in Manchuria (in Japanese). Igaku to Seibutsugaku **2** : 348-351, 1942.

96) **Yamada, Sh.** : Salmonella C-group organisms isolated in Hsinking (Changshun) (in Japanese). J. Jap. Assoc. Inf. Dis. **17** : 102-112, 1943.

97) **Yamada, Sh.** : Food-poisoning due to S. paratyphi B (in Japanese). Igaku to Seibutsugaku **3** : 123-126, 1943.

98) **Yamada, Sh.** : S. typhi strains isolated in Hsinking in 1942 (in Japanese) J. Jap. Assoc. Inf. Dis. **18** : 803-806, 1943.

99) **Yamashita, I., Ogata, Sh.**, and **Morita, T.** : Studies on bacterial food-poisoning in Manchuria, with special reference to an interesting mass occurrence of it due to S. cholerae-suis (in Japanese). Manchurian Med. J. **39** : 825-830, 1943.

100) **Yoshiki, M.** : Occurrence of the so-called undernutrition in Central China Army (in Japanese). J. Jap. Army Surgeon Corps **328** ; 1061-1064, 1940.

101) **Umemoto, G.** Studies on Salmonella in North China, specially in troops. 1. Type classification (in Japanese). J. Jap. Army

Surgeon Corps **365** : 1161-1172, 1943.
102) **Umemoto, G.** : Studies on Salmonella in North China, specially in troops. 2. Epidemiological investigations and studies. J. Jap. Army Surgeon Corps **371** : 429-436, 1944.

摘　　要

我国のサルモネラに関する研究は，昭和12年の浜松事件（*S. enteritidis* による2,000人を越す食中毒の発生，死亡45名）を契機として急速に進歩した．特に陸軍軍医間に熱意を傾注した人が多かったことは，戦争中現地で数々の信頼に足る調査研究が実施された一つの理由であった．また小島教授以下伝研第4研究部の各位が果した全般的指導の功績も大であった．戦争中現地での系統的な研究としては，大学を代表する北野，広木，満鉄衛研の浜野，陸軍の青木(亮)，梅本，溝上，伊熊，小森，早川等，海軍の阿部，伊藤等によるものがあった．これらを著者等長崎医科大学東亜風土病研究所病理部細菌学科（当時の呼称）の現地出張による菌株の蒐集・分類の成績，青木(義)による中支方面同仁会機関よりの情報整理，集団発生など特殊事例に関する若干の報告，戦後に入手した外国文献などで点綴するときは，一部資料の重複は止むを得ないこととして，当時の駐留地域におけるサルモネラ事情について一応の鳥瞰を行うことは可能と信じる．この意味で成したのが本稿であるが，単なる回想や記録にとどまることはなく，目下資料整理中の第2報（戦後立上り期の本邦），第3報（現在の東亜各地）との比較の基礎になるという一つの役割をも持つものである．

この地域に常在するものとして *S. typhi*, *S. paratyphi A*, *S. enteritidis*, *S. blegdam*, *S. cholerae suis*, *S. paratyphi C* と *S. sendai* を挙げた．*S. paratyphi B* は大陸の北半せいぜい楊子江流域と下流の各省あたりまでであって，それより南方では軍隊内での発生はかなりあったとしても，元元存在していたものとは考え得ない．従ってこの地域では *S. cholerae-suis* (*var. kunzendorf* も含めて)，*S. enteritidis*, *S. blegdam* などが第3位を占めることになる．これに反して *S. paratyphi A* は南に下るに従って *S. typhi* を圧倒する傾向を示し，このことはまた古くから海軍の統計で知られていることでもあった．

附帯的に *S. typhi* の下條法による生物学的型別，*S. paratyphi A*，同 *B* のO抗原一部缺損型（前者 *var. durazzo*，後者 *var. odense*）の地理的分布上の特色を検討したが，これは特に意義ある所見に至らなかった．ただ当時 *S. paratyphi B var. java* といわれていた同菌原型の第2相缺如型が，海軍部内と広東及びシンガポールにおいてのみ検出されていたことは，この菌が1935年De Moorによってジヤバで最初に発見されたものであることをも考慮に入れて，南方独特のものであるかの感を持った（この変異菌は1961年改訂のKauffmann-White-Schema では *S. java* として独立した地位を獲得している）．*S. enteritidis* (*var. danysz* 同 *chaco*, 同 *essen* なども含めた意味での）と，*S. blegdam* にはその本来の病原性発揮様式——急性胃腸炎のほかに，集団的にチフス性感染を招来する可能性がある．これには宿主対病原菌の関係が充分に考慮されるべきであり，補給が伴わないような急進撃を敢てした武漢作戦で有熱患者が多発した時や，インパールよりの敗退時いわゆる戦争マラリアと称された患者から，この種のサルモネラが血液培養で共にかなりの高率に検出されたことは，宿主における抵抗力の減弱，これによる感染様式の変化を考えさせるに充分である．また北京では中国の学者が，上海では Pasteur 研究所の Fournier が，中国の難民や回帰熱合併患者中に本症を見出して報告していることも参考になる．なお武漢地区が平静を取戻した或期間この両菌の検出が殆どなかったことも別の意味でのこの説の根拠となろう．戦争末期湖南進攻が敢行され，著者は同仁会で一班を編成従軍したがこの時も診断不明の熱病患者多数の発生があった．岳陽長沙間の新市で空

襲をうけ，ひきつづいての火災で同定前の分離菌株と一切の検査用具を失ない，病原究明の機を逸したことは残念であった．

S. cholerae-suis, *S. paratyphi C* と *S. sendai* は高率ではないが今回の対象地域に広く分布し，首位及び第2位を競う *S. typhi*, *S. paratyphi A* と共に比較的変動が少く，東亜におけるサルモネラの基盤をなすものと思う．*S. paratyphi B* は上述のように地理的分布上最も明瞭な特徴を示し，*S. enteritidis* と *S. blegdam* はその土地，その時期の状況に応じ検出率にかなりの変動があるものと考察された．

その他，この期間この地域で邦人により多少にかかわらず検出されたサルモネラ型を列挙し，特に，既述の *S. java* のほか，新たにKauffmann-White-Schema に登載された *S. onarimon* と *S. singapore* の来歴について述べた．

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