



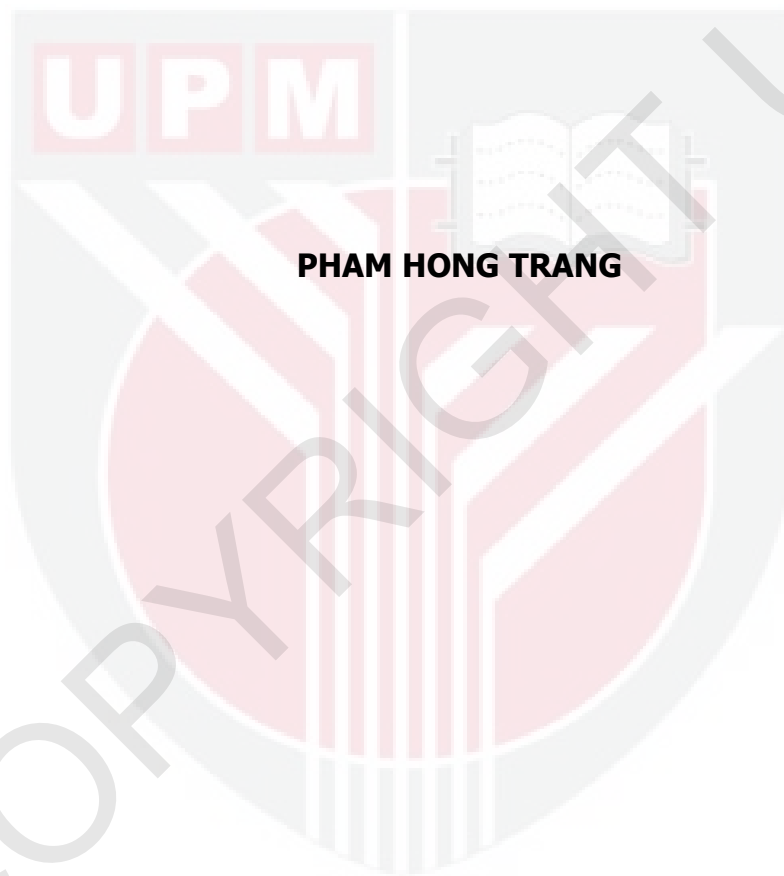
UNIVERSITI PUTRA MALAYSIA

***COMPARATIVE BIOMETRY AND MORPHOMETRY OF
STOMACH AND INTESTINES OF MUONG INDIGENOUS AND
VIETNAMESE WILD PIGS***

PHAM HONG TRANG

FPV 2012 32

**COMPARATIVE BIOMETRY AND MORPHOMETRY OF
STOMACH AND INTESTINES OF MUONG INDIGENOUS AND
VIETNAMESE WILD PIGS**



PHAM HONG TRANG

**MASTER OF SCIENCE
UNIVERSITI PUTRA MALAYSIA
JUNE 2012**



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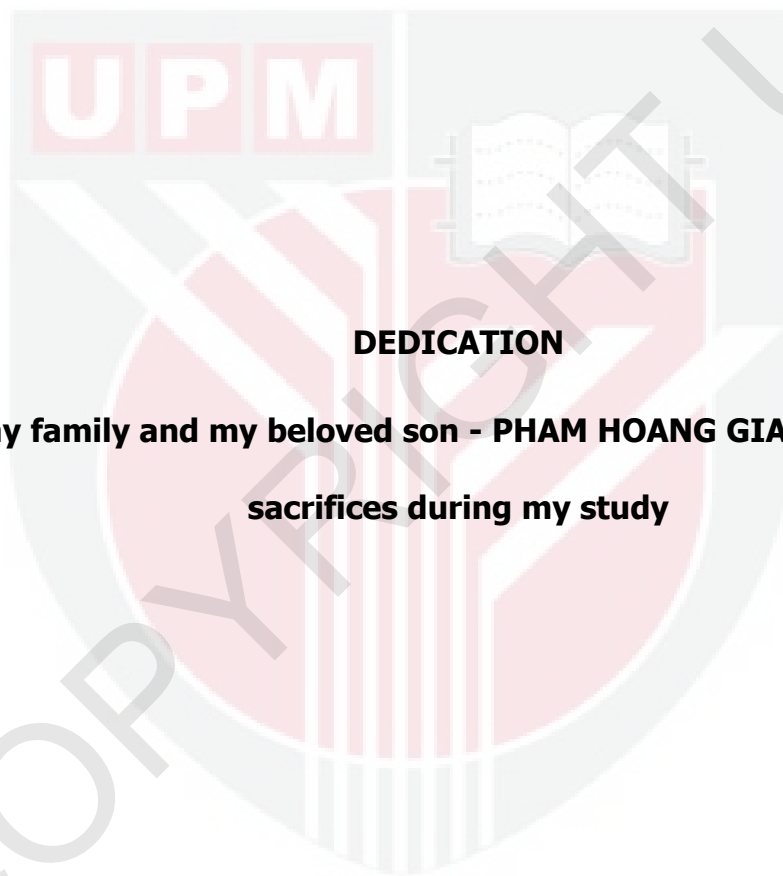
By

PHAM HONG TRANG

**Thesis submitted to the School of Graduate Studies,
Universiti Putra Malaysia, in fulfilment of the Requirement for
Degree of Master of Science**

June 2012



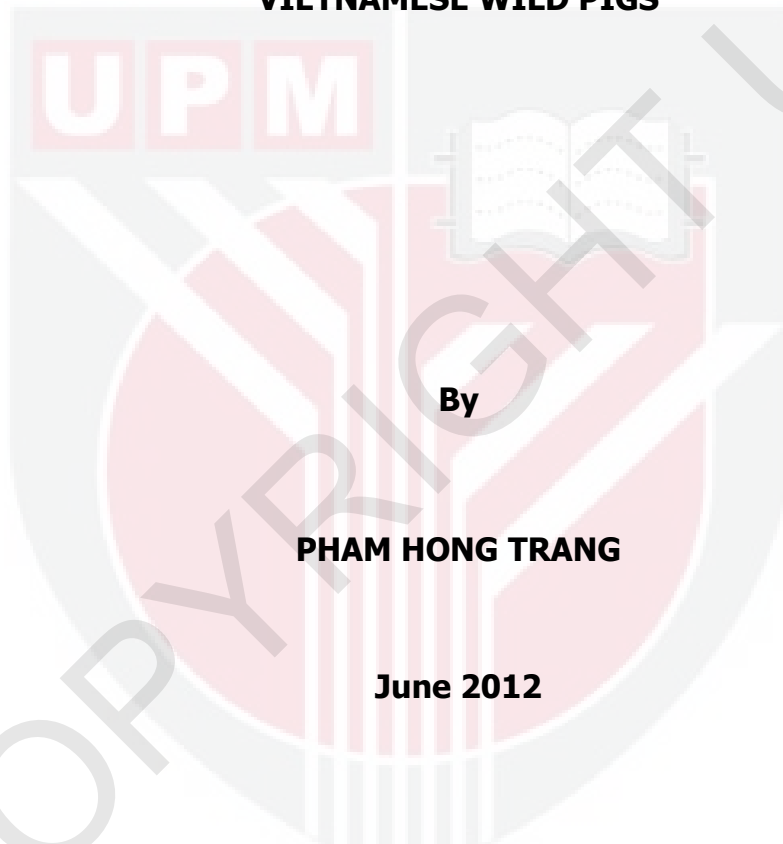


DEDICATION

**to my family and my beloved son - PHAM HOANG GIANG, for their
sacrifices during my study**

Abstract of thesis presented to the Senate of
Universiti Putra Malaysia in fulfilment of the requirement for
the degree of Master of Science

**COMPARATIVE BIOMETRY AND MORPHOMETRY OF
STOMACH AND INTESTINES OF MUONG INDIGENOUS AND
VIETNAMESE WILD PIGS**



By

PHAM HONG TRANG

June 2012

Chairman: Prof. Noordin Mohamed Mustapha, PhD

Faculty: Veterinary Medicine

Genetic studies have proven the diversity of Vietnamese indigenous pigs which is together with the Chinese strain providing the main genetic source of domesticated pig across East Asia. Moreover, the vestiges of wild pig ancestor of some Asian islands as well as Borneo have been found and still inhabit in center Asia. However, the genetic relationship between Vietnamese domestic and wild pigs has not been yet clearly defined. We hypothesized that after the long period of adaptation, the Vietnamese indigenous and wild pigs which are living in the same habitat may reveal some identical characters in morphology. On the top of genetic aspect, with regard to the evolution of the gastrointestinal system, we aim to assess the similarities and differences between Muong indigenous pigs and Vietnamese wild pig. Due to the protective nature and scarcity of procuring wild pigs, a total of 12 Muong indigenous pigs and nine Vietnamese wild pigs were studied.

The tape and commercial scale have been used in recording biometric data with 0.1 cm and 0.1 g graduation marking. The morphometry of gastrointestinal tract has been examined by using the basic histological staining method Haematoxylin and Eosin (H&E). Different staining methods such as Periodic Acid Schiff (PAS), Alcian blue pH 2.5 (AB pH 2.5) and Orcein - Alcian blue (Orcein - AB) were employed in evaluating histochemical reaction of GI tract.

The comparison of some selected biometric parameters indicates the marked difference; the body of the wild boars was 27.8% heavier and 31% longer

than the domestic form ($p < 0.05$); even the mass stomach of wild boar was statistically greater than that of Muong indigenous pigs (412.85 ± 15.21 vs. 271.72 ± 28.39) but the relative weight (to body weight) was not different reflecting the similar in ability of development. However, the dissimilarity in the shape of stomach may implies the difference in morphological structure; the Muong indigenous pig a presented higher relative weight of small intestine (5.2 vs. 4.8) but lower relative weight of large intestine (3.3 vs. 4.7); the wild boars revealed the shorter digestive tract but the difference was not significant ($p \geq 0.05$). Interestingly, the development of live body length, stomach mass, small and large intestine was highly correlated with live body weight ($0.96 < R^2 \leq 1$).

The histometry of the gastric gland region has reflected the identical structure with two out of three measured elements including the layers of tunica muscularis and tunica mucosa which were not statistically different ($p \geq 0.05$). On the other hand, the layer of submucosa was significantly thicker ($p < 0.05$); apart from the presence of numerous loose connective tissues, this feature may contributed by the abundance of blood vessels, white adipose tissues and nervous plexus. The appearance of lymphoid follicles underneath the tubular gastric glands in the wild boars exceeded that of Muong indigenous pigs. This finding suggested that the different immune responses are the result of feeding behaviors as well as individually reactions.

The small intestinal morphology and the thickness of the duodenum, jejunum and ileum and their muscularis externa, submucosa, inner mucosa, the height of villi and the depth of crypt were estimated. Only in the duodenum of the domestic pigs, the tunica muscular was significantly thicker ($p < 0.05$) than that of the wild counterpart. By contrast, the tunica mucosa was only significant different in the last portion of small intestine between two studied subjects. Additionally, the submucosal layer gradually elevated in two lower segments of the small bowel and once again, the domestic pigs presented higher proportion of this element. The height of villus decreased throughout the small intestine; however, the villus of Vietnamese wild pig was higher ($p < 0.05$) in the ileum. The depth of crypt shared the same falling feature but the significant different can be observed in the jejunum and ileum.

Despite the similarities at the duodenum and jejunum, morphometry of the ileum was significantly different between the two subjects in four out of five studied factors ($p < 0.05$). The most interesting finding was the quantity of duodenal goblet cell. Muong indigenous pigs possessed 2.88 times higher number of duodenal goblet cells compared to Vietnamese wild pigs. This result implied the differences of nutritional composition.

This study has partially completed the biometrical picture of the two subjects apart from providing the morphological data of the stomach and small intestines of Vietnamese wild pigs and their domestic counterpart. It also paved the way as a reference for further zoological studies.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Master Sains

**PERBANDINGAN BIOMETRI DAN MORFOMETRI PERUT DAN USUS
KECIL ANTARA KHINZIR MUONG TEMPATAN DAN BABI HUTAN
VIETNAM**

Oleh

PHAM HONG TRANG

Jun 2012

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Kajian genetik telah membuktikan terdapat kepelbagaian pada khinzir tempatan di Vietnam dan babi tempatan baka Cina yang merupakan sumber genetik utama untuk khinzir domestik di seluruh Asia Timur. Tambahan pula, wairisan babi hutan di beberapa kepulauan Asian dan juga Borneo telah ditemui dan didapati masih mendiami Asia Tengah. Namun begitu, hubungan genetik di antara baka domestik Vietnam dan babi hutan masih belum lagi ditakrifkan secara jelas. Dengan hipotesis bahawa setelah jangkamasa yang lama untuk ubahsuai, baka tempatan Vietnam dan babi hutan yang tinggal di habitat yang sama mungkin boleh menunjukkan beberapa cirian yang serupa dari segi morfologi. Selain daripada aspek genetik, berhubung dengan evolusi sistem pencernaan, matlamat kajian ialah untuk menilai persamaan dan perbezaan di antara baka domestik (khinzir tempatan Muong) dan babi hutan Vietnam. Oleh kerana peraturan perlindungan dan kesukaran mendapatkan babi hutan, sejumlah 12 ekor babi Muong tempatan dan sembilan babi hutan Vietnam telah dikaji.

Perbandingan beberapa parameter biometri terpilih menunjukkan perbezaan yang ketara: berat badan babi hutan Vietnam adalah 27.8% lebih berat dan 31% lebih panjang berbanding baka Muong tempatan ($p < 0.05$); kepadatan perut babi hutan Vietnam juga tinggi berbanding baka Muong tempatan (412.85 berbanding 271.72) tetapi berat relatif (berbanding berat badan) didapati tiada perbezaan yang menggambarkan keupayaan tumbesaran yang sama. Walau bagaimanapun, perbezaan pada bentuk perut mungkin menunjukkan perbezaan pada struktur morfologi; babi Muong tempatan

mempunyai berat relatif usus kecil yang lebih tinggi (5.2 berbanding 4.8) tetapi berat relatif usus besar yang lebih rendah (3.3 berbanding 4.7); babi hutan didapati mempunyai saluran pencernaan yang lebih pendek tetapi perbezaan tersebut adalah tidak ketara ($p \geq 0.05$). Menariknya, kadar tumbesaran panjang badan, kepadatan perut, usus kecil dan usus besar sangat berkait rapat dengan berat badan ($0.96 < R^2 \leq 1$).

Histometri bahagian kelenjar gastrik telah menunjukkan struktur yang sama dengan dua daripada tiga unsur yang telah diukur termasuk lapisan tunika muskularis dan tunika mukosa didapati tidak berbeza dari segi statistik ($p \geq 0.05$). Sebaliknya, lapisan submukosa didapati lebih tebal dengan ketara ($p < 0.05$); selain dari kehadiran pelbagai tisu perantara kendur, ciri ini mungkin disebabkan oleh banyak saluran darah, tisu adipos putih dan plexus saraf. Kehadiran folikel limfoid di bawah kelenjar gastrik tubul dalam babi hutan melebihi babi Muong tempatan. Hasil penemuan ini mendapati perbezaan pada kelakuan makan dan juga tindak balas individu boleh mengakibatkan gerak balas imun yang berbeza.

Morfologi usus kecil dan ketebalan yang merangkumi duodenum, jejunum dan ileum dan eksterna muskularis mereka, submukosa, mukosa dalam, ketinggian vilus serta kedalaman kriptal telah dikaji. Hanya dalam duodenum khinzir domestik didapati tunika muskular. Hanya pada babi Muong tempatan sahaja, tunika muskular adalah tebal secara ketara ($p < 0.05$) berbanding babi Vietnam hutan. Sebaliknya, tunika mukosa menunjukkan perbezaan yang signifikan dalam bahagian terakhir usus kecil antara dua

subjek yang dikaji. Selain itu, lapisan submukosa secara beransur-ansur meningkat pada dua segmen yang lebih rendah usus kecil dan sekali lagi, babi domestik menunjukkan perkadaran yang lebih tinggi bagi elemen ini. Ketinggian vilus didapati berkurangan sepanjang usus kecil; walau bagaimanapun, vilus pada ileum babi hutan dari segi statistik adalah lebih tinggi ($p < 0.05$). Kedalaman kriptas menunjukkan ciri penurunan yang sama tetapi perbezaan ketara didapati pada jejunum and ileum.

Walaupun banyak persamaan didapati pada duodenum dan jejunum, morfometri ileum menunjukkan perbezaan yang ketara di mana dua subjek dalam empat daripada lima faktor yang dikaji menunjukkan nilai p kurang dari 0.05. Penemuan yang paling menarik ialah kuantiti sel goblet duodenum. Babi Muong tempatan memiliki 2.88 kali lebih tinggi bilangan sel goblet duodenum berbanding babi hutan Vietnam. Hasil penemuan ini menggambarkan perbezaan dari segi komposisi pemakanan.

Kajian ini hanya memberikan gambaran biometri yang separa lengkap untuk kedua-dua subjek selain itu juga telah memberikan data morfologi untuk perut dan usus kecil babi hutan Vietnam berbanding khinzir domestik. Ia juga membuka jalan sebagai rujukan untuk penyelidikan lanjutan berkaitan zoologi.

ACKNOWLEDGEMENT

First of all, I would like to express a special thanks to my supervisor, Prof. Dr. Noordin Mohamed Mustapha for his kindness, advice and guidance during my study in Malaysia.

I also would like to thank the members of my supervisory committee: Prof. Dr. Md Zuki Abu Bakar and Dr. Ooi Peck Toung for their invaluable advice throughout my study.

I wish to thank officers and staffs in the School of Graduate Studies, Universiti Putra Malaysia for providing good services. I also want to present my appreciation to the officers and staffs in the Faculty of Veterinary Medicine, particularly to the staffs in the Laboratory of Histopathology. I am grateful to the staff in the Laboratory of Virology as well as the staff in the Laboratory of Hematology and Clinical Biochemistry for their assistances. Special thanks to Ms. Jamilah Jahari and Ms. Latifah Mohd. Hanan for their cooperation during the experiments. Thanks to Dr Mazlina Mazlan for helping to translate the abstract into Bahasa Melayu.

I would like to thank all my friends for their encouragement and assistance which provided me the endless power to complete my study.

Finally, I would like to express my most sincere gratitude to my beloved family for bringing me up and their ceaseless love and for the greatest sacrifice of my husband and my son Pham Hoang Giang.

I certify that a Thesis Examination Committee has met on 8 June 2012 to conduct the final examination of **Pham Hong Trang** on her thesis entitled **“Comparative biometry and morphometry of stomach and intestines of Muong indigenous and Vietnamese wild pigs”** in accordance with the Universities and University Colleges Act 1971 and the Constitution of Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The committee recommends that the student be awarded the **Master of Veterinary Science**.

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Saya mengasahkan bahawa satu Jawatankuasa Peperiksaan Tesis telah berjumpa pada 8/6/2012 untuk menjalankan peperiksaan akhir bagi **Pham Hong Trang** bagi menilai tesis beliau yang bertajuk "**Perbandingan biometri dan morfometri perut dan usus kecil antara khinzir Muong tempatan dan babi hutan Vietnam**" mengikut Akta Universiti dan Kolej Universiti 1971 dan Perlembagaan Universiti Putra Malaysia [P.U.(A)] 15 Mac 1998. Jawatankuasa tersebut telah memperakukan bahawa calon ini layak dianugerahi ijazah **Master Sains Veterinar**.

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Date:23 July 2012

DECLARATION

I declare that the thesis is my original work except for quotation and citation which have been duly acknowledged. I also declare that it has not been previously, and not concurrently, submitted for any other degree at Universiti Putra Malaysia and at any other institutions.



PHAM HONG TRANG

Date: 8 June 2012

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LIST OF ABBREVIATIONS

µl	- Microlitre
µm	- Micrometer
%	- Percentage
°C	-Degree Centigrade
AB	- Alcian blue
ANOVA	- Analysis of Variance
cm	- Centimeter
CD	- Crypts depth
g	- Gram
GIT	- Gastrointestinal tract
GLP-2	- Glucagon-like peptide-2
H&E	- Hematoxylin and Eosin
kg	- Kilogram
MC1R	- Melanocortin receptor 1
ml	- Millilitre
mtDNA	- Mitochondria Deoxyribonucleic acid
PAS	- Periodic acid schiff
SCFA	- Short-chain fatty acids
S.E.M	- Standard error of mean
VH	- Villous height
VH:CD	- Ratio of villous height and crypts depth

CHAPTER 1

INTRODUCTION

Pig breeding is one of the key drivers of the agricultural sector of Vietnamese economy. An increment of approximately 150% (2,230 tones) in national live pig output has been achieved through the five year period commencing from 2001 to 2005 (Anon, 2006). Currently, the Ministry of Agriculture and Rural Development of Vietnam reported that the total national pig population is about 26.3 million heads which is more than thrice that of cattle (Anon, 2011).

Alongside the foreign hybrid and exotic breeds utilized in large farms on an industrial scale, indigenous breeds are also popular and provide an important source of income for the household economy especially for the mountainous areas (Steinfeld, 1998). Furthermore, livestock in the Vietnamese household are small-scale and are mainly by taking full advantage of agricultural crops and does not require high initial investment (Tung *et al.*, 2005; Huynh *et al.*, 2006). These pigs are favored because of their advantage in endurance with low nutrient conditions, high resistance to disease, early sexual maturity in both male and female and ingenious in taking care of piglets (Jiang *et al.*, 2011). However, their growth performance is relatively low and is not favorable for modern pig industry (Ton and Thang, 2008; Dang-Nguyen *et al.*,

2010).Therefore, phasing out of this breed in the pig industry and also backyard farming is not an unexpected problem.

The unbalance in selecting and rearing of pigs has been observed in the Vietnamese pig industry. The documented studies have not been adequately focused and was mainly concentrated on more economically efficient strain such as MongCai (Ly *et al.*, 2002; Dang-Nguyen*et al.*, 2010). Among Vietnamese domestic pigs, Muong indigenous pig is one of the less popular due to its low growth rate, lower litter size, the rather slow first estrous appearance and exceptionally longer parturition interval later than other domestic breeds (Dang-Nguyen*et al.*, 2010). In an unpublished annual report in 2007 by the Hoabinh province's veterinary department, it is stated that this breed accounted for only 7.54% of the total pig population. Thus, this breed is deserved receiving more efficient conservation strategies.

The contribution of Vietnamese domestic pigs to the genetic diversity of Asian domestic population has been investigated. Hongo*et al.* (2002) have examined the skeletal morphology and mtDNA sequence of Vietnamese pigs and divided them into two groups. These are large and small Vietnamese pigs which have genetic relationship to Ryukyu wild boar of Japan and East Asia domestic pigs, respectively. The most common Asian halotypes appearing across East Asia

including Vietnam were also the most common modern domestic halotypes have been found in central China (Larson *et al.*, 2010).

However, the relationship between Vietnamese wild pigs and the East Asia domestic pigs still remains to be debated. Lan and Shi (1993) were unable to obtain the genetic relationship of Vietnamese wild pigs to those of both domestic and wild Chinese pigs while the Chinese domestic pig were obviously the direct descendant of its wild ancestor. Moreover, with the exception of the Vietnamese wild pigs, the wild pigs from Ryukyu Islands of Japan have no genetic relation to the domestic pigs of neighboring countries such as Laos, Thailand and Cambodia (Larson *et al.*, 2007; Ishiguro *et al.*, 2008). Conversely, a close genetic relationship has been found between the Vietnamese wild pigs and East Asian wild pigs (Ishiguro *et al.*, 2008). Hence, the complete picture of the relationship between wild and domesticated pigs of Vietnam requires further investigation.

Hypothesis

Vietnamese wild pigs bear anatomical and histological differences to others pigs (domesticated and wild) from different parts of the world.

In order to partially establish the similarities and differences in morphology as well as identify the degree of adaptation between Muong indigenous and

Vietnamese wild pigs, a study was conducted in this thesis with the following objectives:

- i. to compare biometric data of body and gastrointestinal (GI) tract;
- ii. to compare morphometry of the stomach;
- iii. to compare morphometry of the small intestines.

In an attempt to explain the mechanisms relating to their growth pattern, we also compare the two breeds with their commercial counterparts.

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