Treasure with blood: on the discovery of *Traumatocrinus* (Echinodermata, Triassic) crowns in China

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Abstract

A team of three paleontologists led by the important Triassic worker Te-You Hsu were killed in Guizhou during a field mapping project in 1944. A.T. Mu studied Hsu's crinoid collection and named a new species *Traumatocrinus hsui* after him in 1949. The first edition of crinoid Treatise did not acknowledge Mu's work and placed *Traumatocrinus* as junior synonym of *Encrinus*. However, it is now regarded as a valid taxon in the new edition published in 2011. During this study, original specimens reported by Mu were re-examined. Among them, 21 specimens survived to this day, and the rest of specimens mentioned in Mu were lost during the Second World War. The collection is illustrated with modern standards for the first time. Despite the hard working conditions endured by the Chinese workers during and shortly after the Second World War, this collection, including eleven slabs of crowns, one cup, eight columnals, and one holdfast curated in Nanjing, is the basis for family Traumatocrinidae.

Keywords: Crinoidea; *Traumatocrinus* crowns; Lagerstätte; Guanling; Guizhou

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1. Introduction

On April 24, 1944, three Chinese geologists/paleontologists Te-You Hsu (1908-1944), Kang Chen (1916-1944), and Yi-Si Ma (1919-1944) from the National Geological Survey of China (GSC) were killed by robbers on their field excursion to western Guizhou during the Second World War (see Lin, 2014; and references therein). Mr. Hsu was an outstanding paleontologist who specialized in Triassic stratigraphy of China. He received a Masters degree at Université Montpellier in 1935, and then he went to Paris to study decapods with Léonce Joleaud (1880-1938) (Joleaud and Hsu, 1935) before he returned to China. Mr. Chen received a Bachelors degree from the College of Arts and Sciences of Guangdong Province (now South China Normal University) in 1941, and joined the GSC in the following year. Mr. Chen worked closely with Mr. Hsu in Guizhou on several geological excursions. He was also a skillful technician and he prepared the first blastoids found in China and made accurate blastoid illustrations in Chi (1943, p. 113). Miss Ma received a bachelor degree in geology from the Central University in 1943. She was the only certified female geologist/paleontologist at that time, and she was fluent in English, German, French, Russian, and Japanese in addition to Mandarin Chinese (Geological Society of China, 1944).

This tragedy had a huge impact among the scientific community in China. Colleagues organized a special issue of *Geological Review* dedicated to them (Fig. 1) that was published in December of 1944. A close friend, Mr. Yu Wang (1909-1984), salvaged a manuscript from Hsu's backpack after searching through victims' belongings, and he edited the manuscript so that it could be included in the special issue (Hsu, 1944). The famous Chinese vertebrate paleontologist Chung-Chien Young (1897-1979) heard about the bad news while he was visiting abroad. He named a Triassic marine reptile *Platyognathus hsui* after T.Y. Hsu (Young, 1944). During the period from 1945 to 1949, the Geological Society of China established and named new awards/scholarships after Hsu, Chen and Ma to encourage more Chinese people to pursuit their careers in geology.

During the late 1940s, Professor A.T. Mu (also known as En-Zhi Mu) (1917-1987), Nanjing Institute of Geology and Palaeontology, was assigned to clean up and to sort out the fossil collection left behind after the Second World War. During the process, he found well-preserved crinoid crowns in the collection and published a short note in Chinese (Mu, 1948). Mu (1949) named a new crinoid species as *Traumatocrinus hsui* after T.Y. Hsu. This was the first report of *Traumatocrinus* crown in the world (Hagdorn, 1995, 1998; Wang et al., 2008a). A few workers (Klikushin, 1983; Kristan-Tollmann and Tollmann, 1983) had also reported the materials from China and Afghanistan, but they assigned *Traumatocrinus* to the Flexibilia rather than the Cladida (H. Hagdorn, personal communication, 2014). Yu et al. (2000) reported a new species *T. guanlingensis* from the Guanling area, Guizhou. Subsequently, Wang et al. (2011) reported another new species *T. strumiformis* from the same area. Today, this area is known for a major Triassic Lagerstätte and a national geopark has been established to protect fossil treasure on site (Wang et al., 2008b).

It has been 70 years since the tragedy. To commemorate the work of Hsu, Chan, and Ma, the author re-examined the type and figured specimens in Mu (1949) as a token of appreciation of this important work. This study emphasizes the historical significance of this collection to Chinese paleontologists. The history of the entire study of *Traumatocrinus* will be reviewed elsewhere (H. Hagdorn, personal communication, 2013).

2. Locality information

There are five crinoid localities listed in Mu (1949): 1) locality 1308; 2) locality KF39; 3) locality KF70; 4) locality KF97; and 5) locality KF102. Mu (1949, p. 85) mentioned that locality 1308 was discovered by S.S. Yoh (1899-1989) in 1927, but the description of this locality was not published until later (see Yoh, 1929, pp. 10-11). Locality KF39 was reported in Hsu (1940, p. 170), and it was the same locality discovered by Yoh (Mu, 1949, p. 85). Localities KF70, KF97, and KF102 were reported in Hsu and Chen (1943, pp. 22, 24, 26); however, Hsu and Chen (1943) mentioned that they followed the study by Chang (1942).

To summarize the information, Yoh obtained the first collection containing a few crowns of *Traumatocrinus* and passed it to Mr. Hsu. Hsu revisited the locality 1308 of Yoh (1929) and relabeled this locality as KF39 and/or KF39b (e.g., Hsu, 1940). With helps from K. Chen during subsequent field mapping in the region, they re-discovered fossil localities mentioned in Chang (1942) and reported the fossil localities KF70, KF97, and KF102 (Hsu and Chen, 1943). The specimens collected by Hsu, Chen, and Ma during the last trip in 1944 were not recognized in the collection.

3. Label types

3.1. *Mingguo label (MG; in Chinese)*

There is one unfilled label printed in traditional Chinese characters (Fig. 2A), with writing on its back (Fig. 3C). The date of entry on the bottom left starts with “Mingguo” (MG) for year designation; thus, the usage of MG label begins in 1911.

3.2. *Department of Geology, Shanghai Science Institute (SSI)*

This type (Fig. 2C) of label was produced by Japan’s colonial scientific research institute, The Shanghai Science Institute (SSI), during the Second World War. According to Liang and Zhai (2002), SSI was established on April 1, 1931 and was taken over by the Chinese government in September of 1945 after Japan surrendered. Although it was a short-lived institute (less than 14 years), it was a well-organized and well-structured institute with western standards. Subsequently, the geological/paleontological collections and reference books of SSI were transferred to its present day location in Nanjing. Therefore, the SSI labels are adopted for the present as the collection labels for the GSC after the war until the government agency began to print their own labels (Fig. 2D).

3.3. *Laboratory of Palaeontology, National Geological Survey of China (GSC)*

The GSC was founded on January of 1928 in Shanghai, and it was moved to Nanjing in September of 1932 to the present location in 1933 (Zhou, 1990). Due to

the Japanese invasion beginning in 1937, the GSC was relocated toward inland several times and returned back to Nanjing, finally, in 1946. Therefore, it was quite likely that there were no formal ID labels for paleontological samples before 1946. GSC labels (Figs. 2D, F, G, 3G, H) were printed and in use after the usage of SSI label because the earliest date was March 18, 1948 based on Mu's identification labels (Figs. 2D, 3G, H).

3.4. Institute of Geology and Palaeontology, Chinese Academy of Sciences (NIGP; in Chinese)

This type of label (Fig. 2E), also known as the NIGP label, is characteristic and came into usage in the 1960s (note the last digit of year designation was blank; thus, it is intended to use from the year 1960 to 1969). Therefore, it was used after Mu's study in the late 1940s. According the museum staff Dao-Jun Yuan, it was printed for the specimens that were on loan for display.

3.5. Others

There are some identifications written on papers of particular materials, including a) cotton paper (Fig. 3F); b) old exhibition ticket (Fig. 3B); and c) note card (Fig. 3E). In addition, there is another type of note card label that was a blank piece of paper cut into rectangles (Fig. 2B). These labels were used by A.T. Mu to make a preliminary identification prior to making the official identification label.

4. Writing on labels

Writing was inked on labels during several different periods by different authors. The oldest one is a label containing Chinese characters and four-digit locality numbers made with a large sheet of cotton paper (Fig. 3F). It was found in the box of the slab that was collected by S.S. Yoh. There are labels made by T.Y. Hsu, K. Chen, and/or Y.S. Ma (e.g., Figs. 2A, 3A-E). After the Second World War, A.T. Mu began his study on *Traumatocrinus* and left notes on three types of labels (e.g., Fig. 2B-D). In the 1960s, some specimens were on loan for display, and new labels with NIGP

headings were placed by the museum staff (e.g., Fig. 2E).

5. Discussion

5.1. Comments on labels

The oldest label in this collection is the Chinese label starting with the number of “1308” using type 5a material. Pencil marks of S.S. Yoh was added by Mu as he discovered that this locality number was used only by Yoh (see Mu, 1949).

The most obvious labels are the ones made by A.T. Mu with the identification dates on March 18th of 1948 or March, 1948 (e.g., Figs. 2B-D, F, G, 3G, H). These were written on either the type 2 (SSI label; Fig. 2C) or type 3 (GSC label; Fig. 2D) labels. Less formal identification notes were written on plain paper (Fig. 2B). The latter was probably written by Mu before transferring the information onto the formal labels. Type 4 or NIGP labels were added when these specimens were on loan for exhibition.

According to Mu (1949), some older identification labels were made by Hsu. These were type 1 (also known as MG label; Fig. 2A) and/or type 5b labels. There is only one note card (type 5c) (Fig. 3E) with “Encrinus carnalli Berich” (should be Beyrich; see Beyrich, 1856) typewritten and Chinese phrases of “crinoid”, “Middle Triassic” and “Guanling, Guizhou” (in traditional Chinese characters) written by using a Chinese pen brush. On the top, there are pencil marks of the Chinese below (but in simplified Chinese characters) with a number of “125” at the top right-hand corner. This label is clearly done during Hsu-Chen-Ma’s time. Although Mu (1949) thought this label was made by Hsu (Mu, 1949, p. 85), it is likely the label was prepared by Y.S. Ma because her first task, when she started working at the institute, was to sort out and categorize fossil specimens (Geological Society of China, 1944). In addition, the Chinese writings made with a calligraphy brush look very feminine. The pencil writing was added much later (after the 1950s) because of the simplified Chinese characters.

In addition, three labels (Fig. 3A, C, D) with handwritten Latin names were found

in the collection. These include one label of “*Traumatocrinus reticulatus* (Dittmar)” (Fig. 3D) and two labels of “cf. *Encrinus*” (Fig. 3A, C). They were probably marked by T.Y. Hsu, based on the fact that the locality “KF39b” was not mentioned by Mu and the latter two labels cited a German reference “Crinoiden des Musch.”, which is an important work done by H.E. von Beyrich (1858). Hsu thought Ernst Friedrich von Schlotheim (1764-1832) and Friedrich August von Quenstedt (1809-1889) also mentioned *Encrinus* in their studies. Among Hsu, Chen, and Ma, Hsu was the only person who had extensive training and was experienced with classical foreign paleontological literature. Hsu identified *Traumatocrinus* (see Dittmar, 1868) and *Encrinus* (see Beyrich, 1856) in the collection from the locality KF97 (see Hsu, 1944), but he assigned the crowns to the latter. Mu (1948, 1949) revised the identification and concluded that only *Traumatocrinus* was present in the study collection.

5.2. Comments on specimens

Within the collection, specimens 6909, 6923-31 mentioned in Mu (1949) were missing in the present collection at NIGP. Specimen 6908 was misprinted as 6968 in Mu (1949, pl. 2, fig. 2), because the latter number was used in Hsu and Ma (1948) for a graptolite *Acanthograptus bifurcus*.

During the re-examination of the type collection, there is no label marked as KF102. However, in the box of NIGP 6891 there were two specimens that do not look like they were collected from the same locality. The unlabeled specimen is referred here as collected from the KF102 and should be NIGP 6893, which was missing in the number sequence.

The figured specimens in Mu (1949, pls. 1, 2) are re-illustrated herein (Figs. 4, 5) for several reasons. First, the original image quality was not as high as the new illustrations. Second, some specimens were cut out in order to fit in the plate. Re-illustration is intended to capture and preserve as much information about the specimens as possible. Third, due to the difficulty of access to Chinese material the specimens are refigured for future reference. Fourth, there are six additional specimens (Fig. 6A-F) in the same collection that were not illustrated in Mu (1949). It

is clear from the illustration that NIGP 6921 (Fig. 4B) and 6922 (Fig. 6A) are part and counterpart specimens.

Some of the specimens were re-illustrated in Tien and Mu (1955, pl. 50, figs. 1-6), but they mentioned neither *T. hsui* var. *enormis* nor *T. sp. aff. T. timorensis* in Mu (1949). Most of the figures in Tien and Mu (1955) were reproduced from Mu (1949), except that *T. uniformis* was illustrated as both specimens NIGP 6933a and 6933b on the same bedding surface. They also reported and illustrated stems of *Encrinus* (Tien and Mu, 1955, pl. 51, figs. 1-3) in the same section for comparison. Although not in the same horizons, *Encrinus* had been reported in other Triassic strata in Guizhou (see Qingyan section; Hsu, 1943; Stiller, 1999).

Despite new information revealed by the discovery of crowns (Mu, 1949; Tien and Mu, 1955), *Traumatocrinus* was synonymized with *Encrinus* in the first edition of the crinoid Treatise (Moore et al., 1978, p. T720). In the new Treatise, the family Traumatocrinidae Mu, 1949 was recognized and included *Traumatocrinus* and *Vostocovacrinus*. Additional specimens of *Traumatocrinus* from North Afghanistan and Guizhou were also illustrated (Hess, 2011).

6. Conclusions

This study illustrates for the first time the entire pre-1950 *Traumatocrinus* collection from China that is present at the NIGP (Figs. 4-6). Based on the handwriting on the identification labels, some details of the early history of the collection and collectors can be understood and inferred. Although no specimen collection by Hsu, Chen, and Ma in 1944 can be located or confidently identified, these historically oldest *Traumatocrinus* crowns are highlighting the importance of this early collection not only for the Chinese but also for the international echinoderm research.

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Figure Captions

Fig. 1. Front cover of the *Geological Review* special issue (Volume 9, Issue 5-6) dedicated to Te-You Hsu (1908-1944), Kang Chen (1916-1944), and Yi-Si Ma (1919-1944). The journal width is 145 mm.

Fig. 2. Different label types of *Traumatocrinus* sp. at the Nanjing Institute of Geology and Palaeontology (NIGP), Nanjing. (A, E) From the container of specimen 6922. (B, C) From the container of specimen 6890. (D) From the container of specimens 6906 to 6908. (F) From the container of specimen 6920. (G) From the container of specimen 6933.

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Fig. 3. Important handwriting on the labels of *Traumatocrinus* sp. at the Nanjing Institute of Geology and Palaeontology (NIGP), Nanjing. (A, B) From the container of specimen 6890. (C) From the container of specimen 6922. (D) From the container of specimens 6906 to 6908. (E) From the container of specimen 6933. (F) From the container of specimen 6920. (G) From the container of specimen 6934. (H) From the container of specimen 6921.

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Fig. 4. Specimens of *Traumatocrinus* sp. illustrated originally as figs. 1-7, pl. 1 in Mu (1949). (A) NIGP 6920a-s. (B) NIGP 6921. (C) NIGP 6920n. (D) NIGP 6920a. (E) NIGP 6894. (F) NIGP 6891. (G) NIGP 6896. Scale bars = 10 mm (A, B, D-G); 3mm (C).

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Fig. 5. Specimens of *Traumatocrinus* sp. illustrated originally as figs. 1-11, pl. 2 in Mu (1949). (A) NIGP 6889a-c. (B) NIGP 6908. (C) NIGP 6910. (D) NIGP 6892. (E) NIGP 6932. (F) NIGP 6935. (G) NIGP 6934. (H) NIGP 6936. (I) NIGP 6937. (J)

NIGP 6933a. (K) NIGP 6933b, which is on the same slab of (J). Scale bars = 15 mm (A, D, E); 10 mm (B, C, F, G, J, K); 5 mm (H); 4 mm (I).

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Fig. 6. Specimens of *Traumatocrinus* sp. that were not figured in Mu (1949). (A) NIGP 6922, counterpart of NIGP 6921 (Fig. 3B). (B) NIGP 6890. (C) NIGP 6906. (D) NIGP 6907. (E) NIGP 6895. (F) NIGP 6893. Scale bars = 35 mm (A); 10 mm (B-F).

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地質論評

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中華民國三十三年十二月出版

許德佑 陳康 馬以思 紀念號

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中國地質

學會編輯

臨時通訊處:重慶

小龍坎四川省地質調查所博

fig 2

名稱			
系		時代	
號數		地點	
民國	年	月	日
目錄號			

A

Traumatocrinus hani (sp. nov.)
 貴州省關嶺縣法郎村後
 許德佑採 1938

KF 39

B

No. KF 39	6890
<i>Traumatocrinus hani</i> sp. nov.	
Loc. 貴州關嶺縣法郎村後 (中三疊統)	
Coll. 許德佑	
Department of Geology, Shanghai Science Institute.	

C

LABORATORY OF PALAEONTOLOGY
 National Geological Survey of China

Name	<i>Traumatocrinus hani</i> (sp. nov.)		
Loc. No.	KF 39	Coll.	T. Y. Hsu
Loc.	貴州法郎村		
Age	Ladinic		
Formation	Halobia Beds		
Ident. by	A. T. Mu	Date	18-IV-1948

D

中国科学院地质古生物研究所

名稱	<i>Traumatocrinus hani</i> (sp. nov.)		
野外號碼	KF 39	登記號碼	
產地	貴州法郎村後		
時代	T	建造	Halobia 層
采集人			
鑑定者	穆恩之	196	年 月 日
附注			

E

LABORATORY OF PALAEONTOLOGY
 National Geological Survey of China

Name	<i>Traumatocrinus hani</i> (sp. nov.)		
Loc. No.	1308	Coll.	S. S. Yok.
Loc.	貴州關嶺縣法郎村後		
Age	Ladinic		
Formation	Halobia beds		
Ident. by	A. T. Mu	Date	March 1948
6920			

F

LABORATORY OF PALAEONTOLOGY
 National Geological Survey of China

Name	<i>Traumatocrinus uniformis</i> (sp. nov.)		
Loc. No.	KF 39	Coll.	T. Y. Hsu
Loc.	貴州關嶺縣法郎村後		
Age	Ladinic		
Formation	Halobia beds		
Ident. by	A. T. Mu	Date	March 1948
6933			

G

fig 3

Cf. Encrinurus
Schlotheim Quenst.
 See "Crinoiden des Musch."
 410/13

A

中國地質學會主辦
 地質展覽會
 地點：兩路口中央圖書館
 時間：三月十四日至十六日
 上午九時至下午五時
 入場券
 每券收費壹元

B

Cf. Encrinurus
Schlotheim Quenst.
 See "Crinoiden des Musch."
 410/13

C

Traumatocrinus
reticulatus (Dittmar)
 KF3916

D

海百合 中三疊紀 貴州關嶺
Encrinurus carnalli Berich

E

S.S. 401308 海百合
 法郎, 關嶺縣
 貴州

F

LABORATORY OF PALAEONTOLOGY
 National Geological Survey of China
 Name *Traumatocrinus feneichouensis* (sp. nov.)
 Loc. No. KF 70 Coll. T. Y. Hsu & K. Chen
 Loc. 貴州關嶺縣關嶺場西
 Age Anisian
 Formation Huanling Formation
 Ident. by A. T. MU Date 18-III-1948

G

LABORATORY OF PALAEONTOLOGY
 National Geological Survey of China
 Name *Traumatocrinus hani* (sp. nov.)
 Loc. No. KF 97 Coll. T. Y. Hsu & K. Chen
 Loc. 貴州關嶺縣關嶺場西
 Age Ladinian
 Formation Haliluo Beds
 Ident. by A. T. MU Date 18-III-1948

H

A

D

fig 4

C

E

B

F

G

fig 5

A

B

C

D

J

E

F

G

H

I

K

fig 6