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A Review of Leishmaniasis Research in China from 1960 to 1986

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Introduction

China is known as an important area of visceral leishmaniasis (VL, Kala-azar) in the world from the early of this century. Active study and control of Chinese VL had been carried out after 50's through thousands of doctors and paramedicals and the organization of the People's Government and it seemed to be a real prospect of eradicating VL from larger areas of China (Wang *et al.* 1956, 1983). The author already reviewed the VL research in China from 1949 to 1959 (Leng 1982, 1984). But during the political catastrophe from 60's to 70's the system of control and prevention suffered a severe setback. The disease has reappeared in a sporadic form in certain rural areas over north, northwest China (Xiong *et al.* 1976), Inner Mongolia and the northwestern mountainous region of Sichuan Province. Though VL is no longer a serious epidemic disease in this country cutaneous leishmaniasis (CL) has been found in the mainland and Taiwan (Gater and Lien 1970), naturally infected wild canidae (*Nyctereutes procyonoides*) has been found in the vicinity of Beijing and also lymphatic leishmaniasis has been discovered in a certain amount in Inner Mongolia, Gansu and Xinjiang. The species and strains of *Leishmania* have been studied by isoenzyme electrophoresis. Although contrary results were obtained, it has been distinctly identified as *L. donovani s.l.* and *L. infantum* by isoenzyme characterization. Four more phlebotomine sandflies other than *Phlebotomus chinensis* are considered to be the vectors in different endemic areas. But little is known about these in abroad where few relevant publication are available and few people know Chinese. The author has been engaging in the leishmaniasis research and the practice of control of leishmaniasis in Northeast China (Manchouria) from early 1950, especially in the sandfly research of all over China, and wish to present a brief review of leishmaniasis research in China from 1960 to 1986.

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I Historical

In 1951 VL was known to occur in epidemic form in East, Northeast, North and Northwest China. It occurred mainly along the Yellow River (Huang He), the birth place of China's ancient culture, and the north of Yangtze (Changjiang) River. It covered an area about 1,200,000 km^2 and threatened 400 million people who lived in this area. The epidemicity was about 1–5 per thousand and 530,000 cases were estimated to occur. The VL was one of the main parasitic diseases in China.

Geographically it occurred mainly in 9 provinces, namely, Shandong, Jiangsu, Anhui, Henan, Hebei, Shanxi, Shaanxi, Gansu and Ningxia. Foci were also found in 5 provinces and autonomous regions, namely, northern Hubei, southern Liaoning (Kubo and Sugimoto, 1943), north-western Sichuan, eastern Qinghai and Xinjiang (Chai and Guo, 1963) (Fig. 1).

According to the clinical and epidemiological aspects Leng (1955, 1982, 1987c) and Wang and Wu (1956) considered that the Chinese VL could be divided into two types as follows (Table 1).

1. *Anthroponotic type* (*Indian type*)

This type covers the area of North China Plain and East China where VL mainly affects older patients, and is sensitive to antimony treatment and canine leishmaniasis is none or

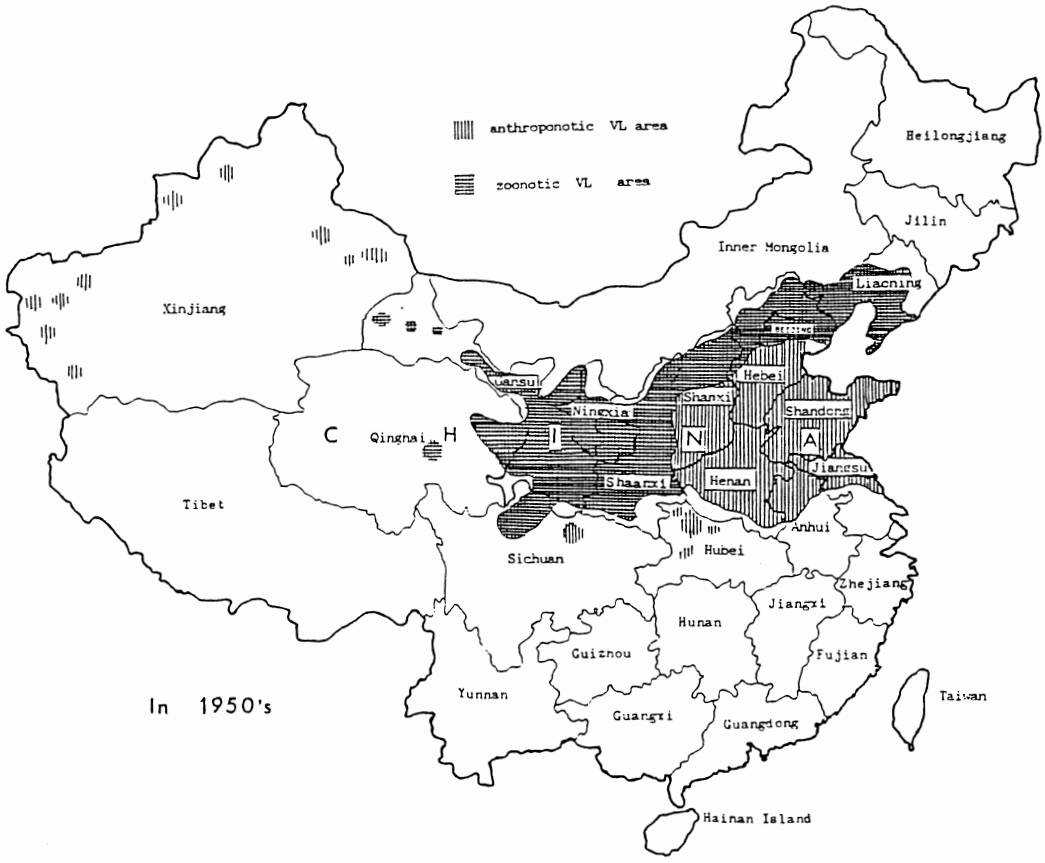

Fig. 1 Distribution of anthroponic and zoonotic VL in China in 1950's

Table 1 Two types of Chinese VL

	ANTHROPONOTIC	ZOONOTIC
DISTRLBUTION	North & East China	Old Silk Road
TYPE	Indian	Midterranean
ORIGIN	Oversea Route	Overland Route
AGE	Young adults & Adults	Infants & Young Children
ANTIMONY THERAPY	Sensitive	Refractory
PATHOGEN	*L. d. donovani s. l.*	*L. d. infantum*
CANINE LEISHMANIASIS	None or Rare	+
WILD RESERVOIR	–	*Nyctereutes procyonoides*
EPIDEMICITY	Epidemic	Sporadic
PKDL*	+	–

*Post Kala-azar Dermal Leishmaniasis
Leng (1955, 1982), Wang and Wu (1956)

extremely rare. Wild reservoir has not been found. The disease occurs in an epidemic form among human population and post Kala-azar dermal leishmaniasis (PKDL) is present. It possibly entered China from the costal region and is easily controlled.

2. *Zoonotic type* (*Mediterranean type*)

This type covers a geographical zone crossing the north of China from Xinjiang along the Old Silk Road eastward to Hebei and Liaoning, where VL occurs in sporadic form and mainly affects infants and young children, and is comparatively refractory to antimony treatment and where canine leishmaniasis is also present. Wild reservoir has been found. A clinical form lymphatic leishmaniasis occurs in Inner Mongolia, Gansu and Xinjiang but PKDL has never been found. It possibly entered China by an overland route.

II The present status in endemic area

1. *The distribution of Chinese VL* (Fig. 2)

In the 1950's, due to the intensive campaigns against VL in China by the cooperation of thousands of doctors and paramedicals and the organization of People's Government, anthroponotic VL almost disappeared from large areas of anthroponotic VL region and they declared to be eradicated in 1960. But Zoonotic VL still exists in a sporadic form along the Old Silk Road and new foci of VL and lymphatic leishmaniasis discovered in Inner Mongolia, Gansu and Xinjiang. A naturally infected canid, racoon dog (*Nyctereutes procyonoides*) was found in the vicinity of Beijing (Miyun County) and two native cases of cutaneous-subcutaneous leishmaniasis discovered in Taiwan (Cross *et al.* 1985). All these data demonstrate leishmaniasis

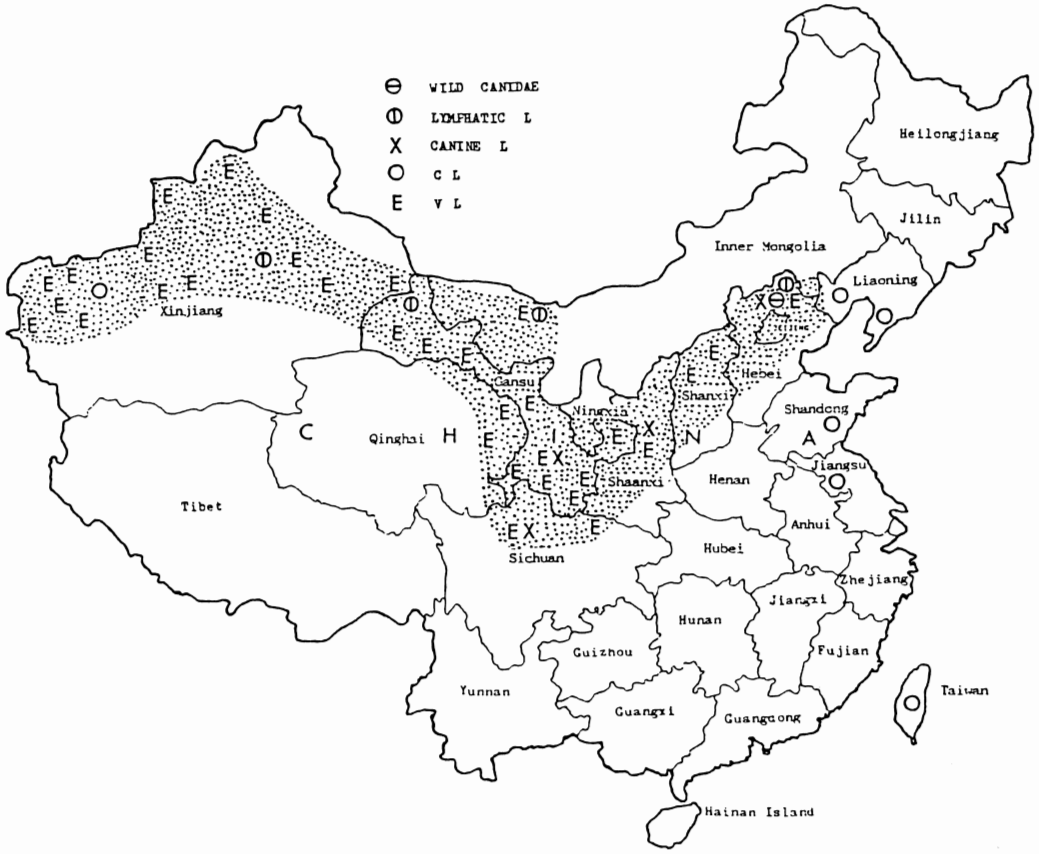

Fig. 2 Distribution of VL in recent China

Table 2 Change of the prevalence of Chinese VL after 1951

YEAR	DISTRIBUTION		CASES
	Prov.	Co.	
1951	16	650	530,000
1960	Declared to be eradicated		
1978	6	—	99
1979	5	—	48
1982*	6	30	302
1985	5	25	100

Prov. = province, Co. = county

Table 3 VL cases reported from different provinces in 1982

PROVINCE	COUNTY	CASES
XINJIANG	14	178
SHAANXI	7	28
GANSU	5	53
SHANXI	2	4
INNER MONGOLIA	1	38
SICHUAN	1	1
Total	30	302

Table 4 The morbidity of VL in Ejina Banner, Inner Mongolia (1972–1982)

YEAR	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
‰	72.0	24.4	13.1	10.6	5.8	5.4	5.0	8.0	13.5	19.5	35.4

Guan *et al.* (1985)

being still a problem within China (Fig. 2).

Table 2 shows the change of prevalences of VL after 1960 and Table 3 shows the distribution of cases in 1982. The yearly change of the morbidity after 1972 in one county in Inner Mongolia is given in Table 4.

III The animal reservoir

1. *Survey of canine leishmaniasis*

From 1959 to 1982, 63, 468 dogs were examined by skin and/or bone puncture for the survey of canine leishmaniasis in Hebei, Henan, northern Jiangsu, northern Anhui, Liaoning, north-western Sichuan, Shaanxi, Gansu and Xinjiang. The results of these surveys (Table

Table 5 Survey of canine leishmaniasis in different provinces

PROVINCE & COUNTY	YEAR	POSITIVE COUNTIES/ COUNTIES EXAMINED	DOGS EXMINED	POSITIVE DOGS (per 10,000)
Hebei Miyun	1959	3	?	—
	1982	1/1	?	2
Henan	1959	1/3	1,258	1(7.9)
North Jiangsu & Anhui	1964	1/26	27,282	1(0.4)
Shandong	1951-57	13/32	36,629	33(10.8)
Xinjiang				
Kashi	1967	1	23	—
Shufu & Kashi	1974	2	102	—
Gansu	1973	1/1	152	7(460.5)
Shaanxi				
Xian	1959	1/1	2,047	13(63.5)
Southern Shaanxi	1959	5/5	30,641	103(33.6)
Northern Shaanxi*	1974-77	4/4	892	12(134.5)
Sichuan*	1973-77	3/3	798	31(388.5)
Liaoning	1959	1/3	273	5(183.2)

*see Table 6

Table 6 Survey of canine leishmaniasis in different counties

LOCALITY	YEAR	DOGS EXAMINED	POSITIVE DOGS (per 10,000)	REMARK
SHAANXI				
Qingjian	1974	27	1(370.4)	ShIPD
Yanan	1974-77	483	8(165.6)	ShIPD
Yichuan	1974-78	370	2(54.1)	ShIPD
Yanchang	1977	12	1(833.3)	ShIPD
SICHUAN				
Nanping	1973	49	5(1,020.4)	SIPD
Wenchuan	1976-77	190	10(526.3)	SIPD
Maowen	1976-77	559	16(286.2)	SIPD

SIPD = Sichuan Institute of Parasitic Diseases
ShIPD = Shanghai Institute of Parasitic Diseases

Table 7 Comparison of canine leishmaniasis before 1958 and after 1959 (per 10,000)

PROVINCE	1951-58	1959-82
Shandong	12.4	−
Anhui	0.9	+
Jiangsu	−	−
Henan	35.6	7.9
Hubei	−	?
Hebei	178.7	+
Liaoning	204.1	183.1
Sichuan	15.2	388.5
Shaanxi	38.0	38.1
Qinghai	131.0	?
Xinjiang	?	−

5-7) showed canine leishmaniasis in China to be:
1) abundant in Gansu, Liaoning, north-western Sichuan;
2) common in northern Hebei and Shaanxi;
3) rare in Henan and Anhui;
4) becoming negative in Shandong and
5) unknown in the plain of Hebei, Xinjiang and Inner Mongolia.

Canine leishmaniasis in the epidemic areas of Shaanxi and north-western Sichuan showed high incidences, even as high as 1,020.4 per ten thousands in one province (Table 6). Dogs must play an important part in the transmission of VL in these districts.

With a comparison of canine leishmaniasis between 1951–1958 and 1959–82 (Table 7) it can be learned that:

1) canine leishmaniasis has remained unchanged in the zoonotic VL area
2) canine leishmaniasis in the anthroponotic VL area has remained in a traceable level or disappeared corresponded with the disappearance of human VL;
3) canine leishmaniasis has never been found in Inner Mongolia and Xinjiang Autonomous Regions.

2. *Wild animal survey*

Table 8 shows various animals other than dog collected from the epidemic areas in which no amastigotes was found, however, Xu *et al.*

Table 8 No. of wild animals examined for infection of leishmaniasis

1951-58		1964-66	
Animal	No. ex.	Animal	No. ex.
Rodent (14)*	3,593	Rodent (11)*	1,875
Sheep	2,198	Hare	89
Cattle	223	Fox	3
Hare	172	Porcupine	29
Fox	101	Bird	7
Badger	36	Bat	6
Cat	7	Horse	5
Wolf	2	Antelope	2
Others	336	Siler stoat	1
		Camel	1
Total	6,581		2,054

*No of species

(1982) discovered a racoon dog (*Nyctereutes procyonoides*) being infected with *L. donovani* out of 59 wild animals examined in the vicinity of Beijing, Miyun County. The number of wild animals examined were 6,581 in 1951–58 and 2,054 in 1964–66.

IV The vectors

1. *The phlebotomine sandflies*

The first discovery of phlebotomine sandfly in China was reported by Bolt (1915) and Bolt's specimen was named as *Phlebotomus major chinensis* Newstead, 1916. There were 14 species belonging to the 3 genera recorded before the founding of the People's Republic of China. From 1916 up to 1986, as a total, 39 species of phlebotomine flies belonging to 5 genera were identified (Table 9).

Table 9 Phlebotomine sandflies reported from China before 1986

	No. species in Genus				
Year	*Phlebotomus*	*Sergentomyia*	*Grassomyia*	*Idiophlebotomus*	*Chinius*
1916-49	5	8	1		
1950-86	8	15		1	1
1916-86	13	23	1	1	1

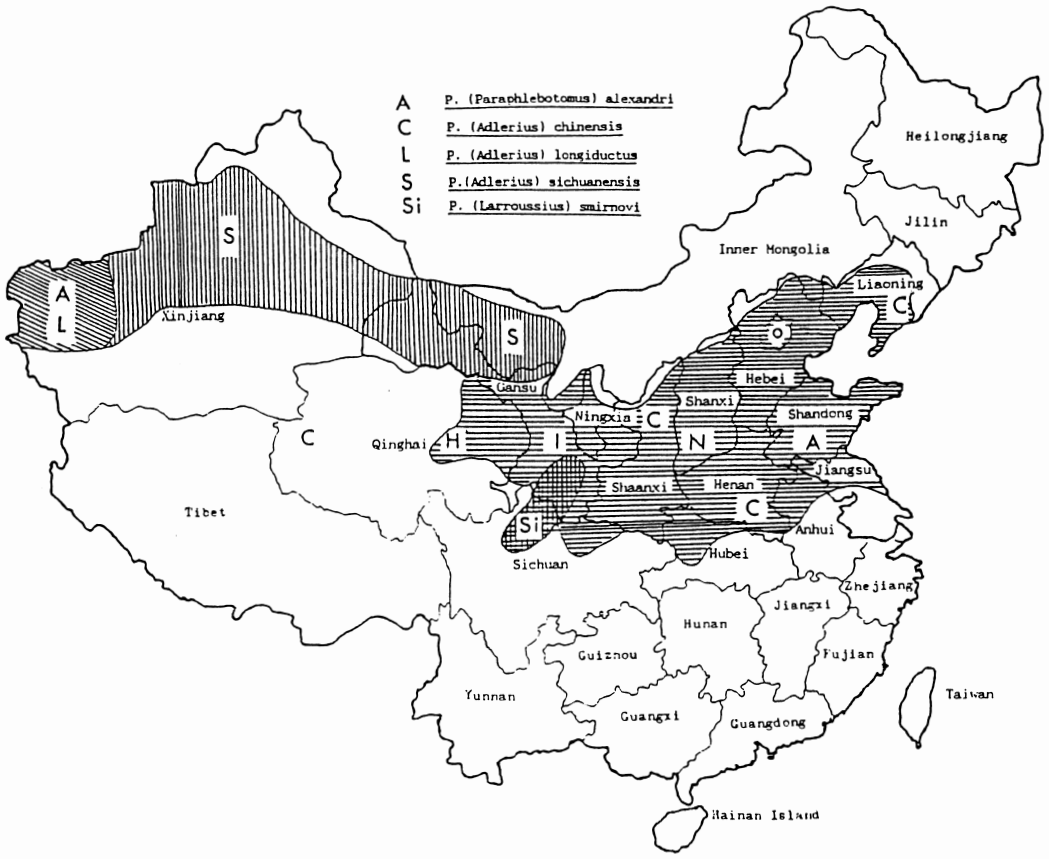

Fig. 3 The geographical distribution of vector phlebotomines in China

2. *Vector of VL in China*

Out of 39 species of phlebotomine sandflies in China, the following five species were considered to be the vectors of Chinese VL.

P. sichuanensis was found an exophilic vector in the mountainous region of northwestern Sichuan and southern Gansu. *P. smirnovi* an exophilic vector in the desert and savannah area of Xinjiang, Inner Mongolia and western Gansu. One of the three endophilic vectors, *P. chinensis* was the most important vector widely distributed over Northeast, North, East and the eastern part of Northwest China; the other two *P. longiductus* and *P. alexandri* distributed in the old residential quarters of western Xinjiang (Guan *et al.* 1986) (Fig. 3). They are grouped in two categories as follows.

1) Exophilic vectors in mountain, desert and savannah
   a) *P.* (*Adlerius*) *sichuanensis* Leng & Yin, 1983
      northern Sichuan and southern Gansu (Leng, 1987a)
   b) *P.* (*Larroussius*) *smirnovi* Perfiliev, 1941
      synonym: *P. major* (Ting & Ho, 1962)
      P. major wui (Yang & Xiong, 1965)
      P. wui (Artemiev & Neronov, 1984; Xiong & Jin, 1987)
      Xinjiang, Inner Mongolia and western Gansu

2) Endophilic vectors of plain and residential quarters
   a. *P.* (*Adlerius*) *chinensis* Newstead, 1916
      main vector in Northeast, North, East and eastern part of Northwest China
   b. *P.* (*Adlerius*) *longiductus* parrot, 1928 (Leng *et al.* 1987)
      old residential quarter of western Xinjiang
   c. *P.* (*Paraphlebotomus*) *alexandri* Sinton, 1928
      old residential quarter of western Xinjiang

3) *Epidemiological view of VL and canine leishmaniasis in Wenchuan County, Sichuan Province*

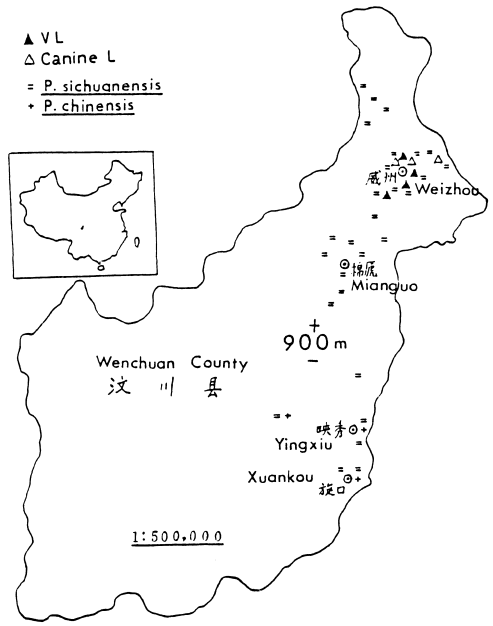

Fig. 4 Distribution of human VL and canine L in Wenchuan County with reference to vector phlebotomine

Figure 4 clearly shows that at an endemic area in Wenchuan County of Sichuan Province the presence of human VL and canine leishmaniasis closely corresponded with the presence of their vector *P. sichuanensis* instead of *P. chinensis* (Fig. 4).

4) *Geographical distribution of* P. smirnovi

P. smirnovi is one of the three phlebotomine sandflies (*P. longiductus* and *P. alexandri*) which are the common vectors of VL shared in China and Soviet Union. It is meaningful to share the achievement worked out by both countries (Fig. 5).

V The pathogen

1. *Classification of the genus* Leishmania

Based upon the site of promastigote development in the phlebotomine host Lainson and Shaw (1979) classified the genus *Leishmania* into following 3 sections.

1) Section *Hypopylaria* (under the gate). 2)

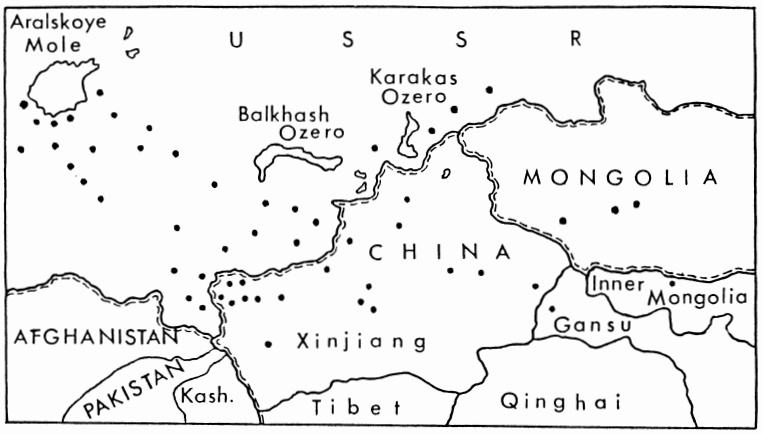

Fig. 5 Zoogeographical distribution of *Phlebotomus smirnovi*

Section *Peripylaria* (on all sides of the gate). 3) Section *Suprapylaria* (above the gate).

All the Old World human parasitic species of the genus *Leishmania, L. donovani, L. tropica, L. major* and *L. aethiopica*, are said to be in the section *Suprapylaria.*

2. *Distribution of promastigote in the infected sandflies from China*

L. donovani s.l. isolated from human and/or canine from Sichuan, Beijing, Xinjiang and Shandong were studied in the phlebotomine hosts, *P. sichuanensis, P. longiductus, P. smirnovi* and *P. alexandri* (Guan *et al.* 1985, Leng and Yin, 1983, Yin *et al.* 1985, Xiong *et al.* 1974). According to their investigation, 7 to 11 days after taking infected blood meal the distribution of promastigotes in the insects' alimentary canal showed that the Chinese *Leishmanias* were belonging to the section *Peripylaria* of Lainson and Shaw (1979). In this aspect, Chinese *Leishmanias* differs from those of Old World *Leishmania* species out side of China (Table 10, Fig. 6).

3. *Isoenzyme characterization of Chinese* Leishmania

Only two reports concerning this field have

Table 10 Distribution of promastigotes in infected sandflies (%)

STRAINS OF *Leishmania*	SANDFLIES INFECTED	PHARYNX	OE	AM	PM	HG	REMARKS
SICHUAN	*P. sichmncnsis*	6.7	48.9	55.6	100.0	8.9	Leng & Yin 1983
BEIJING	*P. longiductus*	9.7	80.6	87.1	96.8	25.8	Xiong *et al.* 1974
	P. smirnovi	8.7	49.5	72.8	100.0	47.6	
XINJIANG	*P. longiductus*	14.3	28.6	57.1	85.7	—	
	P. smirnovi	—	—	50.0	100.0	12.5	
	*P. smirnovi**	23.5	70.6	88.2	94.1	29.4	
	P. alexandri	51.4	83.8	100.0	100.0	5.5	Guan *et al.* 1985
SHANDONG	*P. longiductus*	6.5	69.6	93.5	100.0	19.6	Xiong *et al.*
	P. smirnovi	5.0	23.0	58.0	100.0	32.0	

*Natural infection with a rate of 5.7%; OE = oesophagus, AM = anterior midgut, PM = posterior midgut, HG = hind gut

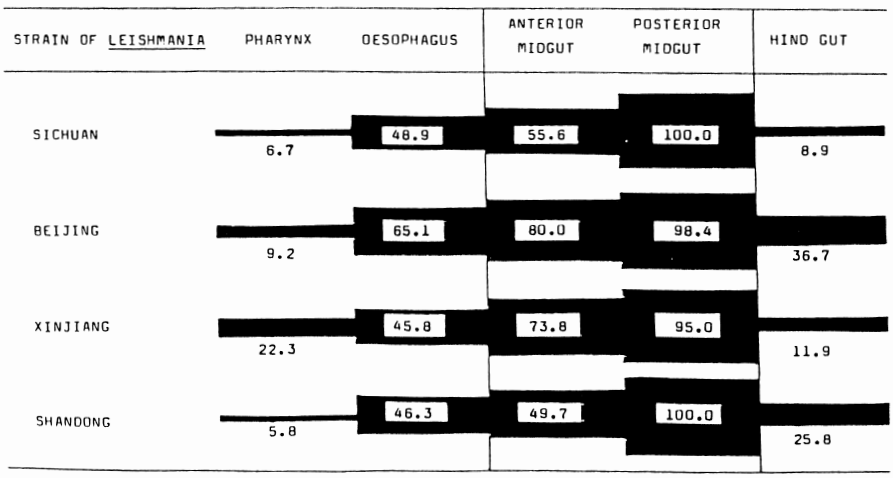

Fig. 6 Distribution of promastigotes in infected phlebotomine sandflies (%)

been collected (Xu *et al.* 1984; New and Leng, 1985). It was verified that Chinese *Leishmania* comprises two isoenzymically distinct species, *L. infantum* and *L. donovani s.l.* of the *L. donovani* complex, and the human strains from Xinjiang and Shandong and the wild animal strain of racoon dog from Beijing showed identical isoenzyme profile with *L. infantum* marker strain of Tunisian dog. But contrary results have been obtained as each human strain from Beijing and Gansu appears identical isoenzyme profile with human *L. infantum* marker strain

Table 11 Isoenzyme characterization of Chinese *Leishmania*

LOCATION	HOST	DONOR	ENZYME USED	MARKER STRAIN	IDENTIFICATION	REMARK
BEIJING	Racoon dog	Xu, Z. B. (1980)	ASAT, ES, NH, PEP, GPI	Dog, Tunisia (Rioux)	*L. infantum*	Xu *et al.* 1984
	Man	Xu, Z. B. (1984)	G6PDH	Man, Frantum (Ranque)	*L. infantum*	New and Leng 1985
	Man	Xu, Z. B.	G6PDH, MDH	Man, India (Chowdhury)	*L. donovani* s. l.	New and Leng 1985
GANSU	Man	Wang Jie (1980)	ALAT, ASAT, ES, NH, PEP, GPI	Man, Saudi Arabia (Evans)	*L. donovani* s. l.	Xu *et al.* 1984
	Man	Wang Jie (1984)	G6PDH	Man, India (Chowdhury)	*L. donovani* s. l.	New and Leng 1985
	Man	Wang Jie (1984)	G6PDH, MDH	Man, France (Ranque)	*L. infantum*	New and Leng 1985
	Rhombomys optimus	Wang Jie (1964)	AL, AT, ASAT, ES, GPI, MPI, NH 6-PGDH, SOD		*L. gerbilli*	Xu *et al.* 1984
SHANDONG	Man	Wang (1978)	ASAT, ES, NH, PEP GPI	Dog, Tunisia (Rioux)	*L. infantum*	Xu *et al.* 1984
	Man	Waug (1954)	ASAT, ES, NH, PEP, GPI	Dog, Tunisia (Rioux)	*L. infantum*	Xu *et al.* 1984
XINJIANG	Man	Wang Jie (1978)	ASAT, ES, NH PEP, GPI	Dog, Tunisia (Rioux)	*L. infantum*	Xu *et al.* 1984

Racoon dog = *Nyctereutes procyonoides*, ALAT = Alanine aminotransferase, ASAT = Aspartate aminotransferase, ES = Esterase, GPI = Glucosephosphate isomerase, G6PDH = Glucose-6-phosphate dehydrogerase, MDH = Malate degydrogenase, MPI = Mannosephosphate isomerase, NH = Nucleoside hydrolase, PEP = Peptidase, SOD = Superoxide dismutase

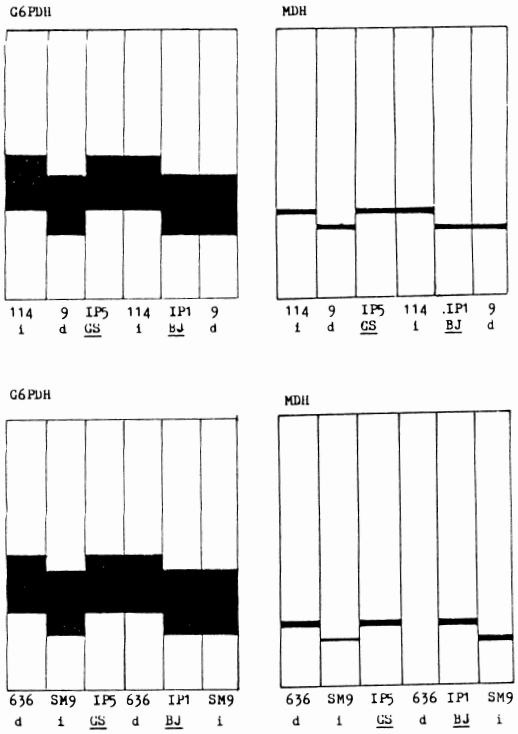

Fig. 7 Diagram of isoenzyme electrophoretic patterns of Chinese and reference laboratory strains of *Leishmania*

of France and human *L. donovani s.l.* marker strain of India (Table 11, Fig. 7).

Some of these differences may be explained by the fact that the strains have been grown for a long period of time in continuous culture, and may have changed spontaneously, or under selection pressure after isolation. While it is clear that the laboratory strains of Chinese leishmania from different regions have different isoenzyme profiles, it is not possible, on the basis of single isolate local strain, to come to firm conclusion as to the status of different strains of VL in natural conditions. Additional isolates and enzyme system are currently being studied (Fig. 7).

4. *The specificity of monoclonal* Leishmania *antibody in identifying the strains of* Leishmania *promastigotes*

It seems that the strain "801" of Kashi, Xinjiang is similar to the strain from Shandong and corresponded to *L. donovani s.l.* identified

Table 12 The specificity of monoclonal *Leishmania* antibody in identifying the strains of *Leishmania* promastigote

Le. donovani s.l.				
Xinjiang "771"	+	+	−	−
Xinjiang "801"	−	−	+	−
Shandong	−	−	−	−
Beijing	+	−	−	−
Le. gerbilli	+			
	−	−	−	−
Le. tarentolae?	−	−	−	−

(Qu & Bao, 1986)

by isoenzyme electrophoresis; the strain "771" of Bachu savannah, Xinjiang is similar to the strain from Beijing and corresponded to *L. infantum* identified by isoenzyme electrophoresis (Hu *et al.* 1985, Qu *et al.* 1986) (Table 12).

Isoenzymically and monoclonally, the Chinese *Leishmania* falls into two distinct species.

VI Diagnosis

From 1970's the following methods have been studied and/or used in diagnosis for VL within this country. (Chai *et al.* 1981, 1984)

1. Indirect Haemagglutination Test (IHA)
2. Direct Agglutination Test (DAT)
3. Indirect Fluorescence Antibody Test (IFAT) (Wang *et al.* 1981)
4. Cross Immune Electrophoresis (CIEP) (Qu *et al.* 1981)
5. Enzyme-linked Immunosorbent Assay (ELISA)

Samples of 20 cubic millimeter blood absorbed in filter paper taken and delivered for IFAT are used for surveillance.

VII Three type suggestion

According to the epidemiological figures Guan *et al.* (1976) considered that the Chinese VL can be divided into 3 types, namely, anthroponotic type, caninotic type and zoonotic type. But in the aspects of the origin of infection, the presence of CL, the responsible vector and the complications occurred, this classification was

Table 13 Three types of Chinese leishmaniasis (Guan *et al.* 1976)

	ANIHROPONOTIC	CANINOTIC	ZOONOTIC
DISTRIBUTION	plain area	hilly & mountainous area	desert area (Xinjiang, Inner Mongolia)
EPIDEMICITY	epidemic mainly in human population	sporadic	mainly among wild animal?
AGE	young adult & adult	under 10 years & infant	under 2 years
ORIGIN OF INFECTION	man	dog	wild animal?
TYPE	CI, non or rare wild animal +	CI, common	wild animal?
VECTOR	endophilic *P. chinensis* & *P. longiductus*	exophilic *P. chinensis*	*P. smirnovi*
COMPLICATION	PKDL present		

PKDL = Post Kala-azar Dermal Leishmaniasis, CL = Cutaneous Leishmaniasis

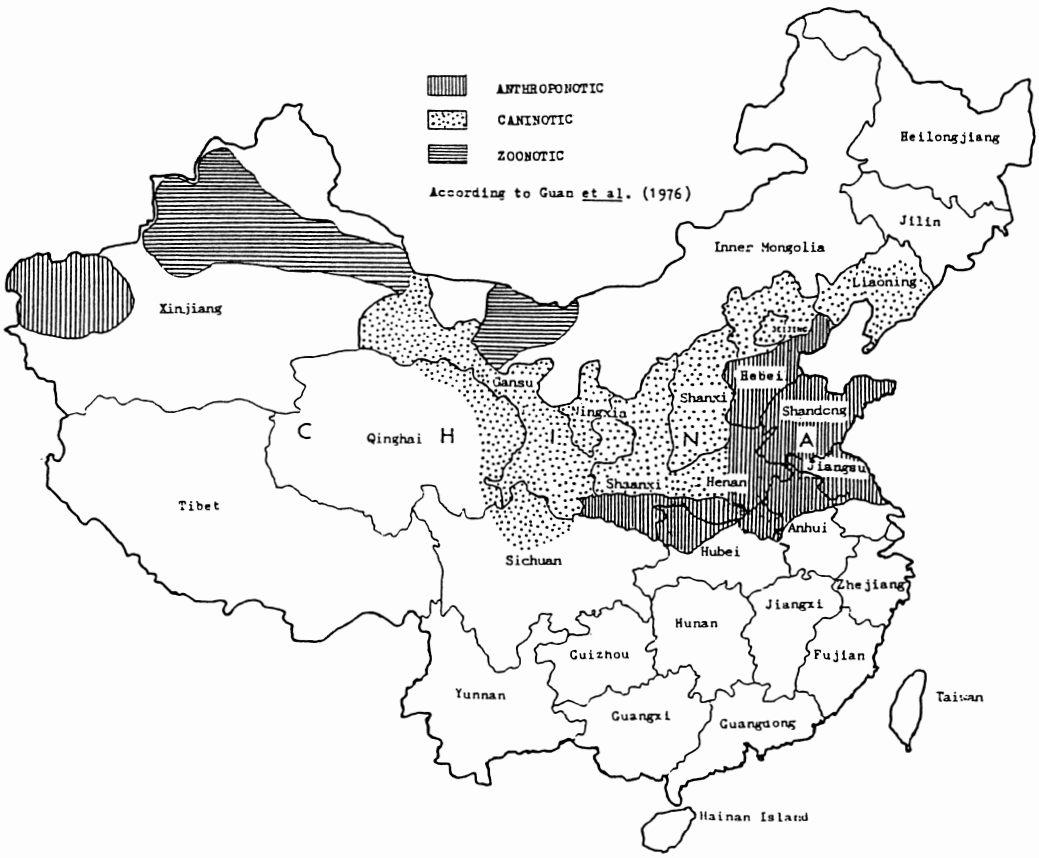

Fig. 8 Distribution of the three types of Chinese VL according to Guan *et al.* 1976

seemed to be artificially rather than naturally (Table 13, Fig. 8).

VIII The prospect of the study of Chinese leishmaniasis

1. *Qualitative*

1) The study of dermal leishmaniasis and its nature

About one hundred cases were reported with only one exception from the mountainous region of Gansu (Zhu *et al.* 1981), all cases scattered in the plain area of Shandong, Jiangsu, Heibei, Henan, Shaanxi, Anhui, Liaoning and Xinjiang. According to the analysis of 30 cases made in Shandong in 1980:

a. male: female = 13:1; b. adulthood: youth = 97: 3; c. combined with VL: PKDL: original CL = 5 :4 :1

2) Clarification of the existence of CL caused by *L. tropica* complex

About 10% of the reported dermal leishmaniasis from mainland were without any visceral change. The species of their pathogens of mainland CL and 2 autochthonous cases of cutaneous-subcutaneous leishmaniasis reported from Taiwan (Cross *et al.* 1985) have not been studied.

3) Other human leishmaniasis

Lymphatic leishmaniasis firstly noticed (Zhong, 1942) in a medical student of Beijing and it existed in Xinjiang (one case from Emin, Xia, 1978), Gansu (Zhong *et al.* 1982) and in Ejina Banner, Inner Mongolia (44 cases, Chen *et al.* 1981).

A case of muco-cutaneous leishmaniasis without visceral changes was reported from Tianjin (Zhu *et al.* 1953).

4) Incrimination of phlebotomine vectors in different endemic areas, sandfly fauna, relation to disease.

5) Indication of the wild and/or domestic animal reservoirs

6) The comparison of a sufficiently large number of *Leishmania* isolated from man, sandflies and animals by the aid of DNA probes, monoclonal antibody and isoenzyme electrophoresis.

2. *Quantitative*

1) Follow-up analysis of the human population and incidence of diseases in endemic area

2) Follow-up analysis of the sandfly and animal reservoir population, especially on their fluctuation in density and infection-rates

Shao *et al.* (1982) reported the results of surveillance in Shandong Province. Accordingly anthroponotic VL seems going to cease in this country. A small amount of phlebotomine sandflies were caught in 25 villages (15.2%) out of 165 in 31 counties. Intradermal test with leishmanin was carried out among 2,043 young children in the old epidemic area. No positive was revealed in 1982 compared with that over 20% positive in 1960. It seems that the preventive measure (discovery and treatment of patients, destroy the infected dogs and control of the vector phlebotomine) in anthroponotic VL area is successful. But the zoonotic VL still remained as an endemic disease over a huge area which shall be eradicated in the days to come.

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References

1) Artemiev, M. M. and Neronov, V. M. (1984): Distribution and ecology of sandflies of the Old World (Genus *Phlebotomus*). The USSR Committee for the UNESCO Program on Man and the Biosphere (MAB). Institute of Evolutionary Morphology and Animal Ecology, USSR Academy of Science, Moscow, pp. 70–71, 103–105. (in Russian)

2) Bolt, R. A. (1915): Sandflies (*Phlebotomus*) in China and their relation to disease. Chinese Med. J., 29, 78–86.

3) Cates, M. D. and Lien, J. C. (1970): The *Phlebo-*

tomus of Taiwan. J. Med. Ent., 7, 529–543.
4) Chai, J. J. and Guo, Y. K. (1963): An epidemiological survey of Kala-azar in Artux, Xinjiang. Chinese J. Hyg., 8, 100–102. (in Chinese)
5) Chai, J. J., Li, B. S., Wang, W., Liu, Z. E., Zhao, E. M. and Yi, M. M. (1981): Observations of immuno-diagnosis in Kala-azar patients. J. Epidemiology, 2, 206–208. (in Chinese)
6) Chai, J. J., Li, B. S. and Wang, W. (1984): Agglutination activities of lectins on various strains of *Leishmania* promastigotes. J. Parasit. parasitic Dis., 2, 43–45. (in Chinese with English summary)
7) Chen, D. H. (1981): Lymphatic leishmaniasis. Chinese Med. J., 61, 392. (in Chinese)
8) Cross, J. H., Gunning, J. J., Drutz, D. J. and Lien, J. C. (1985): Autochthonous cutaneous-subcutaneous leishmaniasis on Taiwan. Am. J. Trop. Med. Hyg., 34, 254–256.
9) Guan L. R., Wang, J., Hu, Y. D., Xiong, G. H. and Zheng, S. C. (1976): The epidemiological type of Kala-azar in China and its meaning for prevention and control. Res. Control Epid. Dis., 3, 225–232. (in Chinese)
10) Guan, L. R., Xu, Y. X., Li, B. S. and Dong, Q. (1985): The role of *Phlebotomus alexandri* in the transmission of Kala-azar. J. Parasit. parasitic Dis., 3, 85–88. (in Chinese with English summary)
11) Guan, L. R., Xu, Y. X., Mao, Y. D. and Wang, W. (1986): The Sandfly fauna and its role in transmission of Kala-azar in four landscape zones of Aksu Region, Xinjiang. J. Parasit. parasitic Dis., 4, 169–172. (in Chinese with English summary)
12) Hu, X. S., Lin, F. Q., Yi, T. L., Li, K. R., Yan, H. P., Hu, A. Q. and Peng, X. D. (1985): Studies on monoclonal antibodies against *Leishmania donovani* Xinjiang strain. Ibid. 3, 166–169. (in Chinese with English summary)
13) Kubo, D. and Sugimoto, T. (1943): A study of *Phlebotomus* in Manchouria. Part II The species, Part III Seasonal distribution and female-male ratio. Proc. Jap. Parasit. Soc., 15, 109–112. (in Japanese)
14) Lainson, R. and Shaw, J. J. (1979): Manson-Bahr, P.E.C. & Apted, F.I.C. (1983) Manson's Tropical Diseases, Bailliere Tindall, London, p. 746.
15) Leng, Y. J. (1955): Human Parasitology (editor in chief). China Medical College, Shenyang, 1st ed., p. 137. (in Chinese)
16) Leng, Y. J. (1982): A review of Kala-azar in China from 1949 to 1959. Trans. Royal. Soc. Trop. Med. Hyg., 76, 531–537.
17) Leng, Y. J. (1984): The basic knowledge and advance in phlebotomine sandfly (Diptera: Psychodidae) research, A guide to the advanced course for parasitologists in medical colleges, Organized by the Ministry of Education, PRC pp. 1–79. (in Chinese)
18) Leng, Y. J. (1987a): A preliminary survey of phlebotomine sandflies (Diptera: Psychodidae) in lime stone caves of Sichuan and Guizhou Provinces, Southwest China, and description of a primitive new Genus *Chinius*. Annals Trop. Med. Parasit., 81, 311–317.
19) Leng, Y. J. (1987b): Genus *Grassomyia* Theodor, 1958 (Diptera: Psychodidae) and the confirmation of *Grassomyia indica* Theodor, 1931 in China. J. Sci. Med. Jinan Univ., 2, 25–29. (in Chinese with English summary)
20) Leng. Y. J. (1987c): Phlebotomine sandflies and the transmission of leishmaniasis in China. Jap. J. Sanit. Zool., in publication.
21) Leng, Y. J. and Yin, Z. C. (1983): The taxonomy of phlebotomine sandflies (Diptera: Psychodidae) of Sichuan Province, China, with descriptions of two species, *Phlebotomus* (*Adlerius*) *sichuanensis* sp. n. and *Sergentomyia* (*Neophlebotomus*) *zhengjiani* sp. n.. Annals trop. Med. Parasit., 77, 421–431.
22) Leng, Y. J. Lane, R. P. and Lewis, D. J. (1987): The identity of two species of phlebotomine sandflies from Xinjiang, China. Annual Bulletin of the Society of Parasitology, Guangdong Province, 8–9, 40–43. (in Chinese)
23) Newstead, R. (1916): On the genus Phlebotomus Part III. Bull. Ent. Res., 7, 191–192.
24) New, R.R.C. and Leng, Y. J. (1985): Characterization of subspecies of *Leishmania* in China by isoenzyme electrophoresis. An interim report on work carried out in Jinan University Medical School under the auspices of the exchange agreement between Jinan University and the Liverpool School of Tropical Medicine, pp. 1–9.
25) Qu, J. Q., Bao, Y. F., Wang, J. and Hu, Y. D. (1981): The micro-ELISA technique in the serodiagnosis of vesceral leishmaniasis. Chinese J. Microb. Immunol., 1, 134–136. (in Chinese with English summary)
26) Qu, J. Q. and Bao, Y. F. (1986): Preparation and characterization of monoclonal antibodies against *Leishmania donovani*. J. Parasit. parasitic Dis., 4, 199–202. (in Chinese with English summary)
27) Shao, Q. F. Wang, Z. H., Han, S. L. and Zhang, P. J. (1982): The surveillance of Kala-azar after its disappearance in the old epidemic area. Chinese J. Epidemiol., 3, 35–37. (in Chinese)
28) Wang, J. and Bao, Y. F. (1981): A comparative study of indirect hemagglutination test and electrophoresis in diagnosing Kala-azar. Acta Chin. Acad. Med. Sci., Supplement 3, 7. (in Chinese)
29) Wang, Z. J. and Wu, Z. J. (1956): *Kala-azar.*

People's Hygienic Publiser, Beijing, p. 306. (in Chinese)
30) Wang, Z. J., Wu, Z. J. and He, K. Z. (1983): Advances in investigations and studies on Kala-azar in China since 1960. J. Parasit. parasitic Dis., 1, 65–73. (in Chinese with English summary)
31) Xia, H. Q., Sun, Y. Q. and Yu, M. X. (1978): A case report of localized lymph nodes Kala-azar. Res. Control Epi. Dis., 2, 147. (in Chinese)
32) Xiong, G. H., Guan, L. R. and Guo, Y. K. (1974): A study of the Kala-azar vectors in Xinjiang. Ibid. 4, 327–334. (in Chinese)
33) Xiong, G. H., Hu, Y. D., Guan, L. R. and Wang, J. (1976): The natural nidus of Kala-azar in Northwest China. Ibid. 1, 63–68. (in Chinese)
34) Xiog, G. H. and Jin, C. F. (1987): On the classification of subgenus *Larroussius* Nitzulescu, 1931 and *Phlebotomus wui* stat. nov. (Diptera: Psychodidae). Chin. J. Parasit. parasitic Dis., 5, 45–47. (in Chinese with English summary)
35) Xu, Z. B., Deng, Z. C., Chen, W. K. and Zhong, H. L. (1982): The discovery of a racoon dog (*Nyctereutes procyonoides*) as a wild animals reservoir of leishmaniasis. Beijing Medicine, 4, 11. (in Chinese)
36) Xu, Z. B., Blanq, S. L., Evans, D. A. and Peters, W. (1984): The characterization by isoenzyme electrophoresis of *Leishmania* isolated in the People's Republic of China. Trans. Roy. Soc. Trop. Med. Hyg., 78, 689–693.
37) Yin, Z. C., Leng, Y. J., Li, S. F., Wu, Y. X., Cao, C. Z. Jiang, N. F., Zhang, W. X. and Yu, F. Q. (1985): The investigation of a new vector *P.* (*Adlerius*) *sichuanensis* Leng & Yin, 1983 of visceral leishmaniasis in northwestern Sichuan. Internal material, pp. 4, map 1. (in Chinese)
38) Zhong, H. L. (Chung, H. L.) (1942): Localized leishmaniasis of the lymph glands. Chinese Med. J., 61, 19.
39) Zhong, H. L., Xu, Z. B., Cao. W. J. and He, L. Y. (1982): New types of lymph gland leishmaniasis in China. Ibid., 95, 303–306.
40) Zhu, H. Z. (1981): The first case of cutaneous leishmaniasis in Ganzu Province. Chin. J. Dermat., 14, 107. (in Chinese)