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JOURNAL

OF THE

NORTH-CHINA BRANCH

OF THE

ROYAL ASIATIC SOCIETY.

NEW SERIES, No. XIII.

YENCHING UNIVERSITY
燕京大學
圖書館
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SHANGHAI:
PRINTED AT THE "CELESTIAL EMPIRE" OFFICE.
1879.

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ROYAL ASIATIC SOCIETY CHINA SHANGHAI 上海
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REPORT

OF THE

COUNCIL OF THE NORTH-CHINA BRANCH

OF THE

Royal Asiatic Society,

For the Year 1878.

At the Annual Meeting held in January the following gentlemen have been elected Office Bearers for the year 1878, viz :—

T. W. Kingsmill, Esq., *President.*
F. B. Forbes, Esq. } *Vice-Presidents.*
E. C. Taintor, Esq., }
Joseph Haas, Esq., *Secretary and Treasurer.*
P. G. von Möllendorff, Esq., *Librarian.*
A. Fauvel, Esq., *Curator.*
C. T. Gardner, Esq., }
F. B. Johnson, Esq., }
A. Kraus, Esq., }
D. J. Macgowan, Esq., M.D., } *Councillors.*
J. E. Reding, Esq., }
T. G. Smith, Esq., }

During the year five Meetings have been held, when the following Papers were read :—

1.—"The Political and Commercial Intercourse of China with Central Asia, during the second Century, B. C.,"—by T. W. Kingsmill, Esq.

2.—"The Climatology of Eastern Asia,"—by Dr. H. Fritsche.

3.—"The Toming, an enthralled class of Chekiang,"—by D. J. Macgowan, Esq., M.D.

4.—"Droughts in China, A. D. 620-1643,"—by Alex. Hosie, Esq., M.A.

5.—"On the Stone Figures at Chinese Tombs and the Offering of Living Sacrifices,"—by W. F. Mayers, Esq.

6.—"The Ancient Language and Cult of the Chows, being Notes, Critical and Exegetical, on the Shih-king, or Classic of Poetry of the Chinese,"—by T. W. Kingsmill, Esq.

7.—The Comparative Study of Chinese Dialects,"—by E. H. Parker, Esq.

8.—"Sun-spots and Sun-shadows observed in China, B. C. 28—A. D. 1817,"—by Alex. Hosie, Esq., M. A.

9.—"The Fixing of some of the most Prominent Localities of Shanghai by Triangulation,"—by Lieut. G. Kreitner.

10.—"Periodical Change of Terrestrial Magnetism,"—by F. W. Schulze, Esq.

11.—"Supplementary Notes on the Periodicity of Famines in China and their connexion with Sun-spots,"—by Alex. Hosie, Esq., M.A.

12.—"Rock Inscription at the Northside of Yentai Hill,"—by J. Rhein, Esq.

13.—"The Family Law of the Chinese and its Comparative Relations with that of other nations,"—by Herrn P. G. von Möllendorff.

14.—"The Origin of Greek Names for China and the Chinese,"—by T. W. Kingsmill, Esq.

15.—"On the Alligators of China,"—by A. Fauvel, Esq.

In the course of the year twenty-five new members have been elected, while ten gentlemen resigned their membership. There is also to be recorded the sad loss by death of three valuable members in the persons of Messrs. E. C. Taintor, W. F. Mayers and F. E. Heyden, the two former having for a number of years been some of our most prominent and accomplished contributors.

Owing to difficulties which to overcome were beyond the control of the Editorial Committee, the publication of the Society's Journal has been unfortunately very much retarded, however its publication will very shortly appear.

A List of the Members is herewith appended.

Subjoined are the Treasurer's, the Librarian's and the Curator's Reports.

LIST OF MEMBERS.

HONORARY.

Sir Rutherford Alcock, K.C.B.
Sir Brooke Robertson, C.B.
Vice-Admiral Sir Charles Shadwell, K.C.B.
Sir T. F. Wade, K.C.B.
Sir W. H. Medhurst, K.C.B.
Rev. J. Legge, D.D., LL.D.
A. F. Marques Pereira.
Sir Harry S. Parkes, K.C.B.
Rev. S. Wells Williams, LL.D.
Geo. F. Seward, Esq.
Alex. Wylie, Esq.
Col. H. Yule.

CORRESPONDING.

Rev. J. Edkins, D.D.
W. Lockhart, F.R.C.S.E.
D. J. Macgowan, M.D.
Monseigneur de la Place.
Rev. W. Muirhead.
Rev. A. Williamson, LL.D.
Rev. Griffith John.
Rev. C. E. Moule.
Rev. Canon McClatchie, M.A.
Rev. Josiah Cox.
Rev. W.A.P. Martin, D.D., LL.D.
Rev. A. P. Harper, D.D.
Rudolph Lindau.
Dr. Bastian.
F. H. Hance, PH.D.
Rev. S.I.J. Schereschewsky, D.D.
J. C. Hepburn, M.D.
Rev. S. R. Brown, D.D.
D. B. McCartee, A.M., M.D.
Lieut. F. da Silveira.
Lieut. Col. Gordon.
John Fryer.
Dr. Ito Keischke.

RESIDENT.

E. L. B. Allen.
H. Bailey.
J. de Bielke.
J. D. Bishop.
Chevalier C. de Boleslawski.
J. McLeavy Brown.
J. Bryner.
Very Rev. Dean Butcher, D.D.
B. Christiernson, M.A.
J. M. Cory.
J. D. Crawford.
A. Davenport.
A. Fauvel.
H. J. Fisher.
F. B. Forbes.
P. E. Galle, M.D.
P. V. Grant.
R. A. Gubbay.
J. Haas.
G. W. Haden.
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F. Hirth, PH.D.
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J. Johnston, M.D.
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T. W. Kingsmill.
A. Kraus.
A. A. Krauss.
C. Kreyer, PH.D.
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L. S. Little, M.D.
E. G. Low.
G. G. Lowder.
C. Lueder-Redewisch.
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P. G. von Möllendorff.
Herbert S. Morris.
Peter Orme.
Rev. E. R. Palmer.
J. E. Reding.
Charles Rivington.
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J. Sampson.
E. A. Sassoon.
W. Saunders.
C. Schmidt.
Alexander Sim.
T. G. Smith.
A. B. Stripling.
H. Sutherland.
D. B. Tata.
Rev. J. Thomas.
Gerald E. Wellesley.
W. S. Wetmore.
A. G. Wood.
F. Youd.

NON-RESIDENT.

R. G. Alford—Hongkong.
Herbert Allen—Wuhu.
W. S. Ayrton—Hankow.
E. C. Baber—Chunking.
J. J. F. Bandinell—N'chwang.
C. D. Braysher—Newchwang
Byron Brenan—Peking.
H. B. Bristow—Chinkiang.
H. O. Brown—Berlin.
S. W. Bushell, M.D.—Peking.

—. Coignet—Japan
W. M. Cooper—Ningpo.
August C. Cordes—Tientsin.
H. L. Dennys—Hongkong.
J. Dodd—Amoy.
Rev. E. J. Eitel, PH.D.—H'kong.
E. Farago—Chefoo.
His Ex. J. H. Ferguson—Chefoo.
T. T. Fergusson—Chefoo.
Alex. Frater—Takao.
H. Fritsche, PH.D.—Peking.
C. Gardner—Chefoo.
P. Giquel—Paris.
G. B. Glover—U. S.
W. Gottburg, M.D.—Hamburg.
Rev. W. S. Hall.
J. L. Hammond—U. S.
T. Hanbury—England.
R. Hart—Peking.
Ed. Henderson, M.D.—England.
James Henderson—Tientsin.
A. E. Hippesley—England.
H. Hobson—Wenchow.
Alex. Hosie, M.A.—Canton.
J. Jamieson—Chefoo.
F. Kleinwächter—Amoy.
F. P. Knight—Newchwang.
H. Kopsch—Chinkiang.
W. Krey—Ichang.
W. Lancaster.
W. P. Mangum—Nagasaki.
H. P. McClatchie—Hankow.
Rev. G. D. B. Miller.
O. von Möllendorff, PH.D.—Tientsin.
J. Mongan—Tientsin.
Rev. G. S. Owen—Peking.
E. H. Parker—Chinkiang.
L. Pichon, M.D.—France.
Colin de Plancy—Peking.
David Reid.
J. Rhein—Chefoo
E. Rocher—Amoy.
Hon. James Russell—H'kong.
Hon. Phineas Ryrie—H'kong.
T. Sampson—Canton.
Lieut. C. A. Schultz—H'kong.
His Ex. C. A. Skatschkoff—St. Petersburg.
Hon. Cecil C. Smith—S'pore.
Reginald D. Starkey.
G. C. Stent—England.
C. C. Stuhlmann—Hoihow.
S. A. Viguier—Newchwang.
T. Watters—Ichang.
F. W. White—Hankow.
H. Wicking—Hongkong.
R. Chatterton Wilcox—H'kong.

TREASURER'S REPORT.

To the Committee of the

North-China Branch of the Royal Asiatic Society,

Shanghai.

Gentlemen,

In laying the Accounts of the North-China Branch of the Royal Asiatic Society before you, I regret to say that the same show a deficit of $107.64.

This however is not so discouraging as one might be inclined to think, looking at it superficially.

It is true that in comparison with last year's there is a great falling out in the proceeds from the sale of the Society's Journal, but this deficiency is to be accounted for, firstly by not having up to this date received the accounts of the booksellers for the last quarter, the proceeds of which will therefore appear in the new year's account; secondly the retard in the publication of last year's Journal, by which the sale was restricted to the former Journals, and thirdly our very liberal free contribution of the same.

On the other hand I am extremely glad to announce that the subscriptions collected in 1878 represent the goodly sum of $859.50, the highest figure ever reached in this item. Taking in consideration the movements of the resident members, the shifting about of the non-resident ones, this amount is highly creditable to our Society, as it shows the interest China residents take in the wellfare and progress of our Society. This is our chief income upon which our Society depends, with which we defray the numerous expenses, and which helps us to carry on the scheme the Society ever had in view, namely propagation of science in China, and supply means to study the country and people, among whom we live and of whom still so little is known.

Among the expenditures you will find the item of $128.43, the balance of a loan which we borrowed from the funds of the Shanghai Museum, with this item our old debt to the Museum is extinguished, and in the next year's account it will no more appear.

The "house expenses" show the usual annual average, as it is impossible with all economy to reduce them any more; the same remark applies to the "advertisements," and to the item of "expenses for transmitting journals."

Item "rent to the Shanghai Library" really belongs to the account of the Shanghai Museum, but should this expense be thrown upon that institution it would jeopardize its existence, as it has no means to defray it; this sum of Tls. 150 might therefore be looked upon rather as a grant given by our Society to the Museum.

The advance made to the "Celestial Empire" amounting to $126.76 really belongs to our 1879 expenditure, as it was for the printing of our next Journal. The same remark applies to the next item "tracing and carving maps for Journal of 1878," amounting to $114.00, of which we hope that a part of it will be refunded to us by the author of the "Climatology of Eastern Asia."

The expenses for the small exhibition we had on our premises together with the two "Conversaziones" in connection therewith amount to $24.90, a very trifling amount taking into consideration the pleasure it afforded the community in general, and the success the undertaking itself has enjoyed.

The income of the Shanghai Museum does not by much fall short to that of last year's. Next year the deficiency may be greater as there will be no refundment of monies from the Asiatic Society to be expected any more, the latter having paid up what was due to the Museum. While the income of the Museum for 1879 will thus be considerably curtailed, the expenditures on the other hand will be less inasmuch as the expense incurred for show cases, etc. will fall out. An extra expense will, however, have to be considered in order to increase the amount of fire insurance, the present sum Tls. 1,000 being inadequate to the value of the Museum's property say about Tls. 2,000.

The Shanghai Museum having gradually grown into popularity as an interesting and useful institution we may fairly count upon the continuance of the grant of Tls. 250 from the Municipality without which its existence would be doubtful.

JOSEPH HAAS,
Hon. Treasurer.

BALANCE SHEET OF THE

North-China Branch of the Royal Asiatic Society,

FOR THE YEAR 1878.

1878			$	c.	1878			$	c.
Sep.	3	To proceeds from sale of Journal	41	80	Jan.	1	Paid balance due to Treasurer from 1877	190	42
Dec.	31	,, Subscriptions collected in 1878	859	50	,,				
		Balance due to Treasurer	107	64	Dec.	31	,, balance of loan due to Shanghai Museum, Tls. 93.48	128	43
						31	,, house expenses, viz:— taxes, insurance, gas, coolie, wages, etc.	112	89
							,, expenses for Library, as bookbinder, etc.	6	90
							,, advertisements	79	72
							,, expenses for transmitting Journals	18	87
							,, rent to Shanghai Library, Tls. 150	206	05
							,, "Celestial Empire," advance for printing Journal of 1878	126	76
							,, tracing and carving maps for Journal of 1878	114	00
							,, extraordinary expenses, viz: Conversazione, shroff, etc.	29	90
		Total...	$1,008	94			Total...	$1,008	94

E. & O. E.

Shanghai, 31st December, 1878.

JOSEPH HAAS, *Hon. Treasurer.*

BALANCE SHEET OF THE

Museum Fund of the N.-C. Branch of the Royal Asiatic Society,

FOR THE YEAR 1878.

1878			Tls.	c.	1878			Tls.	c.
Jan.	1	To balance of 1877	87	95	Jan.	31	Paid carpenter for cases	102	32
Mar.	8	,, balance of loan to N.-C. B. of the R. A. Society	93	48	Mar.	28	,, Recreation Fund, interest on loan, Tls. 1,500	75	00
,,	20	,, sale of birds.....	1	92	Apr.	13	,, fire insurance	8	00
Apr.	8	,, grant of Municipal Council	250	00	Dec.	31	,, taxidermist's wages and utensils for Museum.....	208	01
					,,	31	Balance in hand of Treasurer...	40	02
		Total...	Tls. 433	35			Total...	Tls. 433	35

E. & O. E.

Shanghai, 31st December, 1878.

JOSEPH HAAS, *Hon. Treasurer.*

LIBRARIAN'S REPORT.

As stated in the various reports of my predecessors the Society has not been able to acquire by purchase any books, all the additions to the Library have been donations by authors and exchanges with other learned Societies.

Appended is a List of Works presented to the Library during the year 1878.

P. G. von MÖLLENDORFF,
Hon. Librarian N.-C. B. R. A. S.

LIST OF WORKS PRESENTED TO THE LIBRARY OF THE NORTH-CHINA BRANCH OF THE ROYAL ASIATIC SOCIETY DURING THE YEAR 1878.

1. Reports on Trade for 1876 and 1877.
2. Returns of Trade for 1876 and 1877, Part I.
3. The same in Chinese.
4. Medical Reports, 15th issue, 1878.
5. W. F. Mayers, The Chinese Government. A Manual of Chinese Titles, categorically arranged and explained, with an appendix. Shanghai, 1878, 8vo.
6. Annual Report of the Board of Regents of the Smithsonian Institution. Washington, 1876, 8vo.
7. Smithsonian Report, 1875, 1876.
8. Smithsonian Contributions to Knowledge, Vol. XX and XXI. Washington, 1875, 1876, 4to.
9. Bulletin of the Essex Institute, Vol. VIII, Nos. 1-12, 1876, 8vo.
10. Annual Report of the Trustees of the Museum of Comparative Zo-ology at Harvard College in Cambridge. Boston, 1876, 8vo.
11. F. Scherzer, Journal d'une Mission en Corée par Koeiling, Ambassadeur de S. M. l'Empereur de la Chine près la Cour de Corée en 1866. Paris, 1877, 8vo.
12. R. K. Douglas, The Life of Jenghiz Khan. Translated from the Chinese. With an Introduction. London, 1877, 8vo.

13. Oestereichische Monatsschrift für den Orient. No. 12, Dec. 1877. Nos. 1-10, 1878.
14. Bulletin de la Société de Géographie. Oct., Nov., Dec., 1877. Jan., April, May, June, July, Paris, 1878.
15. Monatsbericht der Kgl. preuss. Akademie der Wissenschaften zu Berlin. Jan., Febr., März, April, May, June, July and Aug. 1878.
16. Department of Agriculture. Washington, 1877.
17. Naturhistorische Hefte, herausg. vom ungarischen National Museum. Budapest, 1877, Vol. I.
18. L. von Lóczy, Die Liszkovaer Höhle im Baráthegy. Budapest, 1878, 8vo.
19. Atti della R. Akademia dei Lincei. Transunti, Vol. II, fasc. 1-6. Roma, 1878, 4to.
20. Repertorio Sinico-Giapponese, fasc. III. Firenze, 1877.
21. Mittheilungen des Vereins für Erdkunde zu Halle a. S. 1877.
22. Proceedings of the Ninth Annual Session of the Am. Philological Association. Hartford, 1877.
23. Proceedings, Am. Oriental Society, 1877, 1878.
24. Proceedings of the R. Society of Edinburgh, Vol. VI-X.
25. Boletin Astronomico de Mexico, 1878.
26. Legrand, La Nouvelle Société Indo-Chinoise. Paris, 1878.
27. The Entomologists Monthly Magazine. London, 1878, June.
28. A. M. Tudom. Akademia Évkönyvei, 1875.
29. C. B. H. von Rosenberg, Reis tochten naar de Geelvinkbaai op Nieuw-Guinea in de Jaren, 1869 en 1870. 'S. Gravenhage, 1875, 4to.
30. A. Agassiz, North American Starfishes. Cambridge, 1877, 4to.
31. Trübner's Am. and Oriental Literary Record, No. 129-301, 131-32, 133, 134. 1878.
32. Transactions of the Asiatic Society of Japan, Vol. VI, Part I, II (3 copies), 1878.
33. Second Report of the Chinese Polytechnic Institution. Shanghai, 1878, 8vo.
34. Bijdragen tot de Taal-Land-en Volkenkunde van Nederlandsch-Indië. Derde Volgers: X, 1, 2, 3; XI, 1, 2. Vierde Volgers: I, 1; Verslag, 1851-1876.
35. Proceedings of the Royal Society. Vol. XXV, No. 175-178; Vol. XXVI, No. 179-183. 1878.
36. Journal of the Statistical Society of London, Vol. X, Part I (1847); XII, 1 (1849); XVI, 3, 4 (1853); XL, 1-4 (1877); XLI, 1 (1878.)

37. Proceedings of the R. Geographical Society, Vol. X, 1 (1865); XII, 1 (1868); XVI, 4 (1872); XXI, 2-6 (1877); XXII, 1-3 (1878.)
38. The Journal of the R. Geographical Society, Vol. XLVI, 1876; XLVII, 1877.
39. Mittheilungen der Geographischen Gesellschaft in Wien, 1877.
40. Journal of the Straits Branch of the R. As. Society, Vol. I, 1878.
41. Revd. J. B. Hartwell, The Foochow Essays. Shanghai, 1877, 8vo.
42. C. Alabaster, The Doctrine of the Chi.
43. ———, The Triune Powers, Amoy.
44. Sitzunzsberichte der mat-phys. Classe der K. b. Akademie der Wissenschaften zu München. Heft, 2, 3 (1876); 1, 2 (1877.)
45. Gümbel, die Geognostische Durchforschung Bayerns. Rede, 1877, 4to.
46. Sitzungsberichte der philos.-philol. und hist. Classe. München, 1876: 4, 5; 1877: 1, 2.
47. Carl von Prantl, Verstehen und Beurtheilen. Festgabe, 1877, 4to.
48. Döllinger, Aventin und seine Zeit. Rede, 187, 47to.

Shanghai Museum.

REPORT OF THE CURATOR FOR THE YEAR 1878.

The Curatorship of the Shanghai Museum of Natural History having been in my hands since November 1877, that is above a year, I now beg to hand to the Council of the North-China Branch of the Royal Asiatic Society my report hereon and also take advantage of this opportunity to make some suggestions towards the improvement and enlargement of the said Museum.

Since November 1877, one hundred and thirty-seven birds have been presented to the Museum; the greater number from Shanghai and its neighbourhood, some from Ningpo and Chinkiang, and a few from Chefoo. Amongst them we met with only fourteen new to the collection. They were:—

Some couples of the Mongolian grouse (*Syrrhaptes paradoxus*), bought in the Shanghai Market, known as Smith's Market.

A few specimens of the Japanese Ibis (*Ibis Nippon*) sent from Ningpo by Mr. J. A. Meyer.

A female Temminck Tragopan (*Ceriornis Temminckii*), sent by Mr. J. M. Young; also a female Darwin's Puckras Pheasant (*Phasianus Darwinii*), presented by Mr. W. M. Cooper, H.B.M.'s Consul at Ningpo.

Two specimens of the Albatross (*Diomedea Derogata*) were received; an adult one from the Chusan Islands, sent by Captain Croad, and a young one in its brown plumage sent from Chefoo by Mr. Donnelly. Unhappily as often happens with birds sent from distant ports, this last specimen arrived in too bad order to be mounted.

From Mr. Ballard, of the Kiangnan Arsenal, we received the only specimen of Tantale (*Tantalus leucocephalus*) we possess.

A Chelidon lagopoda, taken at sea by Mr. Knot, was also added to the collection.

I myself brought from Chefoo a pair of storks (*Ciconia Nigra*), of which one in young plumage has been placed in the Museum as the only representative of the species. The other one is

still alive and will be sacrificed to science when in full adult plumage.

A parrot is also new to the collection, but its origin is doubtful. To Dr. Burge we owe a beautiful specimen of the Great-Belted Kingfisher. A very rare bird of the same species was sent to the Museum by Mr. G. W. Hayden, Lightkeeper on the Island of Sha-Wei-Shan. Unhappily it was not in a condition to be mounted, and we had to preserve the skin simply by drying it.

With one or two more birds which I have not been able to name yet, I close the list of the additions to the ornithological collection.

This makes up the total of the birds to about four hundred, but as the Chinese birds described or named in Abbé David's beautiful work "*Les oiseaux de la Chine*" are eight hundred and thirteen in number, it is evident that we are far from having completed the collection. However with a few exceptions, most of the northern birds are in Museum; but owing to the difficulty of sending animals in the flesh from distant ports, or of finding men able to skin them properly there, we are poor in southern birds, and it would be a great boon to the Museum if a good correspondent and collector could be found in Hongkong, Canton, or Manila, perhaps even Singapore, as many of the birds of these southern shores migrate in summer as far north as Shantung.

The Museum's collection of Mammals and Reptiles has also been enlarged. Among the most valuable of these additions we must mention a large Fur Seal from the Japanese northern seas. A female of the *Hydropotes inermis* has been bought in the Shanghai market; we still want a good old male with tusks. A grey-breasted squirrel *(Sciurus griseipectus)* was offered by Mr. Krauss and two Angier's Deers were given by Mr. F. B. Forbes.

In September the carcase of a Russian Bear was sent from The Farm, some parts of it being already in a state of decomposition. Our native taxidermist Mr. Clement Wang took great pains in preparing it under my directions; but we failed entirely owing to the heat. Had we possessed a proper dissection room we might have succeeded better.

The two lower jaw bones of a Japanese Whale were recovered from an adjoining timber yard, where they had been placed with some lime to dissolve the fatty tissue attached to them.

But of all the most important addition to the Museum is the still little known Chinese Alligator, of which two specimens have been received. The first, an adult male, was dug up from its

burrow in the neighbourhood of Wuhu, and was presented alive to the Museum by Mr. J. L. E. Palm. It was dissected and mounted, and adorns our collection. The second specimen, a female, was received from Chinkiang in October, and kept alive till December 24th, when it died. The carcase was placed in spirits of wine and sent in January 1879, to Mr. A. Milne Edwards, the learned Curator of the Paris Museum, to be studied and named, as it appears to be a new species.

The number of Insects, Molluscs, and Snakes has been increased by only a few specimens. One Butterfly new to the Museum was found by me in the Shanghai Public Garden.

Of fishes we received two or three only, and I could have made a very decent collection had we proper accommodation and more room. We have only wretched glass tubes made here, which always leak in summer, and still more wretched looking jars or bottles of every form and shape, of all shades and colours, descript and nondescript; old jam pots, preserve bottles, medicine vials, with the names of Crosse and Blackwell or others cast on them. This is really a part of the Museum I am ashamed of; but the sinews of war, which are also those of science and progress, are missing. "*Pas d'argent, pas de "suisses"* say the French; no money, no collections, echoes the Curator of the Museum. Under such difficulties it is indeed impossible to make any serious attempt to form a collection of Chinese fishes.

This collection I consider a most important one, as this branch of our Chinese Natural History is still little known; there is no good work yet published on Chinese fishes. Consequently, I would strongly recommend the Society to spend a certain sum of money in buying proper glass jars at home, then decent looking *étagéres* could be built for their reception, and the Shanghai market would furnish us at once with a goodly number of curious fishes.

I do not know how many pet dogs and birds have been stuffed for their afflicted owners. A good many boar-heads, foxes, and birds, have also been mounted as trophies for the proud Nimrods who have distinguished themselves on the hunting grounds of the Celestial Empire. But no list is kept of these, and the charge of half a dollar or more for such work made is, by a rule which I found established, the benefit of our taxidermist.

A few skins of birds kept as duplicates were also sold to private collectors for the benefit of the Museum. Unhappily we have no room, no accommodation, to keep a stock of these

commodities, and this is another of the desiderata or improvements suggested.

Three new glass cases have been added during the year to contain the new objects, but when I ask for more I am reminded that the Museum has been put in debt by this extravagant expense, and that there is no more money forthcoming.

In the way of an herbarium we have nothing, and really it is useless attempting to create one before we have room to place it, as the Museum is already quite full.

I should recommend that some skeletons of the typical Chinese Mammals, Deer, Tiger, etc., be procured and mounted, but alas, where are we to put them?

An important improvement was tried last year in endeavouring to start a Mineralogical collection, and our President, Mr. T. W. Kingsmill, gave for this purpose his valuable collection of minerals and fossils, which can form a good nucleus for the practical illustration of Chinese geology, another branch of our Natural History which is little known. I am sorry to say that one third of this collection is still unprovided with a show case, for the reason I have already stated.

It is great pity, for Chinese fossils are not known at all. I have endeavoured to increase this mineralogical collection, and have already received through Captain Anderson of the Chinese Revenue Cruiser "Kua-shing" samples of the different rocks of the Islands in the neighbourhood of Shanghai and Ningpo. I intend moreover to write to the engineers in charge of the coal mines now in process of opening in Chihli, Formosa, and Anhuei, in order to invite them to send to the Museum samples of the different strata traversed by the borings and some of the most important fossils. My colleague, Mr. Keymeulen, Assistant-in-charge of the Customs at Keelung, has already promised to interest himself in this matter.

But then we must renew our demand for space. We have really none left in the only room now constituting the whole of the Museum, and supposing that funds are subscribed for the keeping of the institution, they will be of little use as long as the increase of the collections is checked by this want of space.

We must also mention that a valuable collection of books on Natural History was added to the Museum Library. It consists of works belonging to the late Curator, Mr. J. P. Martin, and which, thanks to the liberality of his friends and of some lovers of natural science, were purchased from Mrs. Martin for the sum of 500 Dollars. They are now placed in the cupboards under the show cases for want of a more available and convenient

place. A list of these books is here appended. This is the place to mention that we do not possess yet the most important of all books for the Museum, that is the excellent book on the Birds in China published last year by M. l'Abbé Armand David. In order to be able to classify our collection, I have been obliged to buy a copy at my own expense, as I knew well that our exchequer could not bear the expenditure of six pounds sterling which it necessitates. If money is once more forthcoming, I strongly advise the Council to procure that book, as well as that of Siebold on the Birds of Japan. I am told that another book on the Birds of China is now in preparation in England from the notes and publications of the late Mr. Swinhoe. I dare say it would be also a necessary adjunct to our collection. Sending skins home for identification is a very good thing, but it often occurs that they never come back any more, or at least that the best ones are kept in order, it is said, to recognise the services of such and such Museum towards the North China Branch of the Royal Asiatic Society. I have some experience of this kind of friendship between scientific bodies, and I strongly advise the Council not to allow any rare skins or specimens to leave the Museum, unless it is altogether intended as a gift, for which no returns is expected, except perhaps in books or publications. Some exchanges may be made, but unless they come from Eastern shores of Asia I do not care very much for them. Indeed, our Museum is already far too small to receive the whole of the objects necessary to illustrate the Natural History of China. Why should we attempt generalization? Except in the very largest cities as London, Paris, New York, etc., it is absurd to attempt to collect everything, and scientific people at home are more and more advising the formation of local museums, as the only means of discovery and progress, the generalities of science being pretty well known in our enlightened century. Such I think must be the aim of our Museum curators. Let us illustrate China, and perhaps Japan as it is closely allied in everything, as well and completely as possible; let us collect for our library all the new works on Chinese and Japanese Natural History, publish our new discoveries, and then the Shanghai Museum will be of good use, not only to our increasing community but also to the scientific world at large.

I think there is yet another way in which the Museum could be made useful to the public. From the occasional demands I have received now and then from merchants, for information about various Chinese produce, as hemp, jute, China grass, silk,

it would be perhaps very useful to make in the Museum a collection of the raw products of the Empire.

This would be a kind of commercial collection, which could be accompanied by small models of Chinese machines, etc. If not of great use to merchants it would certainly help them sometimes and aid to the practical education of children destined for trade. It would be easy to procure those samples.

But before thinking of days of glory and use for our Museum, we must turn our eyes to stern reality and make first the necessary repairs to its roof, which leaks badly, endangering the safe custody of the existing collection.

As you will gather from this report, the wants of the Museum are threefold, 1st, repairs; 2nd, more space, and 3rd funds. I should perhaps place first this 3rd consideration, as it is evident enough that we cannot go on repairing without money.

The Municipal Council last year kindly granted us a sum of 250 Tls. for which we can show good use. We must now turn beggars again and implore more assistance, without which we must perish. Now I do hope for the sake of science that the enlightened population of the Model Settlement, always, so ready for progress that it is even mooted by a company of intelligent men to introduce here the electric light, will not allow the useful institution of the Museum to fall to the ground. Museums are indeed becoming daily of more importance in the practical and scientific education of men.

We already possess good schools in Shanghai; some more are contemplated, or even in progress, for the education of both Foreign and Chinese children, and I am sure I cannot be mistaken in saying that the Museum, enlarged as I propose, will be a practical and necessary adjunct to these schools. I am glad to say it has been already understood in this way by the best of our existing schools. The Jesuit Fathers have indeed sent their pupils to visit our collection, and you all know that their Museum in Siccawei, for which they have lately received a skilful taxidermist from Paris, was established for this purpose.

In conclusion, the most important of all things now for the Museum is the sinews of war which are also the sinews of science and progress, that is money. I hope you will excuse me for always asking for it, but if Cato's of old often repeated "*Delenda est Carthago*" ended in success for Rome, I dare say to you, without comparing myself to the old severe censor, and with hopes of glory for Shanghai, go to Mecènes, that is the Municipal Council: "*Petite et Accipietis.*"

Address to the Members

OF THE

N.-C. BRANCH OF THE ROYAL ASIATIC SOCIETY,

DELIVERED AT SHANGHAI, 3RD FEBRUARY, 1879,

BY THOS. W. KINGSMILL,

President.

IN closing the second year during which it has been my privilege to act as your President, it is but right that I should pass in review the more salient points of those investigations in which our society is more especially interested; in the hope that more attention may be paid to many of the important topics on which information may be gained in China.

Although in many respects we are here at a disadvantage compared with those working in Europe, and although we have no official support of any kind to scientific research, and but few means of making ourselves acquainted with the rapid march of science elsewhere; there are conditions which render our position in some cases an advantageous one.

We have ready access to the stores of Chinese records handed down from an antiquity at least respectable, and we enjoy means of making ourselves acquainted with a literature but little studied or comprehended in Europe.

If we ask have we made the best use of those opportunities, I fear that the answer must be in the negative, and that with but few exceptions we have been content to follow rather than to lead, and that most of the sound and useful work already executed has been performed by students at a distance from China.

It is thus that the years immediately past have been marked by few extensions of our knowledge of China, and both our literary and political relations have remained almost in *statu quo*. Few new investigations have been commenced, nor has the period been productive in bringing to an issue former controversies. In the physical sciences our gains have been few, and

the passion for geographical exploration which has so much extended our knowledge of other regions has left China comparatively neglected. Our maps of China are still remarkable for what they omit rather than for what they contain, and its geology and mineralogy remain almost untouched.

In what has been done, however, our Society has continued to hold a high place, and has afforded a stand point where men of differing views have been able to meet on common ground without their differences lending to polemical disputes, and it therefore remains for the members to advance in the future the objects for which we have been formed by themselves moving forward in original researches, or by aiding and abetting by their influence and position those who are willing to assist in the work.

This is the more necessary that our Society has had during the past two years to regret the loss by death or departure from China of many of its most distinguished members. In its recent issues the names of the contributors will, for the most part, be found to be new, and this alone, while it holds out a prospect of future usefulness, should lead us to emulate the zeal and learning of those who have gone before.

Among those who have passed away the name of Charles Wickliffe Goodwin, who has in former times occupied the chair to which you have done me the honour to call me, will long be remembered. Although his early predilections led him to become a master of Egyptian antiquities, his was a mind which could not fail to take an interest in all that concerned philology and ethnology, and to his advice and assistance always willingly given I have myself been frequently indebted. The death of William Frederick Mayers who had risen to the first rank as a student of China and the Chinese, and who has often enriched our pages out of his wonderful stores of Chinese lore has also been a severe loss to our small Society. The volume of our transactions just published contains in an interesting account of Chinese Burial Rites one of the latest of his many investigations. Robert Swinhoe, F. R. G. S., F. Z. S., many of whose valuable and original contributions to our knowledge of the natural history of China are to be found in our Transactions from time to time, has also passed away. Mr. J. Patrick Martin to whose exertions we owe much of the success of our natural history museum is not the least regretted in our list of deceased members.

Besides these losses by death we have to regret the severance from us from other causes of many of our oldest and most active members. Dr. S. Wells Williams, our honorary member,

well and favourable known during his residence in China to many who but for him would have known but little of its history and productions, now enjoys at Yale College the distinguished position of Professor of Chinese. Mr. George F. Seward for some years our President, has been removed by his government from Shanghai to the more dignified position of United States Minister at Peking. Sir Walter Medhurst, also for many years an occupant of this chair, has retired to spend in private life a well-earned and learned leisure.

Perhaps, however, the Society has most to regret the loss of the personal services of our late Vice-President Mr. Alexander Wylie, whose unobstrusive services will long be remembered by those who had the privilege of acting with him. Profound in his knowledge of Chinese his learning was always at the command of the conscientious enquirer, and to his advice and assistance, at all times willingly rendered, many members of our Society owe much of the interest they have been induced to take in Chinese researches. At the request of the Council, Mr. Wylie kindly undertook to represent the Society at the Congress of Orientalists held at Florence last year, and his appearance there in that position cannot fail to be a source of congratulation to our members.

Although tardy in its appearance owing to the large number of tables contained in it, the Journal of the Society for the past year maintains the position occupied by its predecessors.

The synchronous famines in India and Northern China have called attention to the metereology of Asia, and in the papers contained within the volume on Famines in China, on Sun Spots and Sun Shadows, and on the Meteorology of Eastern Asia, there is much which will form the ground-work of future research. The curious tables of Sun Spots observed in China long before Europe had an inkling of their existence, and for which we are indebted to Mr. Hosie, of H. B. M.'s Consular service, will doubtless aid, in connection with his other paper on Droughts and Famines in reducing to a regular rule these latter calamities. Toward this end the observations on the meteorology of Eastern Asia, now for the first time tabulated by our distinguished member Dr. H. Fritsche will greatly tend.

Fortunately at their observatory at Sicawei the Reverend Fathers have introduced a system of observations second in completeness to few in the world. Continuous self-recording observations are made on the temperature, barometric pressure, condition of the atmosphere, and the intensity and direction of the magnetic current. These are checked by frequent observ-

ations of the instruments at stated times, so that any irregularity is immediately noticed and corrected.

These extended observations, commenced in 1874, and the first annual record of which was published under the auspices of our Society, have been continued and enlarged from time to time, and the annual record now fills a goodly quarto. Situated as Shanghai is near the northern limit of the summer monsoon of Eastern Asia, and in consequence subjected to excessively variable hygrometric conditions, no better locality could probably have been adopted for the erection of a first class meteorological observatory.

Although within the past year we had no such paper on Natural History as that published in our previous Journal by Dr. von Möllendorff, it will be interesting to members at a distance to learn that the Museum of the Society at Shanghai is gradually extending its sphere of usefulness. Owing to the public spirited liberality of the Municipal Council its most pressing wants have been met by an annual grant. The private liberality of the foreign residents at Shanghai has likewise, during the past year, enriched the library attached to the Museum by the purchase of some four hundred volumes, the property of its late Curator, Mr. Martin. Under the auspices of our present able Honorary Curator Mr. A. A. Fauvel, the space at the disposal of the Museum Committee is found to be becoming gradually straightened, and some steps must be taken to increase the accommodation, if the growth of the Museum is to be continued.

One extremely interesting and important discovery in natural history has, during the past year, been announced by Mr. Fauvel, and that is the discovery of a species of alligator inhabiting the rivers of China, or at least the Yangtsze, whose nearest analogue is to be found in the *Alligator Lucius* of the Mississippi. One of the most recent authorities Mr. A. R. Wallace remarks (Geographical Distribution of Animals, Vol. II., page 406) "The Alligators which are distinguished by having both the large front teeth and the canines fitting into pits of the upper jaw, are confined to the neotropical and the southern part of the neartic regions from the lower Mississippi and Texas through all tropical America, but they appear to be absent from the Antilles. They are all placed by Dr. Gunther in the single genus *Alligator*." As Alligators have been found in Eocene beds in England accompanied by Gavials and Crocodiles, Mr. Wallace attributes their present distribution to partial ex-

tinction. This opinion will doubtless be strengthened by Mr. Fauvel's recent discovery.

In exploration there may be mentioned Captain Gill's journey from England to Assam which was successfully accomplished. Col. Prejevalsky who nearly succeeded in reaching Thibet in 1872 has made a second journey of even more geographical interest in Central Asia to the basin of lake Lob hitherto unvisited by Europeans. Southeast of the lake he discovered a lofty range of mountains, the Altyn Tagh, and also learned some details of the mysterious Charchan of Marco Polo whose identity has been so frequently disputed. Although Col. Prejevalsky certainly penetrated to the basin of lake Lob it seems to admit of doubt whether the lake be discovered occupied the lowest part of the basin. The fact of his describing it as fresh seems to indicate that the ultimate recipient of the waters of the Tarim has yet to be found.

This present winter Count Szechenyi accompanied by Lieut. Kreitner of the I. R. Austrian army and Mr. Loczy, a geologist of repute, has set out on an expedition to explore the unknown country lying between Sühchow in Kansuh and Llasa. It is pleasant to learn that the expedition has me with friendly assistance from the Chinese government. It is much to be hoped in the interests of science that Count Szechenyi's hazardous expedition may be rewarded with the success it deserves.

The members of the Society can hardly fail to take an interest in Professor Nordenskiöld's bold attempt to complete the north-eastern passage. By last advices received the Professor had safely rounded Cape Chelyuskin, the most northerly extremity of Asia, situated in lat. 77° 41′ N. and had reached the mouth of the Lena, which he left on the 27th of August last to continue his voyage to Behrings Strait. Should he succeed in reaching this point he may be expected in these latitudes towards the beginning of next autumn.

I could have wished that more attention had been paid to the very interesting problems offered by a study of the Ethnology of Eastern Asia. The Chinese section of the Congress of Orientalists at Florence, with the exception of a paper by M. de Rosny on some Ethnographic Identifications relating to Indo-China and Malasia, extracted from ancient Chinese writers, of which no detailed report has been received seems to have confined itself to tracks already too well beaten to be profitable or agreeable. We possess in the ancient writings of the Chinese many valuable indications of the early migrations of Eastern Asia, but understood as these have hitherto been by the unaided glimmer of the Chinese commentators it is a matter of little wonder that the result

has been insignificant. I may be excused for stating my own views on a much controverted point.

Proceeding upwards towards the source of Chinese history our path begins to grow uncertain towards the 5th century B. C.; the seventh century supplies us with little better than legends mixed with historical recollections, and finally, at about 770 B. C. the utmost limit of what we can call consecutive history is reached in the removal eastward of the old capital of Chow and its re-establishment at Loh by P'ing wang. Regarding the destruction of the old capital Mencius (IV. 2 xxi.) tells us "When the traces of the royal sway (of Chow) were extinguished the art of ballad making was lost, and afterwards annals came to be made." 王者迹熄而詩亡,詩然後春秋作. The Ch'un ts'iu of Lu begins with the first year of Duke Yin 721 B. C. which is the earliest date in Chinese history for which we can find trustworthy authority. It is not far removed in time from the destruction of the old capital of Chow, yet the short interval of fifty years marks the transition from myth to history.

In the Analects of Confucius, *cir.* 500 B. C., we find that the state was without a head, and that each petty prince in his own territory did as he himself thought fit. Confucius does not seem to have been acquainted with any strong, tradition of the imperial government of Chow. He does indeed raise his voice against the assumption by the states of imperial sacrifices, but the traditions of empire in the later sense, if such had ever existed had died out. Rather indeed may we conclude from the opinions of Mencius expressed a century and a half later that they had as yet no existence. "How," said King Siang of Liang, "can the T'ien hia be settled?" The sage replies, "It can only be settled by being united under one sway" (Mencius I. 1. vi.)

The nearest analogue of the T'ien hia in the fifth century B. C. was not the feudal states of Europe in the Middle Ages, as has been thoughtlesslessly propounded, but Greece in the period succeeding the Persian war. The people of the several states were as proud of their common origin and common speech as were the Hellenes themselves, but the bond was not strong enough to induce concerted action. Chow indeed as the representative of the head of the family enjoyed a preeminence at the sacrifices and at the assemblies of the states, and acted as the eldest son in the family cult; but in the councils of the assembled states the voice of the Wang was heard but as an equal not a suzerain.

Already in the time of Mencius the oracles had commenced to *philippize*. T'sin loomed on the horizon of the states as Macedon lowered over Athens in the days of Demosthenes. Mencius

sought to excite one of the old stock to unite the conflicting interests of the Chow princes, but the thing was not to be done, and Prince Ching, as T'sin Shi-wang-ti, like Philip of Macedon in Europe, founded the first Chinese empire, to expire as did Philip's in the person of his immediate successor.

Whence came this race of Chow so rich in great names, and which was instrumental in establishing a cult and policy well nigh as lasting as that of ancient Greece?

The ballads spoken of by Mencius afford us an unexpected clue, and a closer inspection opens up to us a treasury of myth and legend comparable in some respects with that of the Hellenes themselves. The idolic character of the writing in which they have been preserved and handed down affords us but little information as to the language in which they were originally compared; we know, however, that at one time[1] the Odes conveyed to the ear the old legends and war songs of the Chows, and though now their sounds are lost, and we have to trust to a laborious analysis of the symbols presented to the eye, we find enough to justify us in identifying the roots with those of the old language of the Vedas, of the Gâthas or or the Hellenic bards themselves.

A prevailing mournful tone is to be noted as underlying the collection; a wail of lamentation at the ceaseless attacks of hostile foes, and this wail rises to its culmination in the latest of the ballads which tell of the final struggle of Chow with its Turkish foes, and the fate of Yü, the *Dark*, and his fair but frail bride Pao-sze (Pritî, *Desire*.)

Wan Wang and his sons Wu Wang and Chow Kung do indeed appear in jubilant form in their conquest of Yam shâng. The familiar myth of the contest of light and darkness, which we shall see again reappearing, has woven itself into the tale of the great fight between the Chows and the Yins; its heroes are Ch'ang, the Effulgent (Wan wang), Fat, the Shooter *of rays* (Wu-wang) and Tan, the Dawn (Chow kung); Wei tsze k'i, the Morning Star and Pak kan the Northern Buckler warn the tyrant Chow[2]-sin or Show (Στυγερὸς or Στὺξ the Odious) of the coming day; Show, however, goes on with his villiany, and with his wife T'anki (Θάνατος, Θνῆσις) provokes more and more the vengeance of heaven. ¿Chow 周 a modification of 晝 chow' (the Day) moves towards the doomed state; it occupies first the territory of Li, the region of the agriculturists, the pronunciation of which we learn from its value in proper names[3] was AR (*ar-are* to plough) and prepares for the great contest.

[1] Chinese Classics, V. 549-50.

[2] *E. g.* Li-kîn or Im-tsai-li-kîn, Samarkand, in the Shi-ki.

The struggle finally takes place in the east, in the wilderness of the herdsmen, Mŭk yĕ, at the grey of morning. It was to no purpose that Yam shâng mustered its forces; those in front turned their spears on those behind, and the red glare rose higher and higher till at last it floated over the pole star. So the T'ien hia was settled, and Fat, as Wu Wang, the martial, became its ruler.

The mixture of myth and legend is evident. The Chows, Li-min or Aryan men, attack the state of Yin, defeat the pastoral tribes and set up instead their own cult and polity. In the midst of the pœans of victory we find traces of the true reason of their approach. The war was none of their own seeking, and they brought with them a very consistent legend of their wanderings in search of a home.

"When king T'ai (T'ân-fû, Danu or Dânava) dwelt in Pin (Mencius I. 2. xv.) the Tik tribes continually made incursions. He gave them presents of skins and silks, but could not escape their depredations; he gave them hounds and horses with a like result; he gave them pearls and jade, but still they harassed him. He therefore called the old men and told them 'What the Tiks want is our territory. This I have learnt, that a prince should not turn the sustenance of his people to their detriment. My children, why trouble yourself at the loss of your prince; I will leave you.' Accordingly he left Pin crossed the Liang shan, built a city at the foot of Mount K'i, and established them his government. The people of Pin said 'This is a benevolent man indeed and we must not desert him.' They followed him like crowds returning from market."

The songs of the Shi king are still more explicit in their recital of the migration, but the pith of the story is given above. T'an fu (called after the establishment in China of the kingdom of Chow, King T'ai), forced to flee from Pin to escape the inroads of the Turks who were there harassing the ancestors of the future conquerors of China, settled in K'i chow, the plain adjoining Lake Lob at the foot of the K'i shan, now the T'ien shan, and there set up the original kingdom of Chow. In those days the district was fertile, well watered and covered with wood, and the rising state seemed about to become powerful under its energetic rulers. To the south lay the state of Madh or 密 Madh-su 密須, *i. e.* Maddhal, with whose rulers the Chows soon came into hostile contact. Chow was victorious and the city of T'sung yung *i. e.* Dardan, the Charchan of Marco Polo was captured. Its great drum was long preserved, and we find it many centuries after still preserved in Tsin as a memorial of the contest.

The Liang shan crossed by the emigrants is phonetically con-

nected with the T'sung ling of later Chinese, and both point to an original form Dar. We thus learn that the mountains, crossed by T'an fu in his migration were those of the Dards, the *T'sung ling* of to-day; and this step takes us back to the previous seat of the Chows in the land of Pîn.

Like K'i chow the settlement of Pîn was not the original home of the Chows. Where that was the Chinese legends afford us no clue, but we do learn from the Shi king that unable to dwell at ease in their ancient home the tribe under the leadership of Kung liu crossed the Wei (? Oxus called 嬀 kwei or wei by Sze-ma T'sien) and settled in the highlands of Pîn along the valley of the Hwang (Varsha, possibly the Vaksh.)

We are here brought into contact with the original birth place of Aryan legend, and there may therefore be the less surprise should I ask you to identify Kung liu of the Chinese legend with the Kereçaçpa, the serpent slayer, of the Iranians. Both are too near the extreme verge of legend to enable us to fix upon any definite act of their lives, but both seem to have been wanderers from their home. The Vendidad hints that Kereshaçpa took to witchcraft, and the Yaçna tells of how, having inadvertently placed his cauldron on the green slimy serpent, Çruvara, the serpent sprung up and Kereçaspa fled. The more modern legends of the Persians make Gersharp the last of the Pishdadians, who having reigned only nine years disappeared leaving no successor.

It is curious that the word kereçaçpa (in Zend *kara horse*) is evidently a corrupted form. The change of a single letter kereḍaçpa instead of kereçaçpa, *i. e.* the '*maker whole*,' gives a meaning to the legend of the serpent slayer, and accounts by the ordinary change of *ḍ* to *l* for the Chinese form Kung-liu.

The usually received dates tally as closely as traditional epochs can be expected to do. The Chinese have fixed approximately on 1800 B. C. as the date of Kung liu's settlement, and according to the Avesta Kereçaçpa was antecedent to Zarathustra whom we most seemingly relegate to the sixteenth century B. C. The Turanian Fraṇraçê was hanging at the time on the borders of the Iranian settlements and the latter found existence scarcely supportable. That a portion of the tribe should have emigrated eastward is in consonance with all we know of the migrations of the early inhabitants of Central Asia.

There are possibly traces of the old settlement of Pîn to be found in the names of various localities of the Pamîr, if that name itself, as suggested by Sir Henry Rawlinson be not a corruption of some such form as Pân-mir or Fân-mir, the lake country of Pân or Fân. There still exist the Fân tau, the Fân lake, etc. and

Strabo XI. 11 speaks of the Φαννοὶ or Φρυνοὶ as bounding to the east the Bactrian kingdom.

The explanation I have offered, but merely in outline, reserving details for some other occasion, will serve to account for many peculiarities in the Chinese cult and Chinese tradition, and is not inconsistent with what we know from other sources of the original dispersion of the Aryas. Indian tradition points to the same period as having witnessed the southern migration of some of the tribes, while Persian legends tell of their settlements in Mid-Asia. The Aryan migration to China is in many respects similar to that into India. In both cases the Aryans penetrated into countries previously inhabited, and impressed on the original inhabitants their language, cult and polity. There is, however, one broad distinction to be noted. In India the early establishment of caste kept apart the conquerors and the conquered, and has preserved to the present day in more or less purity the original type. In China, though for a time the settlers kept themselves distinct from the people of the land, the traditions of difference of race were gradually relaxed, and we soon find that the Aryan Chows did not hesitate to admit into their family by adoption those neighbouring states whose power or influence was sufficiently great to make their alliance desirable.

The most remarkable instance of this practice was in the case of Wû, where a genealogy leading up to T'ai pak the eldest brother of Ki lik, and therefore if true constituting them the representatives of the eldest branch, was found for the rulers of the state. It is curious to observe that on one occasion when the various princes met at Hwang ch'i to discuss the position of affairs, Wû actually raised a claim on this genealogy to the headship of the states. The claim was indignantly repelled by Tsin as head of the Ki clan and might have led to bloodshed, but that at the moment a messenger arrived to tell the prince of Wû of the invasion and impending destruction of his state. The connection of Wû with the other states had all along been looked upon as something disreputable by those of the genuine stock, but these little discrepancies had to be passed over so long as Wû occupied a position of power; and when finally it collapsed as an overblown bubble, its fall was so complete that it was not worth while erasing its name from the family records.

The same process went on all round, T'sin and T'sû were adopted into the confederacy, and at one time the preliminary steps were taken for admitting the Hiung nû, and a genealogy leading up to the Great Yü was actually prepared.

This policy was not long in making itself felt. The Chows in-

deed succeeded in impressing their cult and laws on China, and to a very considerable extent their language, fully half the roots of modern Chinese being traceable to Aryan sources. The admixture of race told, however, rapidly on the speech of their descendants, and it soon lost its inflected form, and even before the rise of T'sin had assumed in great measure its present monosyllabic form. The race characteristics of the Chows gradually died out, as race characteristics usually do where a limited number of immigrants settle in an already inhabited country, and freely ally themselves with the original stock. It is only, in fact, by a laborious process of elimination that we find in the Chinese of to-day lingering traces of the Aryan occupation.

A closer search, however, discloses remains of a partial immigration antecedent to that of the Chows; and on these traces, slender though they be has been erected the fabric of the so-called ancient history of China. It may be remembered that Chow at the battle of Mûk yê vanquished the forces of Yin, but the manner in which, according to tradition, the victory was utilized shows that even in the conquest of the tribe its consanguinity was recognised. Wei tsze k'i, who had fled to meet the coming dawn, was appointed to continue the sacrifices of Yin; and we find the rulers of the petty state of Sung 宋 claiming within historic times the honour of being his descendants. Sung possessed legends of the contest of dawn with darkness as definite as those of Chow itself, and couched under names only dialectically different and betokening as plainly an Aryan origin. In Greece where each city believed its inhabitants antochthonous these differing versions of a common story would have been allowed to remain separate and distinct, but in China they were made to form a thread of quasi connected history, and hence it became necessary to invent a prior invasion of a previously degraded race. Hence the invention of the dynasty of Hia (Hari) and the foisting into it of the old gods gradually displaced by the growing pantheism of the settlers. Hence the legend of T'ang corresponds even to its details with that of Wan and Wu wangs, and the descendants of Yaou, Shun and Yü (Varuṇa, Vishṇu and Manu) end in the miserable Kit (Σκοτός) and his wife Mehi (Megha the Cloud.)

Even beyond Yin T'su seems apparently to have had traces of Aryan influence. The few words of the language preserved, which we learn from Mencius was unintelligible to the rest of China are referable to Aryan roots. Still the jealousy with which T'su's march to power was regarded by the other states and the prolonged refusal to consider it as other than barbarian, seems to

point out that the traces must even then have been very indistinct.

It would not be possible within the limits permitted to an address like the present to point out in detail all the reasons which have led me to form these conclusions. I have brought them forward in the hope that other students of the antiquities of China may turn their attention to the very fertile ethnological field which lies before them. Facts we know are very stubborn things and not to be controverted with impunity, but the same immunity does not rest with the conclusions we may be tempted to draw from them. In no science are these conclusions more open to animadversion in its present condition than in that of ethnology, and I trust that my hearers, while giving me credit for a careful collation of facts, will not assume that the conclusions I have drawn are in any sense incontrovertible.

Those, however, who have watched the progress made in Europe by means of comparative study, towards gaining an insight into the original condition of the Aryan family, will not lightly slight any traces, however, slender of their influence in Eastern Asia. No sufficient explanation has yet been afforded for the remarkable coincidences between the early Chinese cult and civilisation and that of Western Asia and Southern Europe. The near approach in time of the origin of two, and the evidence of early intercommunication in the identity of their astronomical and calendaric systems, has always been accepted as a proof that intercourse between the two did exist in times immediately antecedent to history. The nature of this intercourse has hitherto been concealed, because when history opens the intrusion of the Turkish tribes had already placed an impassible barrier between east and west. It is therefore a matter of interest to discover that the effect of this intrusion was to drive eastwards a portion of the mid-Asian peoples, because it not only throws light on Chinese ethnology, but also aids us to understand better the Iranian legends of the pressure of the barbaric tribes on their own frontiers.

In a previous address I pointed out what seemed to me the exciting cause of the irruption of the Turkish tribes into Central Asia; but as this trends on geological enquiries, and I do not propose to renew them this evening, I shall close by recommending to the members of the Society and others interested in the antiquities of the Far East a reconsideration of the ethnological question.

The progress of ethnological and philological science has been much retarded by the apparently necessary assumption that the Chinese language and Chinese arts had to be relegated to an inde-

pendent origin. The fiction of inflective and agglutinative languages has also been a retarding influence. The fact seems to be that all languages are liable to pass through both stages. Sanscrit is a language only just emerged from the agglutinative stage, and Chinese seems to be one which after adopting inflections has gone back to the former condition.

A third fallacy I have to warn students of Chinese against is the misuse of the word Turanian as applied to peoples and tongues. According to Persian tradition Tûr was equally with Selm and Iredj the son of Feridûn. The modern use of the term Turanian to include all tribes in northern and eastern Asia not supposed to be Aryan has no foundation in fact or tradition.

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ARTICLE I.

ALLIGATORS IN CHINA.*

BY

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IF we consult the oldest of all Chinese records, the Classics, in which most of the natural productions of the country are noted, we find in the twenty-sixth chapter of the Doctrine of the Mean (1) a curious enumeration of the wild animals living in the waters. In Dr. Legge's translation it runs as follows :—"The water now before us appears but a ladleful; yet extending our view to its unfathomable depths, the largest tortoises, *iguanas*, *iguanodons*, dragons, fishes and turtles are produced in them." (黿鼉蛟龍魚鱉生焉.) (*Yüan t'o chiao lung yü*

* Read before the Society on the 13th December, 1878.

(1) 中庸. 二十六章. 九節.

pieh sheng yen.) The Chinese commentary (中庸說) on this passage defines the *Yüan* 黿 as 'the first produced of the chelonia' (介蟲之元); the *Lung* 龍 as 'the chief of scaly animals'; the *Pieh* 鱉 as being 'a kind of *Yüan*'; the *Chiao* 鮫 as being 'a kind of *Lung* 龍'; while the *T'o* 鼉 'has scales like a fish, feet like a dragon, and is related to the *Yüan*.' From this we may infer that the *T'o* is an amphibian with feet and scales and allied to the chelonians.

The *Li Ki* (禮記) says: "in the ninth moon they kill the *Chiao* and capture *T'o*" (to be sent to the palace of the Emperor where drums are made from its skin, according to the commentators.)

Proceeding further, we find in the 4th stanza of the eighth ode of the *Shih King*, decade of *King Wang* (2) the following sentence:—鼉鼓逢逢 *T'o ku peng peng*, translated by Dr. Legge "The lizard-skin drums rolled harmonious." The commentary is the same as the preceding one, indeed we find it in every book quoting the *T'o*.

In the Doctrine of the Mean, Dr. Legge translates *T'o* by *Iguana*, and in the *Shih King*, he gives *Lizard*. Not knowing, probably, of the existence of crocodilians in China he was left with Chinese dictionaries to determine the exact meaning of the character *T'o* (鼉), and I must say that the ambiguity of their statements is such as to render it difficult to get at their exact meaning.

Now, according to *Choo's* commentary quoted by the translator (Dr. Legge), the great drum was eight cubits in length and four cubits in diameter at both ends. Other Chinese authors say that it was made with the skin of the *T'o*. How could it be covered with the skin of the Iguana, which never exceeds five feet in length, or with the skin of a lizard which is far too thin and too small for even the smallest of drums? Besides the Iguana cannot be said to be produced in the waters with fishes, chelonians, turtles, etc., for it is not an amphibian animal, and I have never heard of it being found in China. I could say the same of Iguanodons. The *T'o* then is not an Iguana; let us now try to make out, with the help of the Chinese dictionaries, the exact meaning of the character 鼉.

One of the oldest, the *Shuo Wen* (說文) says: The *T'o* is an aquatic reptilian (水蟲) (3) *resembling the lizard* (蜥蜴)

(2) 詩經. 大雅三. 靈臺. 四章.

(3) Dr. Legge translates 蟲 chelonian (see above.)

and measuring *over ten feet in length.* A lizard of this size can only be a kind of crocodile or Alligator.

In *Kang Hi's dictionary* (康熙字典) we find, besides the above quotation of the *Shuo Wen*, that the *T'o* has *scales as hard as iron* and *a very thick skin* good for making drums. Then quoting the *Shih King* it explains how the sound of drums (逢逢) *peng peng* resembles the call of the *T'o*. This is certainly an example of onomatopœia as anybody who has heard the cry of the Alligator can testify. Indeed we believe that the very name *T'o* is an imitation of the explosive noise made by the Alligator. The word *resounded* would be a far better translation than the *rolled harmoniously* of Dr. Legge's. Whatever might be the idea of Chinese commentators about music it is difficult to find much harmony in the noise generated by striking a huge drum with a mallet. The Chinese had observed the similarity of the two sounds as the *Po Wu Chih* (博物志) (4) quoted by the *Kang Hi's* dictionary, says: "The *T'o* is ten feet long; it makes a noise like a drum." *Cheng Chi* (藏器) considers the cry of the *T'o* as far from harmonious, indeed he says, it is very terrible. "It cries (at night) at each watch (5); thence the phrases: strike the watches *T'o keng*, beat the drums *T'o ku*." (See *Pen Tsao Kang Mu*).

The Great Materia Medica (本草綱目 *Pen Tsao Kang Mu* (6) being a scientific work will probably give us a better description than any dictionary. It gives 鼉龍 *T'o* dragon, 鮀魚 *T'o* fish and 土龍 earth dragon as synonyms. It says: "The nature of the *T'o* resembles that of the dragon. It measures 10 feet in length and belongs not to the family of fishes but to the family of dragons." According to *Li Shih-chen* the character 鼉 is an old graphic representation of the head, body, feet and tail of the animal. The oldest form of this character we find figured like this 鼉 in Morrison's Dictionary. It is composed of the two characters 單 *tan* alone and 黽 *min* a frog. According to the *Po Wu Chih* the *T'o* 鼉 is a land dragon and the *T'o* 鮀 a fish."

The author *Cheng Chi* (藏器) quoted by the *Pen Tsao* says that the *T'o* is of a *sleepy nature, often closing its eyes.* It is

(4) Written in the latter part of the 3rd century.

(5) These watches were struck every two hours with a drum, now a gong or a hollow bamboo is used.

(6) Written by Li Shih-chen under the Ming dynasty.

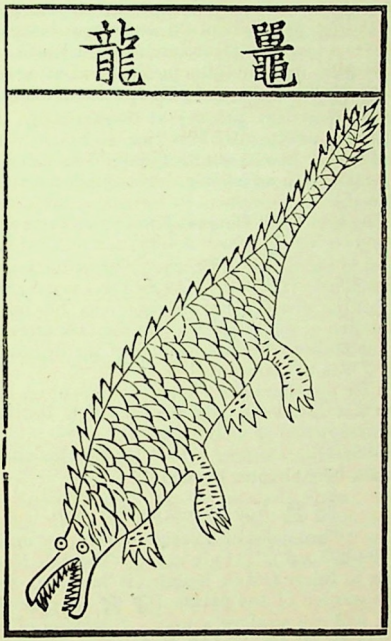
gifted with *great strength* and can *burrow in the banks of rivers*. *Sung* (頌) writing under the Ming dynasty says that they are *extremely numerous in the lakes and rivers*. According to this author it resembles the Gecko and the Pangolin (*Manis pentadactyla?*) but measures from ten to twenty feet in length, its back and tail are covered with an armour (甲). It cries at night and the mariners are much afraid of it. *Li Shih-chen* says that its burrow is very deep. The sailors catch it with a rope made of bamboo, at the end of which is an iron hook baited with flesh. The animal, having swallowed it, is pulled out of its hole little by little. It can move to either side, but cannot jump. It lays a considerable number of eggs, sometimes as many as a hundred, but it often devours them. The people of the south are very fond of its flesh and serve it (as a delicacy) in every marriage feast. *Lu Tien* (陸佃) pretends that the flesh of the body is as good as that of cattle, but that of the tail is unwholesome.

The Kuang records of *Kuo Yi Kung* (郭義恭) say that the fish *T'o* is three feet in length, and about one in height. Besides four feet it has a tail resembling that of the *Yen-ting* (蜒蜓) *(Lacerta muralis* or *Chamæleon)* but much longer. It is the custom of the people of the south to eat the flesh of the *T'o* when they celebrate a marriage ceremony.

A little further it is related that at the time the Emperor *Wei Wu* (魏武) was returning from Hupeh into Honan a *T'o* was found underground by a man who was digging in the fields.

Here we find the measurements a great deal more accurate (though perhaps the exaggeration is the other way) as the Alligator actually living in China is from five to six feet long. The height given is sufficiently accurate and the comparison with the lizard leaves no doubt concerning the nature of the *T'o*.

With the exception of the sentence concerning the flesh of the tail, all the description given by the Pen tsao and the Kuang records agrees wonderfully with all that we know of the nature and habits of the Alligators of the Mississippi and Guyana, as described by Audubon, Whatterton and Bosc. Even the way of catching the animal is similar, only the Indians use an iron chain fastened to a tree as a substitute for the bamboo rope. Indeed we cannot doubt the identity of the *T'o* with the Alligator when we consider the somewhat quaint but sufficiently characteristic picture which illustrates the text of the Pen tsao. As may be seen by this reproduction of it.



We have here the head of a crocodilian pretty well brought out. In the Japanese edition of the *Shih King* a figure of a Gangetic gavial is given for the *T'o* but it is very curious to notice that the artist represents it as being in a glass jar ! (7)

After examination of the testimony given by the Chinese dictionaries, commentaries and scientific works we come to the conclusion that the *T'o* must be an Alligator.

Let us now see what the foreign dictionaries say on the subject.

One of the oldest, Gonçalvez, translates *T'o* : Crocodilo. De Guignes, who is now said to have copied B. de Glemona gives 鼉 *T'o* a crocodile and 蛟 *Chiao* a crocodile.

(7) Probably as he had seen it in some museum.

Morrison, whose dictionary is anterior to Legge's classics, gives the following description, evidently translated from native works: 鼉 *T'o* a large *sea* (?) animal, upwards of ten feet long, a species of fish, its skin was formerly used to make *large drums* (8). 鼉龍 *T'o Lung*; an animal resembling an *Alligator*.

Medhurst's dictionary printed at Parapattan, Batavia, in 1843, translates the *Kang Hi Tsze Tien* and gives: A species of Guana or Iguana, about ten feet long. In this he evidently trusts his imagination as we have already proved that it cannot be that animal.

Finally, the best of all Chinese-Foreign dictionaries, Dr. W. William's work gives 鼉 *T'o* "A large triton, gavial, or water-lizard, found to the South of China." Then he translates the Imperial Dictionary (the *Kang Hi Tsze Tien*) and far from finding the melody of the sacred drums harmonious he translates the famous quotation of the *Shih King* by the less poetical but far more sensible phrase: "The bass roar of the drums" in which by the way *T'o* is not translated at all.

So much for the character *T'o* and its meaning, but this old ideographic sign is not the only one by which the crocodile or Alligator is designated in Chinese books.

If we search the *Tai-ping Yü-lan* (9) for this character 鰐, (10) we find a long chapter headed:

鰐魚 *Ngo yü.*—The fish *Ngo.*

Quoting the "Chronicles of Foreign Countries under the Wu Dynasty (222-277 A.D.)," (11) it says:—The fish *Ngo* measures from twenty to thirty feet in length, it has four feet, and resembles the warden of the palace (守宮 a poetical name for the Gecko), and can swallow a man. Speaking of those found in the kingdom of *Lin Yi* (林邑 Southern Cochin-China), it says in shape they look like the *T'o*. They have four feet and their jaws, which are six or seven feet long, possess, on each side, teeth as sharp as daggers. They devour every deer, stag, or even man they can get hold of. According to the encyclopedia of *Yü Hsi* (虞喜志林) Alligators are found in the south, their jaws are eight feet long. They are very terrible in

(8) Said to breathe a vapour from its mouth, which forms a cloud and cause rain.

(9) 太平御覽卷九百三十八

(10) Formed from 魚 a fish and 噩 frightening abbreviated 咢.

(11) 吳時外國傳.

autumn. When they see men on a ship's side they raise their heads above the water, seize and devour the mariners, who, in consequence always provide themselves with spears for defence.

The *P'o Wu Chih* (博物志), description of all productions, says that they are found in the Canton district and resemble the tortoise. If the head is cut, and the teeth knocked out, they will grow again, as many as three times. We find the same description and measurements, as quoted above, in the records of the curiosities of *Kuang-chou* (province of Kuang-tung), but the story of the teeth growing again is more sensibly told, "If the teeth are knocked out, they can grow again in the space of ten days."

The book called "*Lin Piao Lü Yi*" (嶺表錄異) is the only one that gives the colour of the body, an earthy yellow. It also compares it to the gecko, but says it is more rapid in its movements. All pretend that men and animals fear it equally. It seizes deer and tigers when crossing the water and tears them to pieces.

All these characters are common to the 鼉, and as we will yet demonstrate later on, the animal described under the four characters—鼉, 鱷, 鰐, 鮀 is the Alligator. 鼉 being the oldest form of the character 鱷, which by the way is not found in the classics; and 鰐 or 鮀 are the common forms of character now used. Gonçalvez translates: 鱷 and 鰐 *Crocodilo*, and 鮀 by *Cação*. De Guignes gives *Crocodilus* as signification of the first and second character, and *quidam piscis* for the third. Morrison has: 鱷=鰐 or 鰐魚, a large fish of the lizard species which lurks by the shore and devours men and animals; the Alligator.

In Medhurst's dictionary we find:—

鰐 *Go.*—The Alligator or Crocodile. They are found in the South seas of China(12). The natives say that after the head has been cut off and dried, if the teeth are knocked out, they will appear again three times in succession. The Alligator is about twenty feet long with four legs, and a head three feet in length, with a very pointed nose. It has tiger's teeth, and can bite in two large stags, that attempt to cross the water. *Han Wen-kung* (韓文公) published an essay to drive the Alligators from

(12) This is probably a misconstruction of the Chinese 南海 which stands also for 南海縣 Nan-hai-hsien, the district of Canton, as it is well-known that Alligators do not live in sea-water.

the coast of Canton, and the natives say those beasts have not been seen there since.

鱷 *Go.*—An Alligator described as having the form of a fish, with a dragon's neck, tiger's claws, crab's eyes, turtle scales, a tail several feet long, and very rugged along the spine. It abounds on the banks of rivers, where it frequently takes off men and animals. Medhurst then quotes *Han Wen-kung.*—All this is evidently translated from native works.

鮀 *Tho.*—Another account says that it is found near the banks of *lakes*, where it burrows in the mud; its form is like a lizard upwards of ten feet long, and its back and tail are covered with scales.

Evidently the Alligator again (same article in Morrison's dictionary).

Morrison's dictionary explains this last character 蛟 *Keaou* to mean:—A kind of *Crocodile, found in the Yang Tsze Kiang*, said to weigh two thousand catties, etc., as above. Gonçalvez calls it also: *esp. de Crocodilo.*

In Dr. William's dictionary we find:—

鰐.—From 魚 *yü fish* and 噩 *ngo alarming*, as the phonetic. The crocodile and the Gangetic gavial; the former is said to have existed at one time in the River Han, near Swatow, whence they were exorcised in the Tang dynasty; metaphorically rapacious cruel, for example: 鰐紳劣吏朋比爲奸. "The rapacious gentry and unscrupulous underlings make a worthy union of rascals."

鰐魚 *Ngo yü*: an *Alligator*, cayman, or crocodile; it seems to be sometimes wrongly applied to fresh water dolphins."

Also written 鱷 *Ngo* from *yü* fish and *ngo*, 咢 to startle, to strike the drum at intervals of singing. This reminds us of use of the skin of the animal.

According to Dr. William's 鮀 *T'o* would be a species of bull-head which burrows in the mud, and he gives:—

蛟 *Chiao.*—"The dragon of thickets and morasses, which *has scales, but no horn;* the description size and figure correspond very nearly to the fossil *Iguanodon*, and possibly a large kind of *Salamandra* or *Amblyrinchus* was at first intended." To this, we can say, that an *Iguanodon* with scales and without horn looks very much like a crocodile poorly drawn; besides the *Iguanadon* belongs to the inferior cretaceous formation which as far as we know has not yet been found in China.

We have indeed seen large collections of fossil teeth in the medicine shops of Shanghai and we have a pretty good num-

ber in the R. A. S. museum, still the very characteristic tooth of the Iguanodon has never been met with.

The crocodile being larger than the Alligator we understand the differences of weight and measurements given by Chinese authors, putting aside some misstatements or wrong descriptions. The crocodile being more ferocious than the sleepy and harmless Alligator we understand also why they used to capture the latter and kill the former.

It is also evident from all these native descriptions that the Chinese had heard of, and some of their travellers to India probably had seen the Gangetic gavial and crocodile, hence their conflicting statements. Even in Europe unscientific people often confound the crocodile with the Alligator more vulgarly known as cayman, the name given to it by the Indians and negroes in America.

As a *resumé* and conclusion of this philological discussion which we now bring to a close, having Chinese dictionaries and encyclopedias in one hand; old records, natural history and Chinese and Foreign dictionaries in the other I propose to translate 鼉 *T'o* by Alligator as well as 鱷 or its abreviated form 鰐.

蛟龍 will mean the crocodile or the gavial class of animals. The classical quotation of the Doctrine of the Mean:

黿, 鼉, 蛟 龍, 魚 鱉 生 焉 *Yuan, t'o, chiao lung, yü pieh sheng yen* I should translate:

"The great tortoise, the Alligator, the crocodile, the fish and the turtle are produced in the water."

The phrase of the *Shih-King*:

鼉 鼓 逢 逢 *T'o ku peng peng*, should be understood as: "the alligator-skin drums $\frac{\text{are}}{\text{were}}$ resounding," and these words of the *Li-Ki*:

季 秋 之 月 伐 蛟 取 鼉

would mean: "About the time of the ninth moon they kill the crocodile and capture the Alligator."

II.—HISTORY AND LEGENDS.

In the works of *Han Wen-kung* 韓 文 公(13) also called *Han yü* 韓 愈, a celebrated statesman and poet who lived under the

(13) 韓 文 公 詩 增 註.

dynasty of the Tang (A. D. 768-924) we find this. When *Han yü* was banished and sent to fill the post of governor in the semi-barbarous region of *Chao chou* (潮州) in the modern province of *Kuang-tung* (廣東), he enquired of the people as to the state of the country and the miseries of the inhabitants. They answered him that at a place in the east of the city there was a small lake or marsh not far from *Chao yang hsien* (潮陽縣) (14) called the "*Chiu* waters" (秋水). It was full of *Ngo fishes* 鰐魚 hatched from eggs and some ten to twenty feet long, which devoured the cattle and other domestic animals, thus gradually exterminating them to the consequent impoverishment of the people. A few days after *Han-yü* went to this place and calling his officer *Chin chi* ordered him to have a pig and a sheep thrown to the *Ngo* fishes which he then addressed as follows:—

Under former rulers you have been allowed to remain here, but under the reign of our virtuous emperor you cannot be tolerated and you must leave his empire. How could you be permitted to live here in peace when you are molesting the people fattening on their domestic animals and increasing daily in number? I have come to rule this country in the name of the sovereign and as I am myself much afraid of you we must part company. At the south of this place is an immense sea in which fishes as large as whales as well as those as small as shrimps and sprats can live in peace. You can easily go there in a day but I give you from three to seven days to go. If after that period you are still found here I shall be compelled to bring with me some good archers with strong bows and poisoned arrows and declare against you a merciless war.

In the afternoon of that very day a violent wind arose accompanied by thunder and lightning. The storm raged for a few days driving the waters sixty *li* eastwards leaving the lake perfectly dry. Since this the *Ngo fishes* have disappeared and the people of *Chao chou* live in peace.

On the native maps of the province of Canton we find still to the west of *Ho Yuan hsien* (河源縣) 110 miles west of *Chao chou* a small lake called 鱷湖 *Ngo hu, i.e.* Alligators' lake.

This story we have also found slightly abridged in the Annals of the province of *Kuang-tung* (廣東通志).

(14) Opposite Swatow.

According to Mr. W. F. Mayers(15) this is simply a legend symbolizing the efforts made by *Han Yü* in civilizing the rude inhabitants of the country. But it was during the reigns of the Tang, far from the mythological times, and this story agrees with what we know of Alligators, and as they are still found in the province of Canton, as this paper will show before concluding we think it quite possible that they were really in existence there, and then, and even before. Indeed, the *Ngo* are mentioned in the "Annals of Foreign Countries during the Wu" (222-277 A. D.) where we find them sufficiently well described to leave no doubt of their crocodilian nature. The book of the Liang dynasty (502-556 A. D.) says that in the kingdom of *Lin Yi* (林邑) now southern Cochin-China, crocodiles (*Ngo*) are reared in the moats of the capital as well as in the enclosure where, outside the gates of the city, the wild beasts are kept. Criminals are thrown to them. If during three days they are left unharmed by the animals, they are considered innocent and restored to liberty. These crocodiles measure twenty or more feet in length and resemble the *T'o* (Alligator). There is no mistake possible here, as crocodiles are still found abundantly in Siam. They belong to a variety only known there, thence their name *Crocodilus Siamensis*. The Chinese book adds that they are very ferocious and that they are also found in *Tsang Wu* (蒼梧) (southern Kuangsi?) as well as in foreign countries.

The "Annals of Foreign Countries" (222-277 A.D.) also narrates that the King of *Fu Nan* (扶南) by name *Fan Ch'un* (范尋) had crocodiles (*Ngo*) brought to him and kept them in a pond. Rebels and criminals were thrown to them and released as innocent if left unharmed by these saurians. The kingdom of *Fu Nan* is probably Tonquin where crocodiles are still found.

In the Annals of Annam (交州 *Chiao chou*) we find that crocodiles like to come out from the waters on to the sand where they lay eggs about the size of those of a goose and good to eat. They seize tigers, deer and stags when they cross the water, tear them to pieces and devour them. They even attack man now and then. If their teeth are knocked out they will grow again in the space of ten days.

We now come to China proper. In old times, says the book called *Ling Piao Lü Yi* (嶺表錄異), a military mandarin (called 李 in the *Kuang-tung* Annals) was coming to *Chao chou* (潮州). As his boat was passing the Alligators rapid (鼉魚灘)

(15) The Chinese Readers' Manual article Han yü.

it struck on a rock and was wrecked. All the accumulated treasures of this officer, his books, vases, pictures and maps were lost in the deep. He called his mariners and ordered them to dive in order to recover them if possible. But these men saw so many Alligators under water that they did not dare to rescue the lost treasures, believing that they had come to the private residence of the monsters. So it is not only Han Yü who saw Alligators near Chao chou.

The Canton province is not the only one mentioned as producing the *T'o* or *Ngo*. In the chapter headed Imperial audiences (王會) of the *Shi Chia Chou Shu* (汲家周書) that is: Discoveries made in tombs, we find that the people of Hang chou fu in Chekiang send the *T'o* as a tribute to the Emperor, to make the court drums with the skin, as the commentator explains.

With this we will close our quotations from Chinese history and give a few of the legends concerning the crocodiles or Alligators.

The Chinese have an idea that the Alligator is wonderfully tenacious of life. The Canton annals say that the head can be cut and dried, before the animal dies, the muzzle can be broken into pieces and all the teeth pulled out and still it lives.

The history of the Wu dynasty tells us that in the first year of the reign of *Sun Liang* (孫亮) white barking Alligators or crocodiles were found in *Kung An* (公安). It is a common belief there that when the *T'o* barks and the back of the tortoise becomes flat, a dreadful calamity is surely impending from which people can only save themselves by fleeing to *Nan Chun* (南郡), now the city of *Nan Cheng* in Kiangsi. And indeed in the second year of *Sun Liang* a rebellion arose in *Kung An* and a mandarin called *Ch'u Ko-ch'üeh* (諸葛恪) was defeated by the rebels; his younger brother *Ch'u Ko-jung* (諸葛融) mandarin in *Kung An* was taken prisoner by them. His seal of office was made of gold cast in the shape of a tortoise. In his grief he scraped the back of the tortoise and swallowed the gold so obtained, which gold caused his death.

The book of *Chuang Tsze* (莊子) says that as Confucius was visiting the bridge of *Lü Liang* (in Shantung) the water rose twenty-four *chang* and rushed with great impetuosity over thirty *li* of country. The *Yuan* 黿 and the *T'o* 鼉 did not dare

to risk themselves in the waters but the sage saw a man swimming across some hundred *pu* (about a mile). When he came out Confucius asked him how he had managed. The man answered: "my nature does not fear, my destiny is certain I will follow the strength of the waters. It was because I had no fear that I succeeded in crossing the waters, I really had no other means."

In the *Ch'un Chiu* of *Lü Shih* (呂私春秋) we read that the emperor *Ch'üang Hsü* (顓頊) ordered *Fei Lung* (飛龍) to make a musical instrument of eight sounds (a kind of mouth organ) for the ceremonies of the cult of *Shang Ti*. When this instrument was used for the first time a *T'o* which was near the place kept measure with the melody by striking his tail against his body.

The records of *So Shen* (搜神記) narrate that in Honan a man named *Chang Fu* (張福), being one night in his boat, saw a woman coming in a small canoe. When she came near him she said: "When night comes in I dare not go out as I fear the tiger." *Chang Fu* at first laughs at her then he invites her to come and spend the night with him on his boat. About midnight as the moon was rising in the sky, *Chang Fu* (waking) saw a white *T'o* sleeping on his arm instead of the woman. Greatly afraid he rose up and the animal fled, the man saw then that what he had taken for a small boat was simply an old wooden log.

In the book on foreign countries written by the Buddhist priest *Cheh Seng* (支僧) we find that in the kingdom of 私訶條 (*Ssu Ho Tiao*) on the mountain called *Ch'uan Tao Leao* (全道遼) is the temple of *Pi Ho Lo* (毗訶羅); there a stone figure of a *T'o* is adored. This image is said to possess a supernatural power and when provisions are scarce at the monastery the priests address to it their prayers and their stores are soon replenished.

The records of *Hsü Shih* (許氐志怪) narrate the following story: A Buddhist priest, by name *Yao*, being a sorcerer and an exorcist was once called in (the city of) *Kuang Lin* to exorcise a woman named *Wang* who was possessed. Upon entering her house *Yao* knew that she was possessed by the spirit of a *T'o*, so he scolded this spirit insulting it and asking it why it had entered the body of that woman. *Wang* answered "a man wants to kill my husband." The devil who was near her answered: "I am exceedingly sad for I know that to-day I must die." It wept and moaned. To this *Yao* said "I know

it is a spirit and cannot fight with it." The neighbours heard these words and then saw a *T'o* coming out, it was killed by *Yao.*

In the book called *Yu Min Lou* (幽明錄) we find the following legend:—

At the time of the emperor *Yung Chou* of the Sung dynasty a mandarin named *Chang Chun* (張春) being in office (*Che-fu*) at *Wu Chang* (武昌) in Hupeh was marrying his daughter. Just as she was getting into her carriage she went mad and on the road struck every man she met declaring she would not marry. A countryman, who was a sorcerer, saw the young lady and understood her to be possessed by the spirit of the tortoise (魅邪). He said that he could cure her by taking her to the bank of a river and there beating a drum. *Chang Chun* having heard of this believed that the man was an impostor (was lying) so he ordered him to bring the tortoise (*Kuei.*) A green snake came first and was transfixed with a nail by the sorcerer. Towards midday a great tortoise was seen issuing from the waters, the sorcerer taking a vermilion pencil traced on its back a mystic character and ordered the animal to return to the waters. At evening time a large white *T'o* was seen in the middle of the river rising and plunging as the tortoise pursued it. The *T'o* died, the damsel wept bitterly on what she called the death of her husband and little by little she returned to her senses. As people were questioning which of the three animals had caused the sickness of the lady the sorcerer said: "The green snake was the messenger who informed me, the turtle is a lover and the *T'o* was the husband of the woman." He then brought the three animals to *Chang Chun* who saw that he had not been false (made a lie.)

In the *Pen Tsao* we find that it requires just the same number of men to pull a *T'o* out of its hole as would be needed to dig it out; otherwise it is impossible to capture it. When it cries the country people know that rain is coming. The same book gives a rather curious method of killing and flaying the Alligator. The mode is as follows: pour boiling water down its throat; after a certain time (rather long I fear) it will die then you can peel off the skin.

Of course such a curious animal akin to the dragon must be used in the materia medica of the Chinese. The scales are found in most of the druggist shops under the name of *Lin Yü Chia* (鱗魚甲). It is mostly procured in the district of Canton where according to the *Pen Tsao* it can always be found.

These scales are said to be sour, slightly warm and a little poisonous, though this last is denied by some authors. They are supposed to cure heart and intestinal diseases, fever and female disorders, diseases arising from fear, nose bleeding, tooth ache and they are also used as a vermifuge and as a remedy for goitre and skin diseases.

The recipe is as follows: roast the flesh, pouring wine over it, burn the skin and bones to ashes and mix them with warm wine. The scales are good to make a soup which is said to cure madness. The fat and liver are also used as medicines in different diseases.

The Chinese have a wonderful idea of the length of time an Alligator can live. Indeed they use it as a term of comparison for old age and if we say as old as Methuselah they write: (a friend of mine informed me) "older than the *T'o*" *pi t'o lao* 比鼉老. They also believe that this animal is gifted with greater strength and vitality than any of the known animals, the elephant included and as a Chinaman jocosely remarked to me: "if you foreigners give nine lives to the cat we must give at least twelve to the *T'o*."

III.—FOREIGN LITERATURE.

Having now well-nigh exhausted the Chinese literature on the subject of the *T'o* and *Ngo* let us investigate what foreign books on China can say on the subject of Crocodiles or Alligators in this country.

Thanks to the kindness of the Jesuit Fathers who placed their valuable library at Sicawei at my entire disposal, and even provided me with written copies of the Great Imperial Encyclopedia quoted above, I was able to consult all the works written on China by their eminent predecessors at the Court of *Kang-Hi*.

The valuable collection of books on China found in the library of the North-China Branch of the Royal Asiatic Society was also carefully consulted.

It is curious enough to notice that out of such a considerable number of works written on this country four or five only, and those in the first part of the 17th century speak of the Crocodile or Alligator. And yet, after a careful comparison of the texts, they are found to copy each other so that the original sources of information are reduced to two, namely:—

Marco Polo the Venetian who writes in the 13th century, and evidently speaks from hearsay, and Father M. Martini who no doubt got his information from Chinese works.

I was much surprised to find nothing on this subject in Duhalde, Grosier, and others who seemed to have described everything worthy of note in the Empire. It was also in vain that we consulted, the more modern works on this country. Even those pretending to give the natural history of China are silent on the subject of crocodilians.

In Wells Williams' Middle Kingdom we find:—The larger lizards have not been noticed in China, though the Crocodile is found both in India and Siam on nearly the same latitude as Kuangtung. It may, however, have inhabited once the rivers of the Middle Kingdom, for the character *Ngoh* is evidently an original word, and Marco Polo describes a huge serpent which he had not seen himself, but which seems to have been intended for the Crocodile.

Here is the text of the Venetian traveller. Marco Polo (1280), Vol. II, p. 62 and seq., speaking of Province of Carajan, the actual province of Yunnan, says: "In this province are found snakes and great serpents of such vast size as to strike fear into those who see them, and so hideous that the very account of them must excite the wonder of those who hear it. I will tell you how long and big they are."

"You may be assured that some of them are ten paces in length, some are more and some less. And in bulk they are equal to a great cask, for the bigger ones are about ten palms in girth. They have two forelegs near the head, but for foot nothing but a claw like the claw of a hawk or that of a lion. The head is very big, and the eyes are bigger than a great loaf of bread. The mouth is large enough to swallow a whole man, and is garnished with great (pointed) teeth. And in short they are so fierce-looking and so hideously ugly, that every man and beast must stand in fear and trembling of them. There are also smaller ones such as of eight paces long, and of five, and of one pace only. The way in which they are caught is this: You must know that by day they live underground because of the great heat, and in the night they go out to feed and devour every animal they can catch. They go also to drink at the rivers and lakes and springs. And their weight is so great that when they travel in search of food or drink, as they do by night, the tail makes a great furrow in the soil as if a full ton of liquor had been dragged along. Now the huntsmen who go after them take them by a certain gyn which they

set in the track over which the serpent has past, knowing that the beast will come back the same way. They plant a stake deep in the ground and fix on the head of this a sharp blade of steel made like a razor or a lance-point, and then they cover the whole with sand so that the serpent cannot see it. Indeed the huntsmen plant several such stakes and blades on the track. On coming to the spot the beast strikes against the iron blade with such force that it enters his breast and rives him up to the navel, so that he dies on the spot (and the crows seeing the brute dead begin to caw, and then the huntsmen know that the serpent is dead and come in search of him.")

"This then is the way these beasts are taken. Those who take them proceed to extract the gall from the inside, and this sells at a great price; for you must know it furnishes the material for a most precious medicine. Thus if a person is bitten by a mad dog, they give him but a small pennyweight of this medicine to drink, he is cured in a moment. Again if a woman is hard in labour they give her just such another dose and she is delivered at once. Yet again if one has any disease like the itch, or it may be worse, and applies a small quantity of this gall he shall speedily be cured. So you see why it sells at such a high price. They also sell the flesh of this serpent, for it is excellent eating, and the people are very fond of it. And when these serpents are very hungry, sometimes they will seek out the lairs of lions or bears or other large wild beasts and devour their cubs, without the sire and dam being able to prevent it. Indeed if they catch the big ones themselves they devour them too; they can make no resistance."

As Col. Yule remarks: "It cannot be doubted that Marco Polo's serpents here are crocodiles (or Alligators) in spite of his strange mistakes about their having only two feet and one claw on each, and his imperfect knowledge of their aquatic habits. He may have seen only a mutilated specimen. But there is no mistaking the hideous ferocity of the countenance, and the "eyes bigger than a fourpenny loaf" as Ramusio has it. Though the actual *eye* of the crocodile does not bear this comparison, the prominent *orbits* do, especially in the case of the *ghariyal* (gavial) of the Ganges, and form one of the most repulsive features of the reptiles' physiognomy...And there is some foundation for what our author says of the animals' habits, for the crocodile does some times frequent holes at a distance from water, of which a striking instance is within my own recollection (in which the deep furrowed track also was a notable circumstance.")

"The Cochin-Chinese are very found of crocodiles' flesh and there is or was a regular export of this dainty for their use from Camboja, I have known it eaten by certain classes in India. The term *serpent* is applied by many old writers to crocodiles and the like, *e.g.* by Odoric, and perhaps allusively by Shakspeare *(Where's my serpent of old Nile.")*

"Matthioli says the *gall of the crocodile surpasses all medicines* for the removal of pustules and the like from the eyes. Vincent of Beauvais mentions the same, besides many other medical uses of the reptiles' carcase, including a very unsavoury cosmetic."

For the French text of Marco Polo we consulted, "*Le livre de Marco Polo par M. G. Pauthier*, chapter cxviii, page 393." There we find in a note that Klaproth (in his "Nouveau Journal Asiatique Février 1828, page 118,") is of opinion that the animal in question is a boa, a kind of snake he says common in Yunnan. He ought to say a python, instead of a boa, as we have now at the Shanghai museum skins from this immense snake sent from Yunnan. But we think it more probable that the Venetian traveller mixes the python and Alligator in his somewhat obscure statements. H. Murray quoting Marco Polo in his Historical and Descriptive Account of China adds a few lines to explain that the animals in question are evidently *crocodiles*.

If we also compare the description of Marco Polo with those given by Bosc and Audubon of the Alligators of America, we will find many points of similarity. According to these authors, the Alligators, which are found as far north as the thirty-second degree of latitude, bury themselves in deep burrows, in the banks of the rivers where they pass the *whole of the cold season*, and even *the entire day in summer*. They fall into a lethargic state before the setting in of the frost and their sleep is so profound that they may be almost cut to pieces without manifesting any sign of life. They seldom travel except *during the night*. They can fast long, live on frogs, fish, aquatic birds, *on dogs, hogs, cattle,* and *any animal they can catch*. Slow on land they can move with great velocity in the water. Though usually met with on the edges of the rivers they are sometimes *also found in ponds in woods*. The Indians *eat the tail* only, and their eggs are prized by the natives, though they partake of the musky smell of the animal, which when strong is insupportable, but it is not perceptible when they are in the water. So disinclined are they to attack the human race that Mr. Audubon, and his companions have waded waist deep amongst

hundreds of them. They are caught with a strong hook baited with a bird or a small quadruped, and connected to a tree by a chain. They avoid the salt-water and proximity to the sea. When angry or fighting they swell themselves and utter a dull bellowing sound not unlike a blacksmith bellows. Stones or concretions are often found in their stomachs. They generally lay from fifty to sixty eggs which they deposit in the sand. In *Alligator palpebrosus*, the eyebrows form large knobs of the size of a man's fist (the great loaf of bread of Marco Polo).

After Marco Polo the oldest work in which we find a mention of the crocodiles in China is the Atlas Sinensis of M. Martini Amstelodam, 1656. In the description of the city of *Gucheu* of the province of *Quangsi* we find: "Ad urbis "ortum est lacus parvus Go, in quo olim Rex *Pegao* de- "cem aluit crocodilos, quibus, ut devorarentur objicere solebat "reos et sceleratos; ab iis innocentes nunquam læsos fuisse "narrant, adeo que, quos crocodili non occiderent, liberi eo "ipso, tanquam vacantes omni culpa abire jubebantur."

That is to say: "At the entrance of the city there is a small lake called *Go* (crocodile lake) in which the King *Pegao* used to keep ten crocodiles. It was the custom to give them the accused people and the criminals to devour.

It is said that the innocent were never hurt by them, so that those who were not killed by the crocodiles were free from this very fact and ordered to go as if they were entirely innocent."

These saurians did not appear to be so good criminal judges in the province of Kuang-tung as the same author describing the city of Chingkiang (in the district of Chaochou) says:

"Ad ortum urbis Ço amnis est, quem incolunt crocodili "etiam hic hominibus infesti." *i.e.* At the entrance of the city is (found) the river Ço inhabited by crocodiles, which are a great plague to the people.

In the description of the Province of Huquang, P. M. Martini speaking of the city of Siang Yang, says:

"Siang flumen ad urbis Barrolybicum est, in quo animal nascitur equo non absimile nisi quod squammosum sit, & ungues ut tigris habeat, ferox est, quod et homines et animalia cœtera aggrediatur id præcipue autumni tempore tentat, quo frequentius ex aquis egressum terram pervagatur. (Novus Atlas Sinensis a Martini Martinio versus 1654. 7a. Provincia p. 76)."

This we find copied by Serlinus in a very curious old book printed at Francfort on the Mein (1165) and called "Artificia

hominum miranda naturæ in Sina et Europa. Willelmus Serlinus & Georgius Figwich. Caput XVI p. 1188. But as it was the custom at that time the authority is not quoted and the latin is cramped or badly copied. Leaving altogether the Barrolybicum he writes only Siang flumen alit animal, etc., and *ungues* is badly enough transformed in *angues* which has no meaning.

The following sentence of M. Martini: "At Chaocheu (Provincia Kuangtung) in amne Go incolunt crocodili etiam hic hominibus infesti" is also copied by Serlinus, but he puts *degunt* instead of *incolunt* thinking it probably a more elegant latin. This statement of Martini is confirmed on his map where we find the river Go flowing near Chao cheu.

Father Athanase Kircher, in his "China Illustrata, Amstelodam 1667," prefers to copy the description of these animals from Marco Polo.

Then comes the book "L'Ambassade de la Compagnie Orientale des Provinces Unies vers l'Empereur de la Chine, etc. . . . Leyde 1665." This is the description he gives, in quaint old French, of the Crocodile.

"On trouve aussi force *Crocodiles* près la ville de *Chao cheu* (province de Quantung) dans les eaux du fleuve de *Co* (Go ?) les quels molestent et tüent beaucoup de monde.(16) Cet animal a cinq choses fort considérables ; il devient le plus grand du plus petit principe et commencement, *maximus existit ex minimo*, parce qu'il est produit d'un œuf ; il remuë la maschoire d'enhaut ayant la basse immobile ; il croît tout le temps de sa vie ; il n'a point de langue selon plusieurs, ou l'a courte, ou inutile selon d'autres ; et il fuit devant les personnes qui le poursuivent, ne courant qu'après celles qui témoignent de la peur en s'éloignant de luy. . . . . On dit qu'il peut vivre quatre mois sans manger. . . . . Les *brebis* et les hommes font ses plus friands morceaux. . . . . On le prend avec des hamegons attachés au bout d'une corde fort déliée faite de *cannes*, en mettant quelque méchante brebis ou chèvre pour amorce que ces monstres avalent comme une pillule, et ainsi ils se trouvent attrapés.

"Les Chinois et les autres peuples Orientaux font bonne chère de leur chair qui est blanche, d'un gout de chapon et d'une odeur très agréable. Ils tiennent que l'eau, dans laquelle cette chair aura boüillie, a la force de guérir les morsures des araignées, et que leur sang éclaircit la veuë, et remedie aux

(16) This is evidently taken from Martini.

blessures des couleuvres. Leur peau estant brulée et mêlée avec de la lie d'huile engourdit les membres de telle sorte qu'ils ne sentent point la piqure."

This description is also accompanied with a curious engraving intended to represent a crocodile, but it is evidently drawn a great deal more from imagination than from nature. The body which is covered with oval scales, very distant from each other, does not rest on the ground and the tail has only one ridge of scales instead of two.

From these times 1280 and 1667 we find no books mentioning the existence of the crocodiles in China except Williams in his Middle Kingdom as above quoted and Morrison who says positively in his dictionary that crocodiles are found in Yang-tsze-kiang. We have searched carefully the old files of the Shanghai newspapers and it was not until the year 1869 that we found the first reliable modern notice on the existence of crocodiles in China.

Under the title *Crocodiles in China*, the *Shanghai Evening Courier* of the 17th of March 1869 gives the following:—

"A little time ago, before the rise in opium and the feverish but profitable speculation in rags to arrive, engrossed the active foreign mind of Shanghai, we were interested in a report that a real true dragon had been imported and was to be seen by the curious in the Shanghai tea gardens. Naturally reports magnified the appearance and attributes of this extraordinary creature; nothing of the kind had been seen before; it had come out of a cave in the wild *Kiangse* mountains; could devour a child without distressing its thorax; and was eminently calculated to perform that supreme act of Chinese patriotism: exterminate the barbarian. A goodly crowd of foreigners went to see the monster. Armed with ten cent pieces or whatever small coins the ingenuity of bank compradores induces us to accept as quarter dollars, and unmindful of sundry bad cases of confluent small-pox and other forms of infectious disease with which the entrance to the Chung wang miao (17) is ornamented, we found ourselves amidst the wonders of that most curious ground known as the tea gardens. Passing through the festive crowd who were spending their loose cash with mountebanks, peep shows, story tellers, and sweetmeat vendors, we came upon a large space surrounded by a strong net in the middle of which was a canvas screen about two feet in length, and behind this was concealed the dragon. A notice at the entrance informed the public that he weighed so

(17) Temple of Chung Wang.

many catties and was a real horrible mountain dragon. Above the canvas screen could be seen the manly form of a coolie armed with a bamboo, who every five minutes appeared to be engaged in a kind of Pootung outrage (fight) with the monster within, and every five minutes by the gesticulations and cries of this gentleman it would appear that the dragon had got the better of his antagonist, who disappeared defeated behind the canvas for a time before recommencing the performance. Truly there must be a "pucka" (proper) demon inside! so feeing the attendant, in we went, with a fore knowledge that we were going to be "done" and "done" we were. In an ordinary washing tub about three feet long was to be seen a poor miserable half dead common Crocodile, or Alligator as learned discriminators of species declare it, who resembled his congener of the Nile about as much as a monkey does a man. He had a curious despairing look in his wicked little eye and seemed to be thinking of that feed of fish which he sadly wanted, but would never get. The attendant, he of the bamboo lately engaged in the terrific struggle, took the wretched thing from his tub, turned him upside down, opened his mouth in the gentle way a parish doctor does a pauper's, shewed his teeth, and with a broad grin informed us that he was very terrific. Then the poor beast was returned to his wash tub and instantly went into a stupor! It had most likely come up in a ship from Siam, the crew of which forgot to feed it, and was not comparable as an object of interest to our late friend the salamander. That brute at all events redeemed a long life of the most uncompromising indolence, by turning sharp round on his master and biting his hand severely causing him at once to respect his captive and be more careful in future. The party assembled, among whom were the learned both in law, language, medicine and science felt that they had come a long way to see nothing, but to console themselves, agreed that this wretched little crocodile having thirty-two teeth must be a new species, and that consequently both time and coin were well spent."

This is the first mention of a *probable new kind* of Alligator or crocodile in China and though the article was written in jest some of the scientific men who were with the writer (Mr. Goodwin, an able scholar and great ægyptologue) declared from their cursory investigation that this was a new species as we will see later on by Mr. Swinhoe's note in the Proceedings of the Zoological Society.

This paper was written and going to the press when hearing that Mr. E. A. Reynolds had seen Alligators in the Yang-

tsze long before that I enquired from him on the subject, and he very kindly favoured me with the following note:—

"In April 1853, I lent my house-boat to T. T. Meadows, H.B.M.'s Consul, and accompanied him in her to Nanking, where we were towed by H.M.'s steamer *Hermes*, having on board Sir Sam. Geo. Bonham, Governor of Hongkong. On approaching Silver Island, we noticed what appeared to be human bodies floating near the shore in the eddy tide; but on nearing there were found to be wooden idols, which the rebels had thrown into the river from the joss-houses on the Island. Not seeing anyone moving about Meadows and myself proceeded in my boat and landed. We found all the pavilion, priests' dwellings, etc., burnt down; but all the temples at the landing were perfect. I found one priest, to whom I asked, if there were no small josses about, he took me to a ditch into which a number of brass, bronze, and other metal idols had been thrown. I carried away quite a number. He took me to a pond or a small lake, taking a small bowl of rice and a switch with him, with the latter he beat the water crying 'ado, ado,' presently an Alligator or Crocodile came towards here we were standing, and while still in the water opened his mouth into which the priest threw the contents of the bowl: the Alligator backing himself into the water again. I was quite unprepared for such a sight, and was a little alarmed at first. I should say the animal was of a good size, but as his open mouth only came out of the water, I could not see how long it really was."

"Returning to the temple, I noticed a very fine etching, of an Alligator, also a long inscription cut in the slate tablet, I dug this out intending to bring it away, but on getting it to the ground it was found it would require several men to carry it off, so I had to abandon it. I, however, think it would have been replaced by the priests, and may be now in the wall, from whence I removed it. I should think one could get a full description of this Alligator from the inscription.

"The officers of the *Hermes*, who landed shortly after were much struck with the correctness of the etching, being a departure from Chinese rude pictures of all animals. Doubtless this correctness may be attributable to the fact of the priests having daily opportunities of watching their pet when basking in the sun.

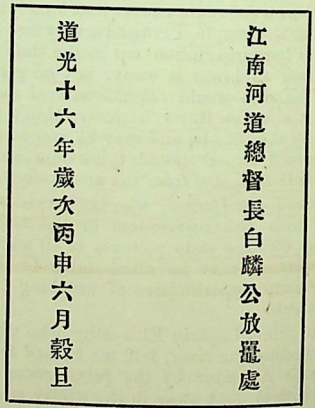
"A friend of mine, Captain Elsworthy, who was in the Taoutai's fleet blockading the river, told me he had frequently been shewn this same Alligator by the priest some months after; and they told him it went away in the winter (more likely only

buried itself deep in the mud at the bottom of the pond), and returned in the spring and remained on the Island during the hot months.

"I since made enquiries about this Alligator, and was told that one of the captains of a Portuguese lorcha, employed also in blockading the river, had fired at it with his rifle while the animal was in the pond; but whether he killed it or not, I did not learn; probably not, or else, we would have heard more of it.

"Three years ago (1876), while ascending the Yangtsze in my steamer, being some miles below Nanking, my people were alarmed at a strange to them looking fish, which was close to the shore not more than ten feet from the steamer. I immediately ran to the side, and then saw an Alligator about eight feet long floundering in the wash caused by the paddle-wheels. I stopped the steamer with the view of capturing it, but it had disappeared. I am led to believe this same Alligator was since seen at Chinkiang, no doubt having drifted down by the current."

Highly interested by this communication I took the earliest opportunity of repairing to Chinkiang, and on the 2nd of January 1879 I found in the *Hai Shen Miao*, Temple of the Spirit of the Sea, at the eastern extremity of Silver Island, the tablet in question. It is a heavy marble slab, six feet in height by two in breadth, standing against a wall and bearing in two vertical lines the following inscription:—



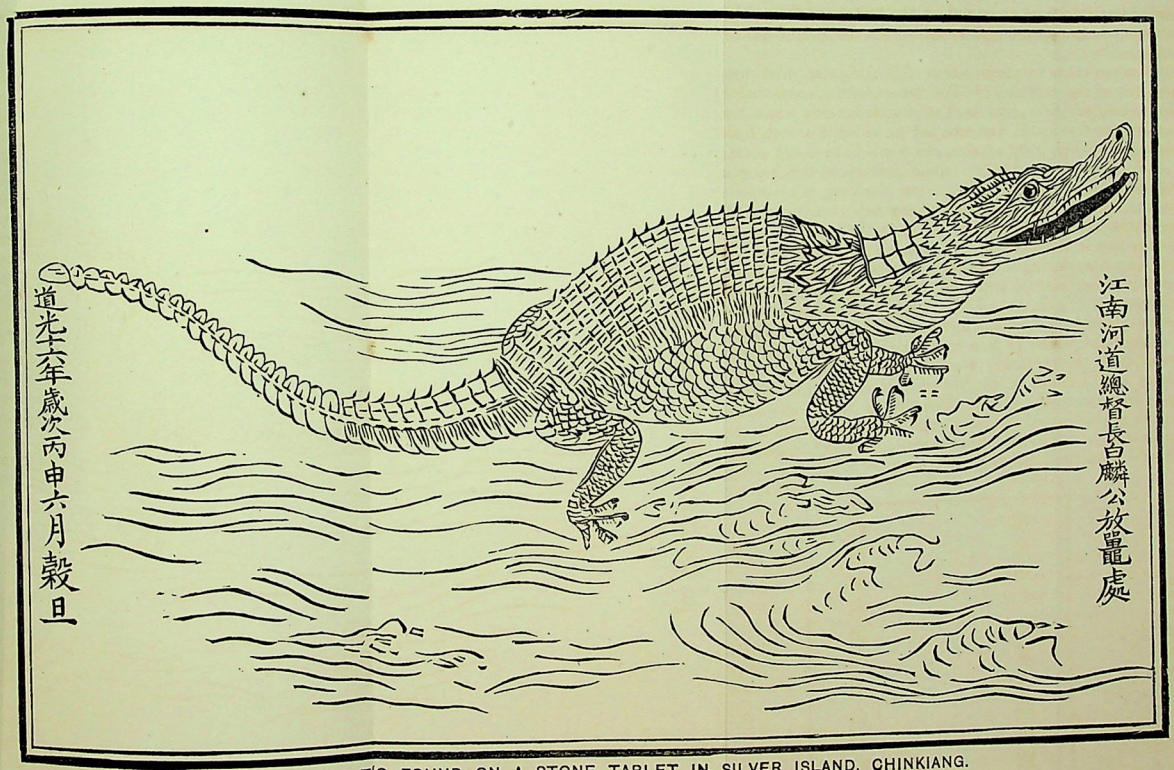


FIGURE OF THE T'O FOUND ON A STONE TABLET IN SILVER ISLAND, CHINKIANG.



That is to say: "*Lin* of *Chang Pai*,(18) Governor-General of the Yellow River of Kiangnan released the Alligator at this place on a lucky day of the 6th moon of the 16th year of *Tao-Kuang* (July 1836). Below the inscription is a very good engraving of the *T'o* Alligator, of which the accompanying woodcut is a reduced facsimile. It was obtained by a direct impression or rubbing(19) made on the stone. A little further on I saw the pond in which a living Alligator is still kept; this specimen has been there for two years. But as it was lying torpid in the mud at the bottom I was unable to catch a glimpse of it.

From the priests I heard that these saurians are often found in the Yangtsze by the native fishermen in whose nets they become entangled. As they are no use to them they are killed by blows on the head and their carcases are thrown back into the stream. Sometimes however they are presented to or purchased by the priests of the *Hai Shen Miao*, where for years past one at least has been kept in the pond. According to my informants at Chinkiang these Alligators come from the Tung Ting and Po Yang lakes being driven in the swift stream of the Yangtsze at flood times.

From the above inscription we understand that the Alligator released from captivity by *Lin* was probably the first seen there. It is a common practice amongst Buddhists to buy living animals and set them at liberty. This is held as a very

(18) There were formerly two high functionaries superintending the course of the Yellow River, one for the southern course in the old province of Kiangnan (now Nganhui and Kiangsu) and one for the northern course in the province of Shantung; thence the two names of *Kiang Nan Ho Tao Tsung Tu* 江南河道總督 and *Tung Ho Tao Tsung Tu* 東河道總督. (*Ho* 河 is often employed in Chinese language as meaning the river *par excellence* the 黃河 Yellow River).

Chang Pai 長白 stands for *Chang Pai Shan*, the name of a celebrated mountain in the north-east of Manchuria, not far from the northern frontier of Corea. Here it must be translated by the adjective Manchurian, as it appears that the whole of Manchuria is often designated by the name of the mountain, a practice often resorted to in Chinese literature.

The governor general Lin of Manchuria must have been the last but one of the functionaries in charge of the meridional course of the Yellow River, as this charge has been since abolished, most probably on account of the change of direction which took place in the course of this river in 1851. (For this information I am indebted to the kindness of my friend Mr. J. de Bielke, interpreter of the French Consulate.)

(19) To obtain those rubbings a thin paper slightly wet is applied on the stone and pressed into the cuts, a cake of black wax is then rubbed upon it and the characters on drawings appear in white on a black ground.

meritorious act and according to one of the Buddhistic rules its value is enhanced by the comparative rarity of the animal.

On the Yangtsze, this ceremony, called *Fang-sheng* releasing the living, is often resorted to in order to propitiate the god of the waters. Turtles are often bought for this purpose and liberated in the great river with a small piece of metal, fastened to the shell, bearing the date with the name of the pious performer.

In the case of the *T'o*, the Governor-General of the Yellow River wanted evidently to commemorate the event of releasing such a rare animal which he most likely had seen then for the first time; accordingly he chose a lucky day for this performance and caused the commemorative tablet to be erected.

It now stands under the guardianship of some Hunan braves as a part of the temple has been transformed into a fortress, foreign guns having taken the place of the wooden images which floated down the river in 1853 to the great amusement of the rebels.

IV.—NATURAL HISTORY.

If we now consult the modern scientific works written on the Natural History of China, still very few, we find that no scientific traveller, nor naturalist has found the crocodile or Alligator in this country. In the Expedition du Meikong which crossed Yunnan, I expected to find something on this subject, but was sorely disappointed. The Abbé David confines himself to geology and birds describing also some new kinds of Mammalia, but of crocodiles he does not even mention the name. The Novara Expedition round the globe which mentions some of the Shanghai new birds did not go far enough into the interior. Baron von Richtoffen confines himself to geology. The Jesuit naturalist, Father Heudes, has made a name for himself in the conchology of China, but it is curious enough that in dredging for shells in the rivers of Chinkiang and Ningko fu districts he never came upon an Alligator, though, he tells me, he has often heard of the existence of what he calls crocodiles in these districts, where, he says, the natives use them for medicine. Once he lost a good opportunity through the saving propensities of his servants, who refused to buy a skin of this animal because the merchant wanted a few hundred cash more than they thought proper to give.

Thinking that some navy doctor, a temporary resident in China, might have per chance discovered these animals and reported upon them, I searched the Proceedings of or the Zoological Society of London and the Nouvelles Annales du Museum de Paris. I found some new species of crocodiles described in the former, but none were of China. At last, I came upon a list of Reptilians and Batrachians collected in various parts of China by the late Mr. Swinhoe and with great interest read the following :—

"No. 3.—*Crocodilus sp.* ?

"In February, 1869, some Chinese were exhibiting, in the native city of Shanghai, what they called a dragon, which they declared had been dug out of a hole in the province of Shense (Mr. Goodwin puts Kiangse). It was a young crocodile about four feet long, which they kept in tepid water. They made so much money by showing it that they refused to sell it. *I cannot, of course, guess at its species; but I, nevertheless, think the fact worth recording, as evidence that a species of this group does occur in China.*"

Having heard that some two or three years ago a crocodile had been seen in Chinkiang, I asked our President, Mr. T. W. Kingsmill, to write to the person who had seen it for information and this is the reply of Mr. T. W. Duff :—

"In 1875 there was an Alligator caught in the Yangtsze, off the British Concession at Chinkiang, but well out in midstream. It was not particularly lively, although summer time, but this may have arisen from the rough handling it got while being caught. No one could account for its presence in the river, although it was surmised that it might have escaped from some temple; but as there are few of these places near Chinkiang at all likely to have such an animal in them, I do not think it at all reasonable.

"It lived some days in a pond until a deputation of Chinese purchased it for fifteen dollars and presented it to the priests on Silver Island. Whether it lived there or what became of it after this I am unable to say."

Having failed to procure it for the Shanghai Museum an Australian Crocodile brought from Australia to Chinkiang in 1868 by the celebrated entomologist, Dr. Martin (who died in America this year), was sent instead to the Museum, where it was gazed at, for a few years, as a Chinese crocodile until the perpetrator good naturedly confessed his joke.

Nothing more was heard of the crocodiles until April this

year, when a member of the Chinese Customs service, Mr. Lloyd E. Palm, Acting Deputy Commissioner at Wuhu, bought from the natives, a specimen which had been apparently dug from the ground in the neighbourhood. When it reached us on the 15th of April, it was still in its torpid state, and could be handled easily without danger. Having no books of reference in the Shanghai Museum, I took the animal with me to the Jesuits' Museum at Sicawei, and there with the assistance of the curator, Father C. Rathouis, M.D., of Paris, studied and dissected the animal comparing it carefully with the plates of Cuvier, Duméril and other works on reptiles, especially those of India. The skin was then prepared and mounted by our native taxidermist of the Shanghai Museum where it can now be seen. From this study we came to the conclusion that it was probably a new species of Alligator, and I took care to state the fact in the *North-China Daily News* of the ninth of May,(20) when acknowledging the contributions of the preceding month. I added a few words asking for another specimen to be forwarded to Paris, in order to have this species named.

This appeal was duly responded to on the 3rd of October last, when we received a second specimen from Chinkiang. It appears that it had been seen coming down the stream in a half torpid or exhausted state, and some Chinese fished it up just opposite the Custom House.

The capture, made without difficulty, was witnessed by the two Customs employés, Messrs. C. W. de Ste. Croix and J. C. Günther, who conjointly bought it on the spot and presented it to the Shanghai Museum, where it arrived on the 4th of October, and where it is still alive in a state of lethargy having only eaten twice since its arrival.(21)

I now had well-substantiated cases before me. In the first some of the mud in which the Alligator had been buried could

(20) The museum has also received two new and important specimens:— A beautiful Albatross (*Diomedea Derogata?*), shot by Capt. A. Croad near the Chusan Group; and a living Alligator (*Alligator Lucius?*) sent by Mr. J. L. E. Palm from Wuhu, where it was captured in the hills. Père Heudes having also seen Alligators near Ning-ko-fu, there is no more doubt about the existence of this saurian in the Yangtsze waters. It differs considerably from the two species described in Cuvier and Duméril, and will likely prove a new variety. If any friend of science can succeed in sending us another live specimen, it will be forwarded to Paris for examination.

A. A. Fauvel, *Hony. Curator.*

(21) It died on the 24th of December, apparently from aneurism of the heart, as the pericardium was found full of blood. It was an adult female, with sixteen immature eggs in the ovaries.

be still found in the mouth and anal aperture, so it must have been found not far from Wuhu, and the capture of the second specimen in the Yangtsze waters proves that these two Alligators were natives of China. About September I saw two live specimens, which Dr. O. F. von Möllendorf, the interpreter of the German Consulate at Tientsin, had bought in the Chinese city of Shanghai for the sum of ten dollars a piece. The weather being then warm, they were very lively and rather dangerous to handle, uttering, when approached their characteristic bellowing sound. The natives who sold them said they had come from the Poyang lake where they were to be found in numbers.

Upon inquiry I soon learned that some had been shown from time to time in the native city, and Dr. Little told me he saw two in Chefoo this summer, where they were exhibited as a great curiosity. They measured about five feet in length. Finally, I myself lately procured in the Chinese city of Shanghai, a skin with the complete skull attached.

One was also procured in the same place by Mr. Löczi, the geologist of the Austro-Hungarian scientific mission. I was then able to study the generic characters from four good specimens and from this study I came to the conclusion that we were in the presence of a real Alligator of a new species or at least not described in Cuvier, Duméril, Bibron or other authors I could consult. Unhappily as I was unable to find here the last work of Professor Vogt of Geneva on the crocodilians I cannot be quite sure that this species has has not been found elsewhere.

However the article on Alligators in the very last edition of the Encyclopedia Britannica clearly states that all the species of Alligators known are found in America and with one exception only (The *A. Lucius* found up to the 32° lat. in the Mississippi) are confined to its tropical parts Brazil, Guyannas, etc.

Cuvier, says the same Encyclopedia in a former edition thinks it most probable that Alligators have their representatives in our hemisphere although it does not seem to be yet ascertained whether any true Caïmans are found in the old world. This is perhaps a little far fetched as the words of Cuvier are "Il serait possible que l'on découvrît par la suite dans l'ancien continent quelque espèce appartenant à la subdivision des Caïmans."

It is probably with still less accuracy that the same edition of the Encyclopedia says, speaking of *Crocodilus Biporcatus* the same as *C. Porosus*: "This species is the common croco-

dile of India and its archipelago, frequenting the Ganges and other great rivers which empty themselves into the ocean, as also those of Corea (?) and China (?), Ceylon, Java, Timor, etc."

Upon what authority this statement is based the Encyclopedia Britannica does not say. Though real crocodiles may be one day found in Southern China I have great doubt about the possibility of their being discovered in cold Corea. At all events I never saw this last country mentioned for its crocodiles elsewhere.

Thinking that our Alligator might have its representative in Annam and Cochin-China I went to see some of our French missionaries who had lived many years in these countries and from their descriptions made sure that the crocodilians found there are the *Crocodilus Siamensis C. Porosus* and the gavial of India. They saw our specimens in the Museum and declared them entirely new to them. I insist upon this point, because of the crocodiles in Saigon being called caimans, a name which belongs only to the Alligator.

The flesh of the Alligator does not now seem to be eaten in China as that of the crocodiles is in Annam, but its skin is found in medicine shops where it is often used in place of a sign board. Two were procured in the native city of Shanghai and the natives who sold them told us they came from Canton. All the natives here called these skins sea dragons' skins *Hai Lung p'i*, and seemed considerably astonished when I told them that the Alligator was never found in the sea. In other districts, Chinkiang and Wuhu, the name for it is *Ngo Yü* or *T'u Lung*, *Ngo* fish or earth dragon.

With this I shall close my disquisition on the history of the Alligator and shall now proceed to the description of the animal.

V.—DESCRIPTION OF THE ALLIGATOR.

As a great many people easily confound the Alligator with the Crocodile we will give first the generic characteristics of the two from Cuvier's book. "Les Ossements Fossiles." 1.—Crocodile. Muzzle oblong; the upper jaw has a notch on each side to allow the fourth tooth of the lower jaw to pass, the hind feet are fully webbed and fringed or denticulated on the outer margin. The teeth are at least 15 on each side in the lower jaw and 19 in the upper one. The first ones of the

inferior jaw perforate the upper one at a certain age and the nuchal plates as well as the dorsal differ greatly in number, shape and position from those of the Alligator. The post-orbital holes are very large and always present.

2.—Caïman or Alligator (the names are synonyms. Caïman being the one given by the negroes in America to the *A. Lucius.*) The muzzle is broad and short. The superior jaw receives the fourth tooth of the lower jaw in a particular hole or foramen which conceals it entirely; the hind feet are only semi-palmated and do not possess the fringe or denticulations.

The length of the head is to its breadth as two to one. The teeth are very unequal in length and there are at least 19 and sometimes as many as 22 on each side of the lower jaw; at least 19 and often 20 on each side of the upper jaw. The post-orbital holes, in the species which possess them, are very small, in one species they are entirely absent. There are about 6 species of Alligators known. Cuvier describes three with one variety viz: *Alligator Lucius, A. Sclerops, A. Palpebrosus* 1st variety and 2nd variety. Since Cuvier's book was written two more have been added to the list: *A. Cynocephalus* and *A. Nigropunctatus.*

I will now compare the Chinese Alligator carefully with the five described by Cuvier and with the two others as described by Duméril and Bibron.

At first glance it looks very much like the *A. Lucius*, the pike-muzzled Alligator. Its head and muzzle are flat, the sides nearly parallel and uniting in front in a parabolical curve. The internal edges of the orbits are slightly elevated. The nasal aperture is, even in the young, divided in two by a bony bridge. A small hole in the bones of the palate corresponds to the nasal aperture but it is covered by skin in the living animal.

All these characteristics also belong to the pike-headed Alligator but it differs in this way that the snout of the *Lucius* is comparatively longer. Its length is as 1 and ¼ to its breadth taken in front of the orbits. The total length of the cranium (taken from the base of the skull to the point of the snout) is as 2 and ¼ to its breadth taken at the same place. In our Chinese Alligator, the length of the snout is nearly equal to its breadth and the length of the cranium is a little less than twice the extent of the snout, so that the head forms an isosceles triangle shorter than the one figured by the head of the *Lucius.*

A greater difference exists in the appearance of the bones which are deeply honey-combed or vermiculated in ours and

smooth in the other, whose snout is also more flat. Other differences exist in the shape and direction of the post-orbital holes. Their external aperture is ovalo-elliptical with the great axis sensibly parallel to the axis of the skull; in the Lucius they are smaller, the perforation being a small one at the bottom of an elliptical *fossa* whose great diameter forms an angle with the axis of the head; the aperture of the angle being in front towards the snout.

The vermiculated appearance of the bones is also possessed by the *crania* of the *A. Sclerops* and *A. Palpebrosus*, but the shape of the head is far different and the post-orbital holes very small in the first are altogether absent in the second.

Nor does it possess the characteristic crest between the orbits which gives its name to the *Sclerops*, *i.e.* spectacled.

But it is very curious to notice that however different the shape of the head from the *Palpebrosus* it possesses like it the bony eyelids from which the specific name is derived.

The teeth formula of the Alligators is from 19 to 22 on each side of each jaw (the one for the *Sclerops* is $\frac{19.19}{21.21} = 80$, as well as for the *Palpebrosus*). In our specimens I find $\frac{18.18}{19.19} = 74$, so it has fewer teeth than any species but the *Lucius*, whose formula is $\frac{18.18}{17.17} = 70$.

Thus by the shape of the head, the weavy edges of the snout, the bony bridge of the *nares* (possessed by no other species than the *Lucius*), and by the post-orbital holes it is nearly allied to the Pike-headed Alligator. By the honey-combed appearance of the bones of the skull and the bony eyelids it approaches the *A. Palpebrosus*.

By the shape, form and number of the teeth it differs from all as well as by the size and general dimensions of the different parts of the body.

But those are not the only specific characters of the Alligators and we must now look to the disposition, form and number of the nuchal and dorsal plates, and also compare the dimensions of the various species.

The nuchal plates of the *Lucius* are 8 in number, oval-shaped and distant from each other, disposed in 4 rows of 2 each. In the *Sclerops* there are 14 square plates, disposed in five rows and close to each other, being 2 in the 1st, 4th and 5th rows and 4 in the two others. In the *Palpebrosus* we count 10 plates in rows of 2 close to each other, they are separated from the skull by a line of 4 plates of good size and distant from each other. The disposition of the nuchal plates in the *A. Palpe-*

brosus 1st variety is very nearly the same as the one found in our specimens when we see six conspicuous nuchal plates closely packed in three rows with a short space of separation from the plates of the back not found in the other species. Two small round isolated plates are found in front of the nuchal shield and between them and the skull is a semi-circular row of six conical plates. These characteristics I have found constant in the six specimens I have been able to study and constitute by themselves a new species.

The number of the rows of dorsal plates is 17 from the shoulders to the base of the tail, they correspond exactly to the number of vertebræ. They are disposed as follows :—

3	rows of	4	plates
7	,, ,,	6	,,
7	,, ,,	4	,,
17			

In the other species I find the number of rows varying from 18 to 19. The number of the plates in each row is also at—variance with the number of those in our specimens. The difference is still more perceptible in the number of the single or double crested bands of the tail.

The length of our adult Alligator is about 5 feet and 8 inches whilst the *Lucius* measures 6 or 7 feet, some go even to 14. (The head is included about 8 times in the length of the body of the Chinese Alligator).

The *Sclerops* measures from 11 to 14 feet (8 heads ½.) The other species measure from 6 to 9 feet. So our Chinese Alligator seems to be the smallest of all known.

Its colour above is a greenish black, speckled with yellow vermiculated lines only apparent when wet. The underparts are of a greyish colour, on the tail bands of faint yellow and green are visible.

This colouration is also peculiar to the Chinese Alligator. The colour in the other species being : a deep greenish brown above and a white tinged with green in the *Lucius;* or a blueish green above and an irregularly marbled green and yellow below in the *Sclerops.* In both the *A. Cynocephalus* and *A. Nigro-punctatus* the back is greenish with black spots. The hind feet of our specimens are very slightly palmated as may be seen by the plate. In this it resembles *A. Palpebrosus,* the least palmated of all.

In conclusion I find that the Alligator of China differs great-

ly from all the described species; at least from all those described in Cuvier, Duméril, Bibron, etc. Its position appears to be between the *A. Lucius* and the *A. Palpebrosus*, so until it has been more carefully studied at home, we propose for it the distinctive name of *Alligator Sinensis* and append herewith the final description of it as a base for further and more complete study.

Alligator Sinensis.

Distinctive qualities and habits drawn from six specimens, of which one is a male and one female.

The Chinese Alligator appears to be a small species measuring from 1.45 to 1.74 mètre; though longer specimens may still be found.

General Dimensions.—In the largest specimen studied the measurements are as follows:—

Length of the head (from the snout to the articulation of the jaws)	0m. 240
Breadth of the head at the same place	0m. 135
Breadth of the head in front of the eyes	0m. 115
Body from base of cranium to the beginning of the tail	0m. 638
Length of the tail	0m. 863
Total length	1m. 741

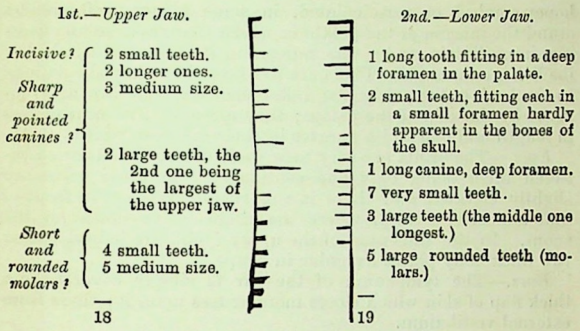
The length of the head is contained about 8 times in the length of the body, and it is double its breadth in front of the orbits.

The measurement round the middle of the body gives 50 centimètres.

The edges of the snout, which is short and slightly concave are very weavy, a great deal more so than in the *Lucius*. It seems a little broader in the male than in the female.

Teeth.—The formula of the teeth is $\frac{18.18}{19.19}=74$ with sometime a small difference of one or two teeth in either of the jaws. It seems also to change with age as in a young specimen we found the formula to be $\frac{17.17}{18.19}=71$.

These teeth vary much in size. They are, with the exception of the back ones (molars!) sharp pointed with a slight curvature directed inwards. Being symmetrically disposed we will give their respective number and disposition only for half of each jaw, beginning from the snout:—



All of them overlap those of the lower jaw.

There seem to be at least three generations of teeth, as in the oldest specimen I found smaller teeth always present within the others.

Cranium.—As may be seen from the annexed plate the skull presents the general appearance of an isosceles triangle whose base measured at the articulation of the jaws is contained 1.7 in the length; otherwise the head is very nearly twice its breadth.

Dimensions of the cranium: length from base to snout. The base taken on the line of articulation of the jaws	Om. 234
Breadth at base	Om. 147
Breadth in the middle, just in front of the orbits	Om. 105
Length of snout from this place	Om. 117
Height of the head at the thicker place (behind the eyes) including lower jaw	Om. 105
Total length of the head including the lower jaw	Om. 264

The sides of the snout are nearly parallel to the axis of the cranium, they are joined in front by a parabolical curve beginning at the upper canine tooth at which place it is much enlarged. The snout is concave being enlarged at the nares.

Nares.—The nares are separated from each other not by a bony septum as in the *Lucius*, but simply by a bony bridge. The ridge is slightly elevated and the shape of the opening in the bones of the snout is quite semicircular.

Bones of the Skull.—The bones of the cranium are deeply

honey-combed or vermiculated, in some places perforated as orund the margin of the palate in which there is a small opening immediately under the nares, but it is covered by skin in ihe living animal.(22) There are two large bow-shaped openings tn the back of the palate just under the eyes, they are also covered by the skin of the palate; they measure five centimètres in length and one and a quarter in their greatest width.

Eyes.—The orbits are very near each other, the distance between them being only one centimètre, the inner edges are slightly elevated and there is a marked depression in front of nine millemètres deep, where the ridges slope down on the snout. In the thickness of the upper eyelid are lodged one or two thick bony plates irregular in shape.

Ears.—The tympanum of the ear is simply covered by a thick flap of skin which closes more or less upon it; there is no external vestibulum.

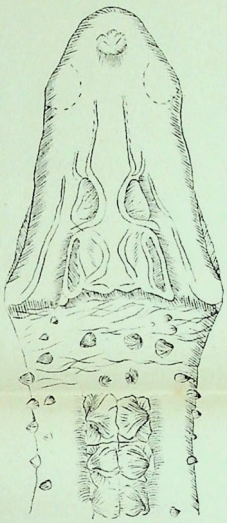
Post Orbital Holes.—They are very apparent ovalo-elliptical in shape and can be felt even through the skin. They are situated immediately behind the orbits and in the same line with them. This line which passes through them according to their grand axis is parallel to the axis of the skull and also passes through the middle of the nasal aperture, so that the post-orbital holes, the bony eyelids and the nares are situated on two lines parallel to each other and to the axis of the cranium.

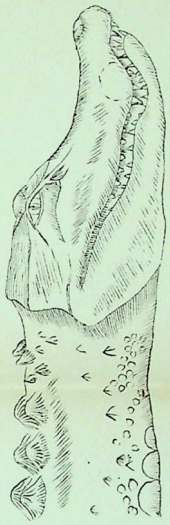
The line forming the basis of the skull is slightly convex towards the body with a very small notch in the middle.

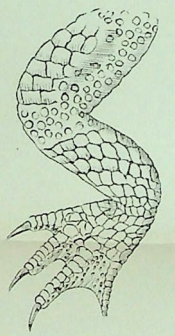
Under the lower jaw near the throat there is on each side a tubular gland containing a musky substance, when the animal is angry these are projected outwards by a kind of telescopic motion like two horns or tubes about two centimètres in length.

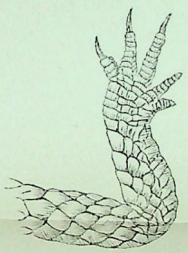
The Chinese Alligator appears very slow in his movements being nearly always in a half torpid state, in the summer time when molested he is inclined to bite but is never first in the attack. For the general colouration of the body see above page 33 and page 32 for the disposition of the nuchal and dorsal plates.

(22) Not always present.

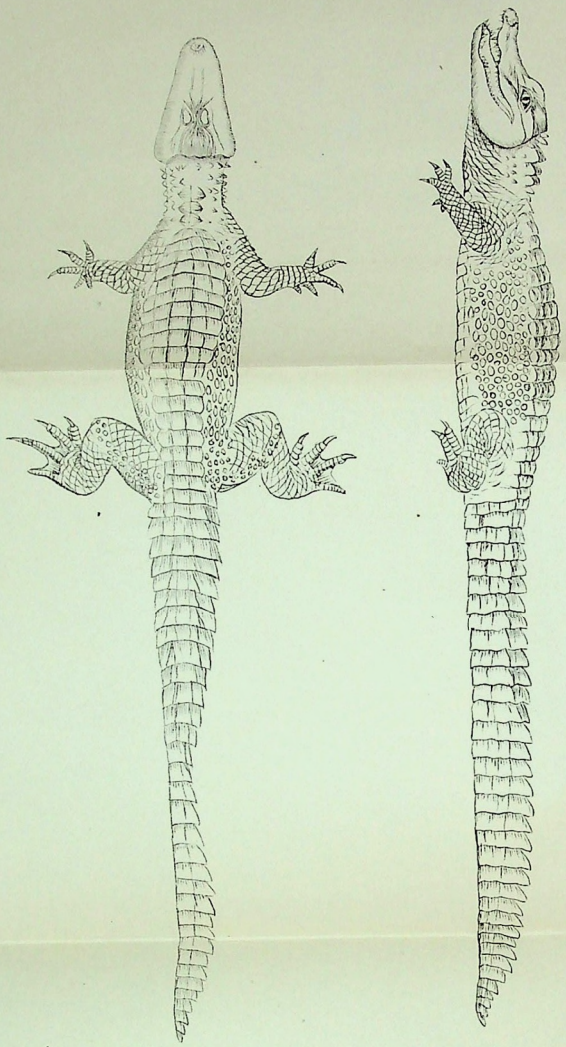








Autogr. de la Mission Cathol. de Zi-ka-wei (Tou-sè-wè), 1878.



Alligator sinensis.

After this paper had been printed I found some curious notes about the Alligators in different works and received further valuable information of which the following are the most important items:—

I.—PHILOLOGY AND CHINESE RECORDS.

In the *China Review* of March and April 1879, Vol. VII No. 5 I read among the notes and queries: Crocodiles. 起蛟 "Raise the Crocodile" means "deluges" or "disastrous floods." The question as to what the 蛟 really is has already been discussed of recent date both in this journal and elsewhere. The watery phenomena known as "crocodiles" are said to occur only in the interior Provinces, and to be especially frequent in Honan. The "crocodile" takes several years to incubate, and during this period lies concealed deeply in a gently undulating mound, which is never covered with snow. If, therefore, it is observed that any given spot is not covered with snow when the rest of the ground is covered, notice is taken of the fact, and persons are sent annually to make examination of the spot, and observe if the absence of snow is repeated. If the spot be uncovered during three successive years, the "crocodile" is unmistakably there, and must be dug out. At a great expenditure of time and labour this is accordingly done, and the animal (whose appearance as described answers to that of a small Alligator) is carefully conveyed to the sea. If he is not dug out, when he himself comes forth and "rages," he speeds like a blight all over the land, cutting through every obstacle, and carrying behind him a huge "tidal ware." All this too in the interior!"

This may explain why the natives made such a demonstration at the finding of an Alligator underground some time ago near Chinkiang. The event was commemorated by a small article in one of our local Chinese newspapers, the *Shen Pao* 申報 and the following is the translation published by the *Shanghai Courier* of the 11th March, 1879:—

"A short time ago, a party of workmen were engaged in clearing out a small canal close to Chinkiang, when they came upon an Alligator which had buried itself in the mud, its scales being distinctly visible. They immediately stopped work and reported the matter to the authorities. The mandarins came down to the place in a body and burnt incense to the beast, in the hopes of inducing it to go, which, however, it refused to do. A large number of people came over from Yang-chow to see

the creature. Its appearance is said to presage a great rise in the river this year."

In March 1879 I also found a notice of the T'o in a beautifully printed and illustrated Chinese work called : 鴻雪因緣圖記 *Hung-hsüeh-yin-yuan-tu-chi*, written by Lin, of Chang Pai. This book (2nd edition) was published in the city of *Yang-chou* of the province of *Kiangnan* in 1849 and is the best illustrated Chinese book I know. The work is in six volumes of about one hundred pages each and having a fine double page engraving after every two pages of printed matter. These two pages are an explanation of the picture. In the second volume of this beautiful work we find a picture of Silver Island at Chinkiang of which the opposite wood engraving is a facsimile. The picture and explanatory notes are headed : 焦山放鼉 *Chiao shan fang t'o*, that is : The release of the Alligator at *Chiao-shan*.

After giving the exact position of the Island, explaining its name, etc., the author describes the temples and nunneries—found there, and mentions the name of the great writer of the Ming dynasty who traced the four large characters 海不揚波 now deeply graven on marble slabs at the entrance of the main temple.

Now he comes to the subject and says : When first I received a government appointment, and had to leave the city of Chinkiang, I saw in the neighbourhood, some distance off, a man standing at the door of a tent, beating a drum to attract the attention of the crowd, and inviting the people to come in and admire an extraordinary object. I sent one of my military officers to see what it was and report to me. He returned with a picture of an animal, which I recognised to be the *T'o*. I immediately bought this Alligator for ten taels of silver and conveyed it to Chiao-shan in my assistant's boat. Later on, (at leisure) I gave orders to have it set at liberty in the great River (the Yang-Tsze-Kiang). But as the animal was continually returning to the Island, I had it placed in the pond called 放生池 *Fang sheng chih* ; that is :—Pond for the liberation of animals. It seemed delighted with its new place and disappeared (in the mud). I then composed a piece of poetry in its honour and showed it to the Abbot of the monastery. It runs as follows :—

In the vast seas was once an old Alligator. It possessed a square head and four feet like a dragon. Its back was marked like that of an immense tortoise. This animal was evidently of the dragon family. It could fly through the air, the clouds, the mists and fogs. Alas, by an accident it lost its liberty, and

鼇放山焦



became the laughing stock of a little child. Being moved with pity at its miserable condition, I bought it for a thousand cash. I was then making a tour on the great Yang-Tsze-Kiang. Still, I took it with me to the place called *Kua pu*. On the Golden Mountain stands an old monastery, whose numerous buildings and ornamented temples are rendered famous by the tomb of *Tu pu*. Knowing well for a fact, as old records will prove, that the spirit of the brute was that of *King tu*, I resolved at once to have it set at liberty, on the very tomb of the great man whose spirit it possessed. Badly directed, I could not find the place, so I took it with me to the Island of *Chiao shan*, where I deposited it in the midst of the waves. The animal looked at first much pleased and happy; but soon turning its head it swam back to the jetty, now gliding on the waves, now swimming with great vigour. Having placed it again in a small and light boat, I reached the Elephant Hill, on the opposite shore, where I placed it once more in the midst of the waters. From the very moment of its new liberation, towards the Silver Island it directed its way. Some one said that it had been probably weakened and that it could not contend with the mighty stream. Another one explained that the spirit of the man, with which it was possessed, was evidently anxious to go and rest on the hill of the sacred spirits. Although the Buddhist priests pretend to know all things, the head of all of them, the wise and old Abbot could not account for it or give an explanation. I had the brute placed in the pond of liberation, where it soon found shelter in the muddy bottom, feeling happy and at home I have not a doubt. This charitable deed, I performed with great hope of bringing good luck to my future career. And another song was made, rhyming with mine, by two of the Buddhist priests of the sacred shrine. Two learned students from two different places wrote also a long memorial telling of the circumstances. Four other *litterati* from four distinct cities engraved a perfect picture of the Alligator on a large stone tablet on which they also wrote that Mr. *Lin* of *Chang pai* set free the Alligator at this place. This monument can be seen on the bank of the pond.

II.—FOREIGN LITERATURE.

Having also heard from my friend Doctor Bretschneider of Peking that a mention of Caïmans as existing in Corea was

made in an old book called "Histoire des naufrages," I searched for it in the libraries at my disposal. I found that a certain Dutchman by name H. Hamel von Gorcum had written a book on Corea under the title:

"Journael van de ongelukige Voyagie von t'Jacht de Sperwer "gedestineert na Tayovan in t'jaar 1653, hoc t'selve Jacht op "t'Quilpaarts Eyland is gestrant: als made een pertinente "beschryvinger der Landen, Provintien, Staten ende Forten "leggende in t'Coningryk Corea. Rotterdam 1668, 4to."

That is: Journal of the unfortunate voyage of the yacht "The Hawk" destined for Formosa, how the same yacht was stranded on Quelpaert Island, with a pertinent description of the countries, provinces, towns and forts in the Kingdom of Corea."

This book, of which a French edition is also known (Paris 1670, 12mo.) I could not find, but I was able to read the French translation in the "Recueil des voyages au Nord, contenant divers Mémoires très utiles au commerce et à la navigation, Amsterdam," Jean Fréderic Bernard, 8 vols. 12mo. 1732 and other dates, which is in the Library of the North-China Branch of the Royal Asiatic Society.

In the fourth volume, pages 310-311, we read:

"Nous n'y avons point vu d'éléfans, mais on y voit des Kaymans ou crocodiles de différente grandeur, qui se tiennent dans les rivières. Leur dos est à l'épreuve du mousquet, mais ils ont la peau fort tendre sous le ventre. Il s'en trouve qui ont dix-huit à vingt aunes de long, la tête large, le groin de pourceau, la gueule fendue jusqu'aux oreilles, l'œil perçant, mais fort petit, les dents blanches et fortes, rangées comme celles d'un peigne. Ils ne remuent en mangeant que la machoire d'en haut. L'épine du dos de cet animal a soixante vertèbres, et il a de longues griffes aux pieds, sa queue est aussi longue que le reste de son corps. Ils mangent également la viande, et le poisson, et sont friands de chair humaine: les Corésiens nous ont souvent dit qu'on avait trouvé une fois trois petits enfants dans le ventre de l'un de ces crocodiles." Now this Hamel von Gorcum was a man of some education, being the secretary of the ship. Made prisoner after the wreck of his ship with the fifteen sailors who had not perished (August 1653) he was taken to the mainland of Corea where he was kept in captivity, first in the capital then in the southern districts, and had ample opportunities of studying the country. With ,seven of his companions he, at last managed to seize a native ,fishing junk and reached Nagasaki where he found his com-

patriots after a captivity of thirteen years and twenty eight days (1652 to 1666). With the exception of some letters from the Roman Catholic missionaries which can be read in "L'histoire de l'Eglise de Corée par Ch. Dallet, 2 vol., Paris 1874," this is the only reliable description of Corea we possess from foreign sources. I searched through this last book, but could not find any mention of the Caïmans amongst the productions of the country therein described.

However, Monseigneur Ridel, the well-known bishop of Corea, who has resided many years in the country and has just escaped for the second time from the prisons of this unhospitable land, tells me that he has often heard the Coreans speak of a huge kind of lizard living in the rivers. It is fond of coming out on the banks to bask in the sun's rays. He has also read of these large saurians in Corean books, but he does not remember that any of his missionaries, of whom five are still in the country, have seen them. Not having his books with him he was unable to give me the Corean names and characters by which these animals are known.

It would be exceedingly interesting to find out what kind of Alligators these are. Judging from the high latitude in which they are found they probably belong to the same species as the one here described. Though they have not yet been found in Japan it is not impossible that they should be discovered there one day, and, if so, it would not be perhaps too wild a theory to suppose that North-Eastern Asia and North-Western America have been connected at some very ancient period. This theory could also be supported on other grounds. For instance, some of our Chinese Unionidæ are also found in Northern America, and some rare birds, plants and animals are also common to both countries.*

III.—NATURAL HISTORY.

In Wallace's "Geographical distribution of animals, 2 vols., London, 1871." Vol. II., page 406 we find:

"Alligatoridæ, 1 genus, 10 species.—The Alligators which are distinguished by having both the large front teeth and the canines fitting into pits of the upper jaw, are confined to the

* Some people even pretend to find an ethnological connection between the Red Indians and the Chinese.

Neotropical and southern part of the Nearctic regions from the lower Mississippi and Texas through all tropical America, but they appear to be absent from the Antilles. They are all placed by Günther in the single genus Alligator."

This book is the latest authority on the subject so we are now sure that up to now Alligators were unknown in the old continent.

Now, one of our Roman Catholic missionaries, Reverend Father Seckinger tells me that Alligators are quite common in his district (Ning kuo fu, Wuhu, Chinkiang). Children play with the young ones and larger specimens are captured in a long and narrow box. They are then killed, and the skin, with head attached, is sold for medicine. The local name for them is *Tu Lung* i.e. Earth Dragon.

In conclusion I may state that the specimen sent to the Paris museum arrived in good order. I have just received a letter from the learned director, Mr. Fremy, who considers the animal as a new and exceedingly interesting species for which the name proposed by me of *Alligator Sinensis* (Chinese Alligator) has been accepted.

ARTICLE II.

PERIODICAL CHANGE OF TERRESTRIAL MAGNETISM.

By F. W. Schulze.

Chapter I.

GLANCING over the contents of Whitaker's Almanack for 1878, my attention was called to the remarks in a short article on Terrestrial Magnetism, "that the dip, like the decli-"nation, is subject to secular, and other variations, the true "laws of which are not yet understood, etc."

Thinking it possible to give a satisfactory account of these changes, I herewith attempt a modest essay to do so.

According to Miller and Pouillet's, "Lehrbuch der kosmischen Physik," Braunschweig, 1856, the variation in Paris has been Easterly before 1663 decreasing. By Sir James Ross, the latitude of the magnetic North Pole is in the parallel of 70° N.; and bearing in mind, that the magnetic needle (if not deflected by local attraction), points to the magnetic pole, it is only natural to suppose, that prior to 1663, the magnetic North Pole must have been somewhere to the northward and eastward of Paris, moving towards the meridian of Paris probably in the latitude of 70° N. and passed near the meridian of Paris in 1663, in which year the variation was Zero; then the magnetic pole continued its westerly movement until 1814; the variation attained in that year its western maximum of 22° 34′. Since then, the pole continuing its westward motion, the westerly variation at Paris decreasing, until about the year 1965, the pole passes near the meridian of 180°, by the west of Paris, when at the latter place the variation will become Zero, and becoming easterly again afterwards attaining its eastern maximum when the pole passes the meridian of 90°, east of Paris, in about the year 2116; then the eastern variation at Paris will decrease becoming Zero, when the magnetic pole returns to the meridian of Paris, about the year 2267.

For illustration, take a terrestrial globe, and a ball of twine and attach *the end* of the twine to the geographical position of Paris; then place the ball on the same meridian, but on the parallel of 70° N. lat.; in which latitude perform an act of pa-

rallel sailing by means of the ball, to the westward, slacking the twine as required, but keep it sufficiently tight to represent a segment of a great circle; after passing the meridian of 180°, roll in the twine as required, until the ball returns to the meridian of Paris, in 70° N. lat. whence it departed. The direction of the thread has undergone the same variations, that the magnetic meridian of Paris is subject to, on the surface of our earth.

It is true the variation at Paris, would change exactly the same way, if in 1663, the magnetic pole had been in 70° N. lat. and 180° long. (from Paris), shifting in an easterly direction towards the meridian of Paris; but, recollecting that the dip of the needle increases, when we approach a pole, it must be the same thing if the pole approaches us; now the inclination at Paris is decreasing since 1671, the earliest reliable record (given in the above quoted work on cosmic physics) at my command. Therefore the variation pointing to the northward, and westward of Paris as the present position of the magnetic pole, and the dip of the needle indicating it is moving away from Paris, it cannot be in an easterly direction, but must be westerly, at least as long as no valid reason exists, to suppose that the magnetic pole changes its latitude also.

The inclination has probably been decreasing since 1163, when it must have been a maximum (the magnetic pole passing then between the true one, and Paris); it will become a maximum about the year 1965, and then increase again until about the year 2267, when the magnetic pole will return to the meridian of Paris.

The secular variation of the compass shews, that the magnetic pole is moving round the true pole, and the inclination decides, that it must be from east, towards the west; at about the rate of 151 years for the quadrant (from the meridian of Paris in 1663, to 90° west of Paris in 1814), or about 604 years for a complete revolution, or at the yearly rate of about half a degree at a rough estimate.

An inspection of Duperrey's chart of magnetic meridians, shews the irregularity of those curves; therefore the calculations introduced cannot claim to be mathematically exact, the full truth perhaps will only be learned by careful observations, and experience of future centuries.

Now, take again a globe, and construct roughly a movable system of magnetic meridians around it, with a circle equidistant from the magnetic poles, to indicate the magnetic equator; then place the magnetic North Pole on the parallel of 70° N. lat. and move the magnetic pole on that parallel round the true

one, from east towards the west; you will then have a fair representation of the movements of the whole system of magnetic lines, as it really occurs on our earth; a precession of the magnetic equator on the geographical one from east, towards the west, will take place, and a nutation of the magnetic poles round the true ones, in the same direction.

In this chapter we have seen how the secular changes are taking place, in the following one I hope to shew more explicitly the reasons why.

Chapter II.

Since writing the first chapter I have been favoured by the kindness of a friend (to whose valuable assistance I am much obliged in compiling these lines) with a copy of "Magnetism and Deviation," by John Merrifield, LL.D., F.R.A.S., etc., London, 1874, in phich I find on page 15, the following passage:—

"Professor Barlow, in his Essay on Magnetic Attraction, says, "all these variations can be accounted for by supposing the "Magnetic Poles to revolve round the terrestrial ones from "West to East, at about 20° from the latter in periods of about "600 years. Sir W. Hamilton gives a contrary direction to the "revolution, and states the period to be 900 or 1,000 years."

I am not astonished that others should have conceived similar ideas to mine, before me. However, Professor Barlow gives a wrong direction of the revolution, and Sir W. Hamilton, allows perhaps too many years for its completion.

Commander W. Walker, R.N., in his book, "The Magnetism of Ships and the Mariner's Compass," London, 1863, page 8, speaking of Columbus, who had discovered the variation of the Compass, writes as follows:—"On his return to Spain his statement, "that the direction of the Compass had varied was not believed.

"Although other Navigators had observed and announced "the variations of their Compasses, the learned of those times "would not admit the fact, they rather choose to charge sea-"men with ignorance, and inaccuracy in their observations, "then admit errors in the principles established by themselves.

"Pedro de Medina, in his Arte de Navigar, 1545, denies the "variation of the Compass; Martin Cortez, in a treatise on "Navigation printed at Sevilla before 1556, treats it as a thing "completely established. So here we see, that a period of 60 "years elapsed from the time of Columbus, observing and re-"porting the variation of the Compass before the truth of its "existence was admitted."

I hope it will require less time, before the truth of what I may be permitted to call "The Rotation Theory" will be admitted.

Mr. Merrifield gives the date of Captain Ross's discovery of the Magnetic North Pole, the year 1830. According to the theory deduced in the preceding chapter the Magnetic Pole must have been in 90° W. of Paris, in 1814. Moving from that year to 1830, at about 35′ 45″ per year nearly, to the Westward, =9° 32′, which would place the Magnetic Pole in 99° 32′ West of Paris, or about 97° 12′ West of Greenwich; Sir James Ross found it 96° 42′ West of Greenwich, half a degree from where I would place it approximately; I consider this the most conclusive proof of the soundness of the basis upon which my theory is founded.

From the same book of Mr. Merrifield's, I see that Capt. E. J. Johnson, R.N., F.R.S., places the maximum (24° 27′) of Western variation in 1815, but Colonel Beaufoy gives 24° 21′, as maximum in 1819, less modern observations, owing to the then still more imperfect instruments, can therefore hardly have been very correct, and calculations based upon them cannot be very reliable; however, they are quite sufficient to establish the principle in question firmly.

And now we will try to investigate the cause of this Magnetic Polar rotation.

Allowing that the thermometer rises one degree (celsius) for every 90—100 feet, towards the centre of the earth, (after Müller and Pouillet, Lehrbuch der kosmischen Physik), "at "a depth of about 10,000 feet water would boil, and at about "20 nautical miles, basalt and iron would melt," but I will be liberal and allow 25 miles below the surface of the earth as the limit, where we would meet a fiery molten mass.

According to "The Border lands of Geology and History" by Thomas W. Kingsmill, Shanghai and London, 1877, by Mr. Mallet's "Physico-chemical Theory," "the earth is now a ball "entirely, or in the main solid, but of high temperature." In the same work Mr. Kingsmill tells us of Sir W. Thomson, "but "although he rejects a fluid nucleus (of the earth) he acknow-"ledges, that the absence from the sea of long period tides is "not easily explained without admitting a considerable degree "of yielding." "If the interior of the earth were liquid and its "crust composed of so rigid a material as steel, and 300 miles "thick, it would yield to the deforming influences of centrifugal "force, and the attraction of the sun and moon, as if it were "India rubber; under such circumstances, as the whole mass "of the earth would be free to move, there could be no flow of

"tides, sea and land yielding equally to external influences."

I will not enter the field against Astronomers and Geologists; I am content to let them fight their own battles; probably the truth lays in the middle: "les extrêmes se touchent;" therefore I will try to steer a pretty clear mid channel course between the Scylla of solid ball, and the Charybdis of fluid nucleus theories.

Presuming at about 25 miles below our earth's surface the heat intense enough to melt all known rocks and metals, I should think it very unlikely, that the limit between solid crust and fluid interior were defined, as if cut off with a knife; I think one would be gradually verging into the other, more or less in the following order:—Outside solid crust about 25 miles; then accumulating solidifying, semi-liquid slake, succeeded by molten fiery mass. Now, let us consider what would be the pressure of such a mass at about 2,000 miles from the surface on a square foot.

Accepting the specific gravity of the earth as five times more than distilled water (according to F. Reich, 5·58, and Baily 5·66), then a column of 2,000 nautical miles = 12,160,000 feet deep × 1 feet × 1 feet of distilled water at 60·5 lbs. per cubic foot, will weigh 735,680,000 lbs.=328,428 tons, multiplied by 5 (specified weight of earth roughly)=1,642,140 tons pressure upon a square foot on the surface of the earth, the same column if placed upon a square foot at 2,000 miles below the surface would probably weigh less—(I am not prepared to say how much)—therefore we will disallow a whole million of tons, and still the enormous weight of 642,140 tons remains; but even then there is such a tremendous pressure upon the square foot, that I believe no molten mass of whatever high temperature could remain liquid under such a stupendous force, but would obtain a state of almost inconceivable density, that steel compared to it would be like cheese.

Late experiments have shewn, that almost all known gases by application of extreme cold, and high pressure can be forced into the liquid aggregate state first, then into the solid state afterwards; and since it is assumed that our whole earth from a gaseous state of high temperature cooled down into its present condition, I cannot be far wrong in representing the nucleus of the earth as possessing indeed an enormous high temperature, but solidified by excessive superincumbent pressure.

These suppositions being accepted as approximately correct, would give us a body of "a considerable degree of yielding," to account for the absence from the sea of long period tides,

and still not so elastic as India rubber, as not to shew any tides of the sea at all.'

Allowing under the solid but sufficiently yielding crust of the earth a fiery liquid, with a fiery solid nucleus within, we must allow that the influence of the same heavenly bodies, which cause the tides of the liquids outside the earth (the Ocean) will do the same with the fiery Ocean within; and this daily interior flood wave will cause a retardation of revolution in the interior fluid mass in exactly the same manner, as it does in the Outer Ocean; it causes a westward tendeucy in the former as well as in the latter, and which I must suppose to be too well and generally understood, that I need not enter here into the explanation; because it is not my object to explain things which others have done much better than I can; but to demonstrate if possible the nature, and causes of the magnetic needle's periodical variations.

Admitting this daily retardation of the fluid interior inclusive the solid nucleus within it (like a sluggish compass card, that remains behind, when the ship's head moves round), it does not matter whether we say, in about 604 years, the outside shell of the earth makes one revolution ahead of its contents, or whether we say, the latter remains one revolution behind the former; the effect is the same, provided we can prove the nucleus of the earth to be the carrier of Terrestrial Magnetism; because in that case the nucleus with its Terrestrial Magnetism would be like a powerful magnetic needle (suspended in a spherical compass bowl), moving in a liquid (like in an ordinary liquid compass).

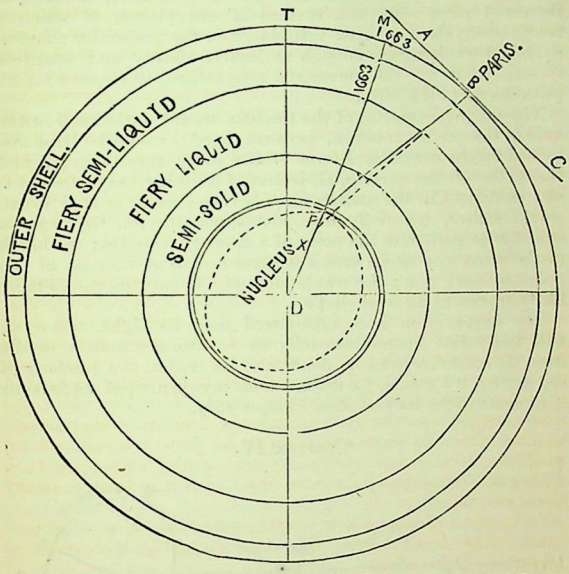
In the next chapter it will be attempted to shew the high probability why the nucleus of the earth should be the carrier of Terrestrial Magnetism.

Chapter III.

In the accompanying figure, let M represent the magnetic pole in 1663, passing between the true North Pole T and the geographical position of Paris. A—C is the horizontal line at Paris, and the angle A B P of 75° the assumed maximum dip of Paris in the same year, probably near the truth; P is a point in the interior of the earth, where the inclination needles from, the surface pole M and Paris, would intersect at the pole of the nucleus P, fixing as it were, the latter by crossbearings,

I am aware, that in reality this is not exactly the case, but do not doubt that a good mathematician could easily lay down

the unknown point X accurately, the position of the actual magnetic pole upon the earth's nucleus:—



Commander W. Walker, R.N., in the before mentioned book, says, (page 17), after giving a list of bodies capable of magnetism besides iron, "Sir W. Harris found, that by condensing "metals, their magnetic energy was increased, and that sub- "stances remain magnetic or take up magnetism more quickly, than they part with it."

This seems to imply, that magnetism can be generated in bodies by increasing their density, or, as I may say: if the density of bodies is increased by external force, then the latter performs partly the work, which previously affinity had to do, in keeping the molecules of the bodies together, and hitherto latent affinity becomes free, putting in an appearance as magnetism; or, by high pressure, a certain amount of affinity of bodies, through increasing their density

mechanically, becomes free and translated into magnetism.

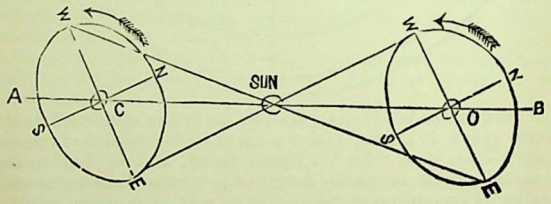
For fuller exposition of this view see first appendix.

Now I believe the enormous power of gravity a couple of thousand miles below the surface of our planet, of which a rough estimate has been introduced in the preceding chapter, sufficient to disengage enough molecular affinity and translate it into what we call terrestrial magnetism, to account for all phenomena of the latter.

The magnetic matter of the nucleus would settle itself in the axis of the earth's rotation, because there it would be least disturbed by the centrifugal force of the daily revolution; round the poles of the nucleus, all bodies of a higher magnetic capacity contained in the molten mass between nucleus and crust, would collect, especially iron, nickel, cobalt, etc., the same as iron filings gather to the poles of a magnetic needle; or much in the same way as we arm a natural loadstone magnet at the poles by soft iron; the whole magnetic apparatus would most likely represent an oval shape.

The explanation here introduced may be right, or wrong, still terrestrial magnetism tells us by the inclination needle from its residence, and no doubt also its cradle, the nucleus of the earth; "J'y suis, j'y reste," and my principal endeavour is to account for its *periodical changes* only.

Chapter IV.



No. 1 No. 2

Figure No. 1 is the spheroidical form of the earth at the summer solstice; A B is the plane of the ecliptic; W E the plane of the equator; N S the polar axis, and to the right is the sun.

During the summer solstice the sun attracts E more than C or W; the effect of this would be to place N S at a right angle with A B in the direction of the arrow; this is prevented by the centrifugal force of the earth's daily revolution from west to east, which brings constantly other masses of the revolving

earth under the stronger point of attraction of the sun in E; the consequence is a circulation of the earth's more yielding fluid interior, as a result of the parallelogram of forces brought to bear upon it; this circulation, if graphically illustrated, would represent an oval shape, the greater axis of which would be congruent with the axis of our planets magnetic nucleus.

In figure No. 2 is the earth at the winter solstice; W is more attracted than C and E; the tendency is to elevate N S at right angles to A B in the direction of the arrow; the influence upon the interior is the same as in fig. No. 1.

Place sun and moon for ever on the equator, or place them for ever at the poles, and the magnetic axis of the earth would soon coincide with the axis of rotation, because the interior circulation would then be deprived of its reason to exist.

It will be seen that during the summer solstice the influence of the sun's attraction must be greater in the northern hemisphere, which will cause the greater amplitude of magnetic fluctuations during the summer months; during the winter months the sun's attractive power must be less in the northern hemisphere, consequently also the amplitude of hibernal magnetic fluctuation.

During the equinoxes the sun's attraction is impartially exercised in both hemispheres, and now the moon's influence becomes to be most apparent, her attractive power being so much greater than the sun's, because she is so much nearer the object of attraction; add to this the celerity with which she constantly changes her position and it will be accounted for why Father Secchi says: "the annual disturbances of the magnetic ele-"ments are at a maximum at the equinoxes, and at a mini-"mum at the solstices."—(Merrifield.)

The magnetic equator laid down on a terrestrial globe almost coincides with the plane of the ecliptic in the Atlantic Ocean; from the interior of South America it runs in a W.N.W. direction towards the geographical equator and follows close to the latter a parallel course to the same across the Pacific; it crosses the geographical equator where the *plane of ecliptic cuts* the latter, and then again follows an almost parallel course to the geographical equator through the Indian Ocean; in the interior of Africa again it almost coincides with the plane of the ecliptic, substantiating as I think, my supposition, that the eccentricity of the earth's magnetic axis may be due to the tendency of the axis of rotation to set at a right angle to the plane of the ecliptic counteracted by the daily revolution round the axis of rotation.

Chapter V.

Month.	1st	2nd	Month.	1st	2nd
	′	°		′	°
Jan.....	6· 7	— 1·90	July.....	12· 1	+15·04
Feb.....	7· 4	— 0·15	August ...	13· 0	+14·43
March	11· 9	+ 2·74	Sep.....	11· 8	+11·75
April	13· 9	+ 6·88	October ...	10· 3	+ 7·97
May.....	13· 5	+10·92	Nov.....	6· 9	+ 3·25
June	12· 5	+13·94	Dec.	5· 0	+ 1·32

In the first column of above table is the mean amplitude (or angle comprised between the greatest eastern and western deviation of the needle from the mean daily variation) per month, as observed at Göttingen in minutes and tenths of arc; in the 2nd column is the result of six years' observations at Berlin, from 1829 to 1834, expressed in degrees and hundredths Réaumur, giving the mean temperature of every month.

It will be seen that the maxima of the needle's mean monthly variation in the first column does not coincide with the maxima of the mean temperature in the 2nd column, which seems clearly to prove, that thermo-electricity has not much to do in causing the daily variations; in June and July the mean monthly variations are not so great (as in the two preceding months), although they have a higher mean temperature; the reason is because on the first of July the sun is in Aphelion, and his attraction decreases inversely, as the square of his distance increases.

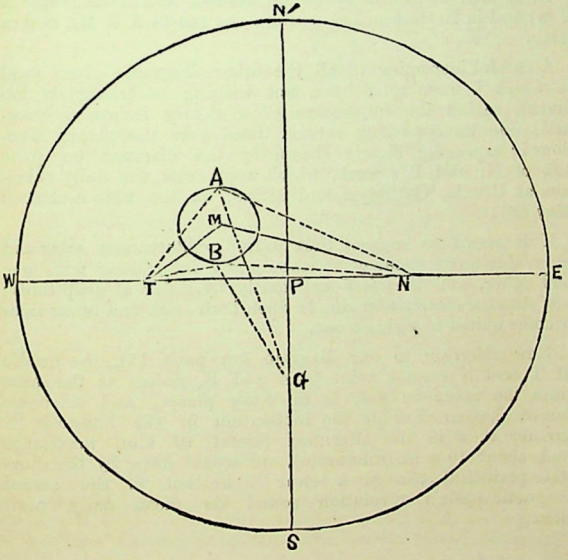
The table also shews that not in January and February, when the mean temperature is least in Central Europe, diurned variation attains a minimum, but in December, when the sun is farthest away from the northern hemisphere on account of his maximum southerly declination; another proof, that periodical change of variation cannot be dependent upon thermo-electricity produced by the sun, as supposed by many; but the greater or lesser proximity of the celestial bodies and their ever varying position principally must be looked to, to account for these periodical changes.

Unfortunately from the southern hemisphere I have no material at hand, beyond the scanty information, that the direction of the needle there is subjected to the same changes, as in

the northern hemisphere, but in an opposite direction; I have however no doubt that there the maximum of daily variation must take place about Christmas, the sun being then in Perihelion and attaining his greatest southern declination.

At the instigation of Humboldt, in the years 1828 to 1830, hourly magnetic observations were taken on previously arranged days at Berlin, Freiberg, Nicolayew and Kasan, by which a remarkable parellelism of the needles changes was proved; still more so by the labours of the Magnetic Society under the presidency of Professor Gauss, about the year 1838, to which twenty-seven observations belonged, from St. Petersburg to Dublin, from Upsala to Milan.

The following well established facts are the result of their labours; the diurnal variations are not local, but alike in places of nearly the same geographical longitude (no doubt still more so in the same magnetical longitude); if in one place a minimum of variation occurs, 90° east and west of the same, maxima will occur, but in opposite directions to one another:—



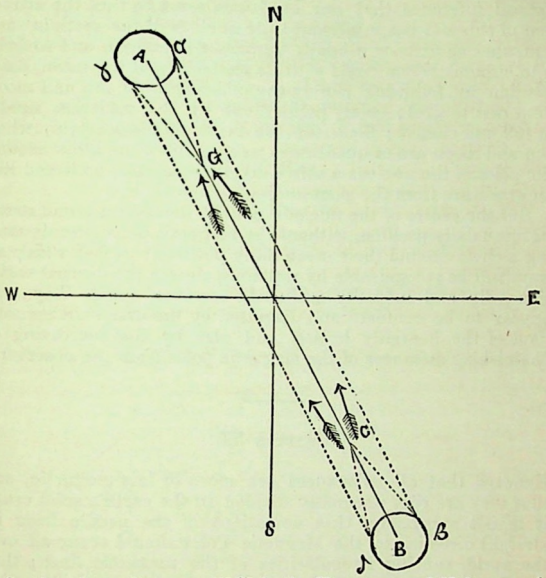
The above figure is the northern hemisphere in polar projection; N′ E S W is the equator, P is the geographical pole, M the magnetic one; T is intended for the geographical position of Toronto, N the same for Nertschinsk, G the same for Göttingen, W E is an east and west line; N′ S a north and south one. Toronto and Nertschinsk are about 180° of long. from one another, Göttingen is nearly in the middle between the two. From a diagram on page 495 of Müller and Pouillet's work, it can be seen that a maximum of easterly variation occurred at Toronto on the 27th and 28th August 1841. Angle B T M of present diagram at 1 a.m., when at Nertschinsk a western maximum (angle M N B) occurred, indicated by the dotted lines T B and B N, converging at the point B to the southward of the mean magnetic pole M; another maximum of eastern variation occurred at Toronto at 1 p.m., and at Nertschinsk was a maximum of western variation at 2 p.m.

At 11 a.m. we find in Toronto a western maximum (angle A T M) and in Nertschinsk an eastern one (angle A N M), and so forth.

A careful inspection of all the other diagrams given (and to which I must refer here, not wishing to transgress too much), makes the impression of a clearly indicated magnetic tide wave passing several times over the places mentioned; especially clearly shewn by the diagram on page 492 of M. and P.'s work, which represents the daily variation at Upsala, Göttingen and Milan, on the 28th and 29th May 1841.

This seems to suggest that indeed subterranean solar and lunar tide waves occur complicated, and interfering with one and other, and therefore apparently irregular at neap tides; but showing clearly and simple when both solar and lunar tides become united to a single one.

Now referring to our diagram (on page 11), the needle at T and N cannot point to A and B, unless at the same time the magnetic pole is in those places, and since we know, that in Europe the inclination in the forenoon is greater than in the afternoon (about 10 a.m. maximum and about 10 p.m. minimum), we would have by the diurnal periodical change a clear indication of the actual magnetic pole's revolution round its mean daily position.



In the above diagram W E is the Equator, and N S a north and south line; G is the assumed position of Göttingen in the northern hemisphere, C is the same of the Cape of Good Hope in the southern hemisphere; A is the magnetic North Pole, B the magnetic South Pole, and A B consequently the axis of Terrestrial Magnetism. Now, when in G the eastern maximum A G α of daily variation occurs, at C the western maximum β C B occurs, and the magnetic axis A B is transferred to α β; the reverse takes place, when in the northern hemisphere the maximum of daily western variation A G γ occurs, in the southern hemisphere an easterly maximum δ C B must occur, and the magnetic axis is shifted from A B to γ δ. Since it is understood that the poles of the needle point towards the magnetic poles of the earth, and since the inclination needle shews that the seat of Terrestrial Magnetism (see 3rd chapter) is deeply below the surface of our planet, the only

natural inference that can be drawn must be that the attraction of sun and moon influence the nucleus of the earth in such a manner as to draw it bodily towards themselves, and so force it to circumscribe a circle with its centre round its mean daily position by following closely the movements of sun and moon from east to west; boldly pointed out by the variation needle at full and change; flickering, wavering and uncertain, when sun and moon are in quadrature; especially if we allow around the poles of the nucleus a softer magnetic matter, collected like an armisture from the surrounding molten mass.

But the centre of the nucleus cannot describe a circle round its mean daily position, without the magnetic poles also describing a circle around their mean daily position; a fact which always will be recognisable by watching closely the diurnal variations, dip and intensity included, however, much they may appear to be confused and disguised by the ever shifting positions of the heavenly bodies, and also by the increasing or diminishing distances of the magnetic poles from the observer.

Chapter VI.

Knowing that all substances are more or less magnetic, and that they are very unequally divided in the earth's solid crust, it is not surprising, that deviations of the needle from its straight direction to the Magnetic Poles should occur all over the world, causing irregularities of the magnetic lines; they are simply deviations of the needle caused by local attraction of Continents, Islands, the presence of rich deposits of magnetic substances in the vicinity, &c.; Müller and Pouillet give two points of greatest magnetic intensity on the surface of the Northern hemisphere: one in North America, and the other in Northern Asia.

For illustration, I extract one very striking instance from Dr. C. Rümcker's Handbuch der Schiffahrtskunde, Hamburg, 1857, translating from page 338, as follows:—"One of the "most remarkable phenomena of this kind is on the Northern "Coast of the Gulf of Finland, within the headland of "'Hangoe,' near the Jussary Cliffs; vessels of 12 to 15 feet "draught may pass to the Eastward of Jussary Gadder, when, "in line with Western Gadd and Lerharn, all compass needles "in 10 fathoms will turn 180° round their axis, returning after-"wards to the usual direction."

Captain Duperrey's charts of magnetic lines shew a remarkable parellelism of Magnetic Meridians between the true and Magnetic Poles, especially in the Northern hemisphere which can be best accounted for, if we admit the circulation of magnetic matter round the nucleus, deflected from the axis of rotation by the nutatory influences of the principal Celestial bodies, see 3rd chapter,

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Chapter VII.

RECAPITULATION AND CONCLUSION.

Reviewing briefly the ground we have travelled over in the preceding chapters, it will be recollected, that in the first one an explanation is given, how secular change of variation is effected; the Magnetic North Pole moving round the true one in about latitude 70° N., and about 604 years from East to West; the great closed curve of no variation divides the globe nearly in a hemisphere of Westerly variation on the right hand (looking from the Magnetic North Pole towards the true one), and the hemisphere of Eastern variation to the left (the latter enclosing an oval of Western variation in Eastern Asia); move a system of magnetic lines around the Terrestrial Globe from East to West, keeping the Magnetic North Pole on the parellel of 70° N. latitude, and the phenomena of secular variation are almost mathematically exact represented.

In the 2nd chapter it is tried to reconcile the conflicting theories of fluid interior and solid ball, in regard to the earth's internal structure, as advanced each by high authorities; introducing gravity as a highly probable agent to compress the nucleus of our planet, although of the highest temperature into a solid body of the utmost density; and subterranean tide waves are pointed out, as most likely to cause one retardation of revolution of the nucleus, suspended within a molten mass, in about 604 years.

The 3rd chapter shews by means of the inclination needle, that indeed the nucleus of our planet must be the seat of Terrestrial Magnetism, and the whole similarity of our globe to the ordinary liquid compass; the solid nucleus being the magnetic apparatus suspended near the centre of the earth by fiery liquid mass; also the possibility is hinted at, that the excessive force of gravitation towards the Terrestrial centre might be the cause of Terrestrial Magnetism. The likelihood is

represented of the whole magnetic central apparatus having an oval shape, and that the divergence of the magnetic axis from the axis of rotation may be a compromise between the centrifugal force of the earth's quotidian revolution, and the tendency of the celestial bodies to elevate the rotatory axis of the fluid interior at right angles to the ecliptic (owing to the spheroidical shape of the earth), by an ecliptic circulation of fluid mass.

In the 4th chapter sun and moon are called upon, to explain by their attraction and different positions at various times of the year the periodical annual changes, and the improbability is shewn of thermal-electricity being the cause of them, as most authorities on this subject seem to have surmised.

In the 5th chapter, it is shewn how a daily displacement of the magnetic axis takes place; and since that can hardly be done, unless the magnetic body itself be displaced, it must be accepted as proved, that the magnetic terrestrial nucleus itself is being removed, attracted towards sun and moon, and thereby describing a circle round its mean daily position from East to West, following the movements of sun and moon, causing thereby a daily nutation of the actual Magnetic Poles round their mean daily position; this actual displacement of the nucleus in the direction of sun and moon, when both pass the meridian together would to my mind account better for a *flood wave* occurring 180° away from the meridian passage, than the best calculation I have ever seen, but never clearly comprehended, concerning this phenomenon.

What Humboldt has called magnetic storms is perhaps most likely to happen, when perigee and full moon occur together, especially at the time of perihelion; and the inhabitants of volcanic regions may then stand by for subterranean squalls. The diurnal nutation of the magnetic poles may be obscurely indicated only, sometimes by the declination needle for reasons pointed out; but it is imperatively proclaimed by dip and intensity, which clearly establish an approach of the magnetic pole during twelve hours towards the observer and the departure from the same during another twelve hours.

The result of these various movements is an epicycloidal track of the magnetic poles round the true ones in about 604 years from east to west.

The 6th chapter treats on some minor matters, pointing out the probable influences of local attractions, etc.

Many ideas which suggested themselves while writing, I have excluded, as not immediately bearing upon this subject; but perhaps may add them on some future occasion, as an appendix.

My sources of information have been mentioned in the body of these pages.

I trust it can be admitted in fairness to the writer, that nowhere wild speculations, which cannot be substantiated, have been advanced; but that everywhere only natural inferences have been drawn from established facts.

I cannot close this essay without acknowledging gratefully my indebtedness to Captain J. H. P. Parker, Commander of the China Navigation Company's steamer *Newchwang* for the many facilities and valuable assistance rendered me, while writing the preceding chapters.

Owing to the limited material at my command, when compiling these pages, my judgment may have erred on minor matters; but I believe to have given *at least in rough contours* a correct theory of Periodical Change of Terrestrial Magnetism.

Note.—Since the manuscript has been returned to me to see the proofs of the woodcuts, I have had an opportunity to read Mary Somerville's "Connection of the Physical Sciences," in which the view is advocated, that Terrestrial Magnetism owes its existence to induction by electricity, evolved by the earth's revolution around its axis; but I am more in favour of Sir W. R. Grove's opinion, who in his "Correlation of Physical "Forces," London 1874, page 9 says:—"But magnetism may "now be said with equal truth to be the cause of electricity, "and electrical currents may be referred to hypothetical mag- "netic lines; if therefore electricity cause magnetism and mag- "netism cause electricity, why then electricity causes electri- "city, which becomes, so to speak, a *reductio ad absurdum* of "the doctrine." However electricity certainly does cause electricity by induction in bodies near it.

Mrs. Somerville writes in her above named work: "Dr. Far- "aday observes that such is the facility with which electricity "is evolved by the earth's magnetism, that scarce any piece of "metal can be moved in contact with others without a deve- "lopment of it, and consequently, among the arrangements of "steam engines and metallic machinery, curious electro-mag- "netic combinations probably exist, which have never yet been "noticed." Perhaps I may be excused for introducing here an extract from a letter addressed to the editor of a local paper as a curious specimen of terrestrial magnetic action:—

STEAM NAVIGATION.

Having noticed the extremes of propeller blades to be more subject to corrosion at their front than anywhere else, I have asked several profes-

sional gentlemen for an explanation, without however receiving a satisfactory answer.

It appears that the brass sheathing of the shaft, etc., in connection with the propeller, forms a closed circuit in the sense of the *British Association Experiment* (compare Deschanel's Natural Philosophy, by Professor Everett, London, 1873), and that *the electric currents* generated by the metal's rapid revolutions across *the field of force of terrestrial magnetism* have the tendency to escape by the most projecting points, which, in our case, are the propeller blades. Now, the nearest and most powerful conductor for electricity is the iron ship immediately in front of the blades, and "there appears to be no real exception to the rule that electricity, in "traversing an electrolyzable liquid, always produces its full equivalent of "decomposition."—(Ibid, page 646).

The "electrolyzable liquid" in this instance is water, which, being decomposed into its constituent elements, hydrogen and oxygen, will allow some of the latter to combine with the metallic surface of the electrode—(front of blade)—forming oxide, *i.e.*, corroding those parts of the blades in question.

The above may appear to many readers an idle speculation without a practical object, because the generation of electric and galvanic currents and their consequent chemical action cannot be prevented; but a means of escape more eligible to the current can be provided by a cylindrical circumference (like a hoop) of thin boiler plate, connecting or rather encircling the blades and projecting an inch or two towards the ship, the width of the ring to be decided by experience. The electricity would escape by means of this convenience, and would *corrode it instead of the propeller;* affording at the same time additional protection to the latter from fouling by ropes, fishing gear, etc.

Friends to whom I submitted the idea embodied in this extract objected to it as unpracticable; but the very screw propellor has been opposed by parties then considered competent, as impractical and objectionable, until practically introduced and approved.

FIRST APPENDIX TO "PERIODICAL CHANGE OF TERRESTRIAL MAGNETISM."

1.—*On the nature of Terrestrial Magnetic Poles.*

Some interesting information concerning Terrestrial Magnetism is contained in the introduction to Horsburgh's first volume of the India Directory, 6th edition, London, 1852. Captain Horsburgh says, page XVII:—"Mr. John Churchman, an Ameri-"can who was a member of the Imperial Academy of Sciences, "St. Petersburg, and Mr. Ralph Walker, the civil engineer, "formerly of Jamaica, appear to have published, nearly at the "same time, an ingenious hypothesis with a view of solving all "magnetical problems, relating both to the vertical and hori-

"zontal declination of the needle. In a diagram of the two "hemispheres on the plane of the equator, drawn by Mr. "Walker upon this principle, there are two magnetic poles re- "presented at different distances from the poles of the earth, "and revolving round the latter in unequal periods of time. "The north magnetic pole is placed for the year 1794 in lat. "71° N., long. 80 W.; the south magnetic pole in lat. 65° S., "long. 130 E., and by the intersections of the magnetic meri- "dians with the terrestrial meridians, the variation of the nee- "dle might be found by inspection on these hemispheres for all "places on the surface of the globe, were the positions of the "magnetic poles well ascertained and correctly laid down, and "the needle not subject to aberrations from various causes al- "ready mentioned.

"But exclusive of the perpetual aberration of the needle "from permanent causes of nature, it is likewise subject to ad- "ventitious and local attractions, liable to operate in a consid- "erable degree against the accuracy of any theoretical solu- "tions.

"Mr. Churchman supposes the periodical revolution of the "north magnetic pole round the North Pole of the earth to be "1,096 years; and the revolution of the south magnetic pole "round the south terrestrial pole to be 2,289 years, its motion "being much slower than that of the north magnetic pole, "which is the cause of perpetual irregularities of the variation "of the needle. He is of opinion that when one of the magne- "tic poles is in the zenith of any place, magnetic tides or great "inundations will there be experienced; and when the magne- "tic pole is far distant from any place, the sea will recede, and "alluvial land will be formed. Mr. Walker, besides his dia- "gram for showing the horizontal declination of the needle, has "drawn two hemispheres on the plane of the equator, for shew- "ing the vertical declination or dip of the needle for all places "on the globe; and in addition to his improvements on steer- "ing-compasses, he has invented a meridional compass for "shewing the quantity of variation by inspection at any time "of the day.

"The celebrated Dr. Halley was of opinion that the varia- "tion and dip of the needle could not be resolved consistently, "on the supposition of the earth having only one magnetic "axis and two magnetic poles; and he inferred that two mag- "netic poles must exist in the northern hemisphere, and two "also in the southern hemisphere of the earth, in order to ac- "count for the discordant magnetic changes.

"Professor Hausteen justly esteemed for his profound inves-
"tigations of magnetical phenomena and for his researches in
"Siberia and other places to ascertain the magnetic influence
"and intensity, has discovered the existence of a magnetic pole
"in that country, Siberia, which leaves no doubt that there are
"two magnetic poles in the northern hemispheres: and as the
"late expeditions of our enterprising navigators have proved
"the existence of another magnetic pole in lat. 70° 5¼ N., long.
"96° 46¾ W., by the observations of Captain Jas. Clarke Ross,
"Dr. Halley's inference seems to have been correct, and may
"soon be demonstrated by similar researches in the southern
"hemisphere, where the existence of two magnetic poles will
"probably be discovered.

"According to the recent researches of Professor Hausteen,
"the earth has four magnetic poles, all revolving in the neigh-
"bourhood of the geographical poles; and the periods of these
"revolutions are respectively about 4,600, 1,740, 1,300 and 860
"years. These times, though long, as historical periods, are
"short compared with many of those cycles of which geological
"researches and astronomical calculations seem to prove the
"existence.

Müller-Pouillet informs us in his popular work on cosmic physics, that there are two foci of magnetic intensity in the northern hemisphere; one in northern Asia; and a stronger one in North America; but the magnetic poles where the inclination needle stands vertical and towards which the declination needle points, is not remarkable as a focus of greatest magnetic intensity.

In the Admiralty Manual for the deviation of the compass 3rd edition, London 1874, page 102, it is stated, "in the north-
"ern hemisphere there are two such foci; and it is believed
"there are two corresponding in the southern hemisphere.
"These foci of magnetic force are of unequal strength; in the
"northern hemisphere, the strongest or the American focus,
"lies to the S. W. of Hudson Bay near the great system of the
"North American lakes; the weaker or the Siberian focus may
"be assumed as in lat. 70° N., long. 120° E. In the southern
"hemisphere the position of the stronger focus may be assum-
"ed in lat. 70° S., long. 145° E., and the weaker is probably
"in lat. 50° S., long. 130° E."

Leaving out the probabilities and what is believed and what may be assumed concerning the southern hemisphere and dealing with the better established facts in the northern one only, the truth appears to be the following:—Hausteen, Halley,

Churchman, Walker and others by assuming more than one magnetic axis and more than two magnetic poles, have created a greater complication of the phenomenon than really exists, and trying to dissolve the mysteries of these self-created perplexities by elaborate calculations, they have arrived at more or less erroneous results.

I am confident if the cause of one of the magnetic foci in the northern hemisphere were to disappear suddenly, then what is now the magnetic north pole, would vanish just as suddenly and the remaining magnetic focus would become the magnetic north pole, for the following reasons: one magnetic focus prevents the needle from pointing in the direction of the other focus, but forces it in line with the diagonal of the parallelogram of magnetic forces towards the place designated as magnetic north pole; the same is the case with the inclination needle; each magnetic focus prevents it from being perpendicular at the other, and where it really does stand perpendicular, again is the magnetic north pole fixed by the parallelogram of forces of both magnetic foci. This magnetic pole naturally must be in line between the two foci of magnetic intensity, nearer to the stronger than to the weaker,—in this case, nearest to the American focus, which is in reality the case. From the preceding it will be seen that it hardly would be surprising, if earlier writers on this subject had assumed three magnetic axis, and half a dozen magnetic poles, rendering thereby the aspect of the whole phenomenon still more intricate. However the object of these lines is not to criticise my predecessors, but to advocate and of course submit to criticism my own views.

From a remark by General Sabini (Mrs. Somerville's Connection of Physical Sciences, Section XXX) it appears that Captain Ross has not been exactly at the magnetic north pole; "the spot where Captain Ross observed the needle so *nearly* "vertical in 1831 marks the approximate position of that loca- "lity at that epoch."

The fact is no doubt as I have stated, that the magnetic pole is no fixed spot of a certain small extension, but constantly fluctuating, of diurnal and secular change,—moving in an epicycloidal track round the geographical poles.

2.—*On the Nature of Foci of Terrestrial Magnetism.*

It will be recollected from the 4th Chapter of the essay on Periodical Change that by the combined efforts of the earth's re-

volution and the attraction of the sun upon the earth's protuberance at the equator (owing to our planets spheroidical shape) an elliptic current round the terrestrial magnetic nucleus was supposed to be created which, if seen from the magnetic equator, would represent a flat oval figure with its greater length in the direction of magnetic axis; if viewed from the magnetic north pole it would also represent an oval shape, the thinner end towards the axis of the earth's rotation; the whole perhaps would have a somewhat twisted appearance, owing to the fact, that during the winter solstice the nutatory circulation current would be accelerated in the northern hemisphere, on account of the sun's greater attraction in perihelion, tending to elevate more the northern half of the axis of rotation at a right angle with the plane of the ecliptic, than the southern half during the summer solstice, because of the sun's lesser attraction in aphelion. This would indeed let it appear possible that the northern magnetic pole might revolve faster round the globe than the southern one, as Mr. Walker and others seem to have supposed.

The foci of the ecliptic current as viewed from the North Pole would in all probability be corresponding to the foci of Terrestrial Magnetism upon the surface of the northern hemisphere. This idea receives confirmation, if we inspect the charts by Captain Duperrey, of the French Navy, in which he lays down in horizontal projection the isodynamic lines round the point of intersection of the meridian of Paris with the parallels of 60° N. and S. latitudes; the same idea is conveyed by the inspection of the charts of the magnetic meridians and parallel curves in polar projection by the same officer; and since from the preceeding chapter we have seen that the magnetic axis of the earth depends upon the relative positions of the magnetic foci to one another, then it will become more easy to understand how the apparent irregular fluctuations of diurnal variation are brought about; the sun and moon passing together or separately once over the astronomical meridian of every individual focus of intensity, and once over the meridian 180° distant from it, would cause one lunar and one solar subterranean tide wave to pass twice in 24 hours over every one of the four supposed magnetic foci, except of course at spring tides, when lunar and solar tides become united into one, each tide wave would alter to a certain extent the momentary position of the respective focus, and would thereby affect the direction of the magnetic axis and of course the position of the magnetic pole, consequently also the variation of the needle. This theory would

account better for the changes of diurnal variation, than the resemblance of the isothermal curves with the isodynamic ones, because the former can be considered stationary for our purpose, while the latter do change. If it could be proved impossible to admit the quotidian displacement of our planets magnetic nucleus (by the sun's and moon's attraction), causing an independent circular motion of the same as pointed out in Chapter V of Periodical Change, then perhaps the idea demonstrated in this present chapter may also be found sufficient to account for all phenomena of diurnal variation; but considering that our whole globe is constantly kept off its mean orbit round the sun by gravitation and since it is consequently not the centre of the earth, which describes the mean orbit round the sun, but a certain point, which is the centre of gravity between earth and moon combined together (making the real track of the earth resemble the pitch of a screw propeller through the water), I believe it indeed possible, that the solid nucleus in the fluid interior of the earth under the influence of gravitation towards sun and moon may have an independent motion as described in Chapter V.

Could we from a magnetic focus on the surface of the earth see the currents of the interior, I think it likely that a rotatory motion would be noticed at each focus round an axis, connecting the focus in question with the corresponding one in the opposite hemisphere, and in the same direction, as the main circulatory current, with the sun.

3.—*On the present shape of the Agonic Lines.*

The simple relation between magnetic focus and pole as demonstrated, and its effect upon the magnetic needle is interfered with by two principal causes, if we disregard possible local attraction of Continents, thermal-electricity, &c., supposed by many competent authorities to influence the variation.

The first principal cause producing, what may be called a deviation of the declination needle from the magnetic meridian is best illustrated by the oasis of Western variation in China and Japan, and caused by the occurrence of the Siberian focus to the Northward and Westward of it; magnetic attraction, like gravitation, increases inversely, as the square of distance decreases, and the Siberian focus being nearer than either pole or other focus, it naturally deflects the North end of the needle in all places within this oasis of Western declination to the

Westward; and again places in the Northern hemisphere immediately to the Westward of this oasis (which indeed ought to have Westerly variation, if the needle were allowed to point to the Magnetic North Pole), shew Easterly variation, because the nearest focus of magnetic intensity (the Siberian one) is to the Northward and Eastward of them. Now supposing the system of magnetic lines to revolve with the magnetic poles from East to West, this repeated change of secular variation from West to East and *vice versâ*, several times over again at the places in the track of this peculiar insula of Western variation would make upon an observer the fallacious impression, that the Magnetic North Pole were moving occasionally in opposite directions; but in fact it proves only, how the plurality of magnetic foci may cause contradictory irregularities in the arrangement of Isogonic lines.

The second principal cause of deviation of the needle from the direction towards the nearest magnetic pole is the existence of the second magnetic pole in the other hemisphere, tending to draw the opposite end of the needle towards itself, to make it parallel with the magnetic axis, *which coincides nowhere* with the axis of the earth; this is well shewn by the shape of the Agonic line passing through America; the difference of longitude between the North and South Pole across the Pacific being only about 110°, the South end of the needle anywhere to the Southward of the Magnetic North Pole and near its meridian having the Magnetic South Pole at its left (when looking towards the centre of the earth), is drawn in that direction, the more, the further to the Southward, and as a matter of course the North end of the needle deviates just as much to the right, or the Eastward, causing the whole Agonic line in that part of the world to encroach upon certain regions of our globe, which otherwise would have Westerly variation; the same effect of the South Pole upon the needle's South end can be proved along the Southern part of the Agonic line passing through Australia; the meridians of the two Magnetic Poles across the Pacific again are only 110° of longitude apart, but *viâ* the Indian Ocean and the Atlantic they are about 250° difference of longitude apart; the consequence is, that the South end of the needle is drawn in the nearest direction towards the Magnetic South Pole, in this case to the right, or Eastward; the North end of the needle must deviate just as much to the left, or Westward, causing in the Southern hemisphere an inroad of Westerly variation into regions, where otherwise Easterly variation ought to be.

Assuming, that Hausteen and Walker were correct in letting the Magnetic North Pole revolve faster than the Southern one, then during one revolution, the former would be once on the meridian of the latter, and once 180° from it; in both cases the geographical meridian would coincide with the line of no variation, and the Eastern and Western variations would be equally divided, as stated in a previous chapter. These supposed unequal motions of the two magnetic poles would cause alternately contortions and distortions of the magnetic axis, and then periodical changes of the geographical latitude of the magnetic poles might presumably also take place.

4.—*Tidal Motion and Diurnal Variation.*

In order to form an idea how the position of the magnetic foci and poles may be affected by the influence of subterranean tidal movements, besides the mere perpendicular tide wave, it is necessary to have before our mental eyes clearly our knowledge of oceanic tide waves, because it is reasonable to suppose that the one must behave analogue to the other.

It is not my intention to reproduce in this chapter what may be read in every good work on tides; but I wish to draw attention to a fact which appears to have been overlooked at least by those writers, whose works I have had an opportunity to consult; I cannot illustrate better what I mean than by making a few extracts from a couple of nautical works. First from the China Sea Directory, Vol. III, 1874, page 350 and 351:—

"The tidal streams at the entrances of the Yangtsze from "Gutzlaff to Shaweishan rotate, performing one revolution "(with the sun) in 12 hours. To the southward of Gutzlaff "the tides are also rotatory, but not with that regularity which "is observed about the Amherst Rocks. There is also reason "to believe, although the fact has not yet been conclusively "established, that they preserve the same character some dist-"ance to seaward, and far to the northward. During its revo-"lution the direction of the stream changes about two points "every hour, excepting when veering from N. W. to N. E. "about the time of high water, and from S. E. to S. W. about "the time of low water, when the change is more rapid. The "northern stream for the most part makes and completes the "flood, and the southern stream for the most part makes and "completes the ebb, although the first part of the flood is made

"by the southern stream, and the first part of the ebb by the "northern, called sometimes "tide and half-tide."

"Mr. G. B. F. Swain, master of H. M. S. *Pilot*, 1850, states "that the revolving tide has been noticed as far out as the Sad-"dle Islands, whilst others assert that the stream when fully "made sets N. W. by W. and S. E. by E. These statements "are not contradictory. Lieut. C. Bullock, R.N., found the "tides to rotate, 120 miles north of the entrance, at 70 miles "from the land."

Captain Horsburgh gives in his India Directory, Vol. I, page 599, the following table concerning tidal motions off the river Hoogly, when uninfluenced by the wind:—

"1st quarter	flood	N. W. by W.
"2nd ,,	,,	N. N. W.
"3rd ,,	,,	N. N. E.
"Last ,,	,,	E. N. E.
"1st quarter	ebb	S. E. by E.
"2nd ,,	,,	S. S. E.
"3rd ,,	,,	S. by W.
"Last ,,	,,	S. W. and W. S. W."

This is a complete revolution (with the sun), in the bay of Bengal, the same as off the Yangtsze.

Lately I have heard that "divers" engaged in salving operations in the vicinity of the Lammock Islands (Formosa Channel), have also observed a rotation of tides in that locality. From personal experience I am able to add the following fact:

In the summer of 1874, when commanding the British barque *Charley* of Hongkong, I was becalmed for several days during a voyage from Japan to Shanghai; to judge by the lead, the currents appeared very unsteady, setting at different times in different directions. I had good observations and found that I was drifting away towards the Strait of Corea, which set I attributed to part of the Japan stream (Kurosiwo current), branching off in that direction; determined not to lose more ground than could be helped, I brought up with the stream anchor on the great Yangtsze bank, about half way between Quelpart and the Saddle Islands in 23 fathoms. Remaining there some time for want of wind, I was much surprised to find the tides rotate with the same regularity as off the Yangtsze (with the sun), which accounted for the seeming irregularities of currents, indicated when consulting soundings only.

By these facts I am led to believe that tidal motion (if not

interferred with by the shape of neighbouring continents and Islands or Galese), in the northern hemisphere always takes place from north, through east by south and west; in the southern hemisphere of course in the opposite direction; to verify this latter supposition the information contained in the 7th edition of Horsburgh is not sufficient; generally the establishment of the port and the rise and fall are only given for most places in the southern hemisphere; but I am confirmed in my opinion by much, what Horsburgh relates of equatorial regions. In the second volume of the India Directory he says on page 759 about Sourabaya Strait:—"Ships are sometimes "detained upon the bank, or at the entrance of the channel, "by the singular tides which prevail there, and for which "science has not yet been able to account, or the pilots even to "reduce to rule. In the chart of the channels leading to Sou-"rabaya, by Lieut. M. H. Jansen, D.R.N., the depths are "given at low water, and the following remarks are made on "the tides:—"During the months in which the sun is on or "near the equator, *i. e.*, in March, April, September and Oc-"tober, there are in this channel, at the full and change, two "tides in 24 hours; but at the quarter moon's, as well as dur-"ing all the other months, there is only one tide, and it makes "low water in the night with south declination, and in the day "when the sun has north declination.

"The greatest rise and fall of spring tides is 6 feet, and it "occurs only in those months when there is but one high "water in the 24 hours, and 3 or 4 days after full and change. "The least rise and fall is 4 feet, and this takes place at the "full and change also, but only in the months when there are "the two tides, which may be regarded as a change for the "day-high-water to the night-high-water, and vice versa. At "the quarter moons of these months the water rises 5 feet, and "in every other month 5½ feet above the depths marked in this "chart.

"In the month of May it is high water between 21½ h. and "0½ h.; June, 20 h. and 0½ h.; July, 19 h. and 0 h.; August, "16 h. and 0 h.; November, 10 h. and 12½ h.; December, 8 h. "and 12 h.; January, 8 h. and 12 h.; February, 7 h. and 12 h.

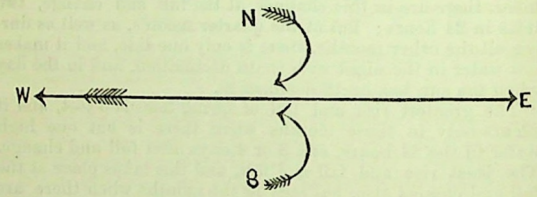
"At the spring tides, as well as at the quarter moons, it is "high water always at 10½ h. or 22½ h.

"During the months when the two tides occur, it is also "high water at 10½ h. and 22½ h. These two tides are, how-"ever, different in height; and when the sun's declination is "north, the morning tide is the highest; but when it is south,

"the evening tide. In those the quarters which give but one "tide,(1) give the higher water as at full and change."

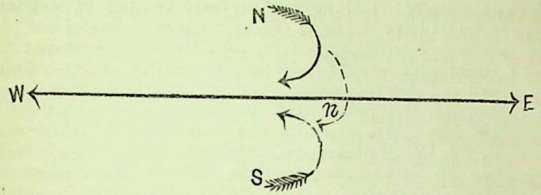
Now I believe that during the sun's northern declination the tides in Sourabaya Strait do rotate the opposite way, as off the Yangtsze; during his southern declination the tides are also rotatory, but the same way as the Yangtsze tides. During the two equinoxes then it will be difficult for local pilots even "to reduce the tides to rule," because the tides changing from one rotation *i. e.* with the sun, to the other, *i. e.* against the sun, or vice versa, may appear to become to a certain extent confused and irregular.

I will not transgress too much by recording more instances of apparently irregular tides, as I could; but refer for one remarkable instance more to page 737 of the same volume of Horsburgh's, concerning Pitt Strait, where several vessels by the tides setting consecutively in "all directions" running considerable danger: I believe, if they could have anchored they would, (as I did on the Yangtsze bank in 1874) have experienced a rotary regular tide, perhaps at springs:—



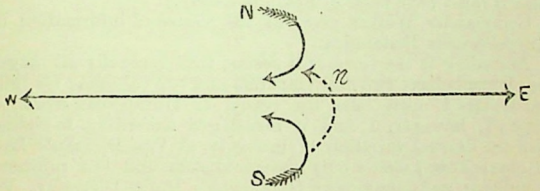
W E is the equator, the curved arrow N indicates the rotation of tides in the northern hemisphere, the curved arrow S shews the same in the southern hemisphere; supposing the strait arrow at W to point out the direction of the flood tide on or near the equator, then the flood and ebb currents will occur at the same time on both sides of the equator, and places near it will have two regular tidal revolutions in 24 hours. At neaps the flood wave resulting from the moon's lower meridian passage becomes so much counteracted by the sun in quadrature, that it is scarcely noticeable, or incapable to overcome the *vis inertiæ* of tidal motion, resulting from the moon's upper meridian passage; then places like Sourabaya Strait will only experience one flood and one ebb in 24 hours.

(1) Horsburgh's tidal account of Banca Strait resembles in many points that given of Sourabaya Strait.



During the sun's southern declination the northern currents stretches over across the equator and arrives retarded at N, continuing the southern already finished flood stream for another 6 hours; a singular phenomenon occurs with the ebb stream, thereby allowing only the effects of the upper meridian passage to appear as one flood and one ebb in 24 hours.

The seeming irregularities of tides must be greatly increased by the circumstance of the principal factor in their production, *i. e.* the moon, crossing and recrossing the equator so many times during the year:—



In the above figure W E is the equator during the sun's northern declination; the stream from the southern hemisphere crosses the equator to the northward in the direction of the curved arrow S N and continues the spent tidal movement in the northern hemisphere similarly as in the preceding case; the consequence is the same; one complete tidal rotation in 24 hours only.

If this view of oceanic tidal motion can be accepted, then it is natural to suppose that the earth's internal fiery ocean must be equally or rather more so affected; being as many miles perhaps in depth, as the briny outside ocean is fathoms only: and then it would be easily understood that the magnetic foci and poles by being carried along with the tidal motion would cause a change of the magnetic axis in the same manner, as if the earth's magnetic nucleus were moving, as described in a

previous chapter; tidal motion or displacement of magnetic nucleus would have the same effect: change of axis of our planets magnetic internal apparatus, and thereby producing the main features of annual and diurnal variation, many seeming irregularities being the result of the unsymetric distribution of magnetic foci and poles, and the consequent eccentricity of magnetic axis. My attention has been called to Humboldt's Kosmos, vol. IV, Stuttgart and Tübingen, 1858 ("Specielle Ergebnisse der Beobachtung in dem Gebiete tellurischer Erscheinungen"), in which much valuable information is contained concerning Terrestrial Magnetism.

Humboldt states (p. 53) that the Chinese, Indian, Arabian, and Malay navigators knew the magnetic variation before Columbus; in fact Andrea Bianca had entered it on his sea charts in 1436; what Columbus did discover is the line of no variation, passing then $2\frac{1}{2}^{\circ}$ east of the Azoric Island, Corvo, and I think what the Spanish savants, according to Commander Walker, refused to credit, may have been Columbus' statement, that to the westward of his newly discovered line of no variation the variation were opposite (westerly) to what at his time it must have been in Spain (easterly.)

Commander Walker gives as his source of information the Encyclopaedia Britannica.

According to the Kosmos it seems, that generally all magnetic elements have two daily maxima and two minima; for fuller particulars I must refer the reader to Humboldt's work; on page 97, however, I find it mentioned according to Sabine, that the diurnal variation of intensity at Van Dieman's Land (Hobart Town) shews only one maximum and one minimum per diem; and referring to Horsburgh's India Directory, Vol. II, page 839, I find the following tidal information about d'Entrecasteaux Channel (Van Dieman's Land): "the rise of the "tide *which flowed only once* in 24 hours was about 6 feet per- "pendicular; high water from 9 to 12 hours at full and change, etc;" this is a remarkable coincidence with only one daily maximum and one minimum of magnetic intensity, which I consider may be a proof of also one subterraneous tidal revolution only in 24 hours.(2)

(2) Humboldt on page 84 (Kosmos, Vol. IV.) calls attention to a zone of weak intensity between the northern and southern magnetic hemispheres, which alternately shares the magnetic movements of the opposite hemispheres during opposite seasons, similar as I suppose a corresponding zone in the same regions, partaking alternately of the tidal rotation of each hemisphere, as governed by the declination of the sun.

Humboldt asks (on page 141) if the line of no variation, which Columbus found near the Azores in 1492 is the same that Davis and Kieling in 1607 found at the Cape of Good Hope? I think not; Columbus's Azoric line must be the one, which now passes through the sea of Ochotsk, the Kurile Islands and to the eastward of Japan; and Davis's and Kieling's line must be the one, which Müller and Pouillet in 1668 passed through Paris (according to Picard in 1666), and which runs now through North America and the South Atlantic.

According to Graham (the same volume of the *Kosmos*, page 189, Philos. Trans. for 1724-25), the variation of declination depends "neither upon heat nor cold, dry or moist air. The "variation is greatest between 12 and 4 in the afternoon, and "the least at 6 or 7 in the evening." To this Humboldt makes the remark "es sind freilich nicht die wahren wendestunden," "(but these are not the true turning hours"); I believe Humboldt is wronging Graham, who for his time may have given the true turning hours correctly, which may change with the revolving position of the magnetic poles.

In more than one place Humboldt states his opinion that temperature has nothing to do with periodical variation, and on page 192 he quotes Relshuber (translated as follows:)— "there are two maxima and two minima of declination in 24 "hours, but only one maximum and one minimum of temper- "ature." At pages 176 and 177 Humboldt quotes from Sa- "bine:—"The turning periods of the year are not, as many "might be supposed to anticipate, those months in which the "temperature at the surface of our planet, or of the subsoil, or "of the atmosphere attains its maximum and minimum. The "annual variation is obviously connected with and depend- "ent on the earth's position in its orbit relatively to the sun, "around which it revolves; as the diurnal variation is con- "nected with and dependent on the rotation of the earth on "its axis. It is a remarkable fact, which has been estab- "lished, that the magnetic force is greater in both hemispheres "in the month of December, January and February, when the "sun is nearest to the earth, than in those of May, June and "July, when he is most distant from it; whereas if the effects "were due to temperature, the two hemispheres should be op- "positely instead of similarly effected in each of the two pe- "riods referred to.

From page 82 the following is a translation:—"The princi- "pal result of researches on the magnetic influence of the "earth's satellite, which according to Melloni, only shews a

"trace of heat generation, is that the magnetic declination "upon our earth in the course of a lunar day suffers a regular "change, arriving twice at a maximum and twice at a mini- "mum. If the moon, says Kreil very properly, produce no "change of temperature upon the surface of the earth, recog- "nisable by common thermometers, then she can produce no "alteration of Terrestrial Magnetism by this means; if in spite "of this such an influence is observed, it must be concluded, "that it is "brought about by other means, than heat." This other means, I repeat it, can only be the same, which produces oceanic tides.

Humboldt says on page 189 (translation): "compare extracts "of a letter from me to Karsten, Rome, 22nd June 1805, *on* "4 *motions* of the magnetic needle, comparable to 4 magnetic "ebb and flood tides, analogue to the barometric periods, etc."

A proof that during perihelion motion and commotion in the interior of the earth by the greater attraction of the sun must increase, is the rise of temperature in the Schergin shaft of Siberia, sunk 382 Parisian feet into the frozen ground; I translate the following from page 168:—"A remarkable and hi- "therto unexplained phenomenon is the rise of temperature, "which in winter sometimes has been noticed in the deeper "parts only, without any traceable influence from the outside."

Since the sun's greater attraction during perihelion accelerates the motion of the earth in its orbit, why should it not also increase the velocity (intensity) of the subterraneous circulatory current? and since greater motion in the earth's interior must manifest itself by a greater production of heat, we have an explanation of the phenomenon in the Schergin shaft: a translation (transformation) of the sun's greater attraction during perihelion into heat. Another direct proof of increased internal motion during perihelion. I translate from page 296: "The activity of the "Stromboll," (volcanse) is like that of the "Aetna, greatest in November and during the winter months,' *i. e.* during perihelion.

Humboldt states on page 488 that Poisson, with whom he conversed several times about subterraneous tides, thought them to be inconsiderable, and Humboldt's astronomical friend Dr. Brünnout expressed himself that internal tides could just as little take place on account of our planet's solid crust, as in the ocean, if the latter were covered with an unbreakable sheet of ice; but Ampere said that owing to the action of the moon on the enormous internal liquid mass, tides would result analogue to those of our seas, but much more terrible ("mais bien

"autrement terribles"), on account of the larger extent and greater density of the mass, it would be difficult to conceive how the shell of the earth could resist, being constantly battered by a kind of hydraulic ballista ("etant incessamment "battue par une espèce de bélier hydraulique (?) de 1400 lieues "de profondeur").

To these various ideas I can only again repeat from Mr. Kingsmill's Border Land of Geology and History, page 5:— "If the interior of the earth were liquid and its crust composed "of so rigid a material as steel, and 300 miles thick, it would "yield to the deforming influences of centrifugal force and the "attraction of the sun and moon as if it were india-rubber."

Considering all, it seems that opinions on these subjects differ widely; or to use a German proverb: "Darüber sind die "Gelehrten noch nicht einig."

To my mind there remains, no doubt, that the force of those celestial bodies which cause the nutation of our planets' axis of rotation and the precession of the equinoctial points, also do cause in the movable fluid interior of the earth those movements, which I have endeavoured approximately to picture.

Biot, Hausteen and others appear to have the idea of a magnetic nucleus before me; Humboldt objects strongly to Halley's views on this subject, but Halley placed his nucleus in a hollow terrestrial shell, while I take the *dense* state of our planets' interior into due account (see Bohn's edition of Humboldt's Cosmos, Vol. I, p. 163). Adhemar states concerning Bertrand of Hamburg: "Il supposait, que la terre était creuse "et qu'il y avait dans son interieur un gros noyan d'aimant," etc. (Croll's Climate and Time, p. 543.) I was unacquainted with these elder ideas, when I occupied myself first with the same question.

Note.—In Amadée Guillemin's "The Heavens," edited by Norman Lockyer and revised by Richard A. Proctor, the latter gentleman writes on page 391, after the current and generally accepted explanation of tidal phenomena is given: "It must "be noted, however, that although the statistical equilibrium "of a tidal wave is thus accounted for, the dynamical condi- "tions of the problem cannot be thus explained. On the con- "trary, if we consider only the dynamical rotations, we shall "find that the place of low water should be under the moon "and at the opposite part of the earth, the place of highwater "between these regions. Newton, Laplace, Airy and others "agree in this view. The theory of the tides remains yet to be "established satisfactorily. Much that has been presented in

"popular treatises as part of this theory is in reality but an "account of the results of observation.

"On the 1st of September, 1859 two astronomers, Messrs. "Carrington and Hodgson, were independently observing a "spot, when they noticed a very bright star of light suddenly "break out over it, moving with great velocity over the sun's "surface. At the same moment the magnetograph at Kew, "where all the changes in the earth's magnetism unceasingly "register themselves, was violently affected."—(Amadée Guillemin's "The Heavens," London, M, DCCC, LXXVI, page 52.)

5.—*Possible Origin of Magnetism.*

To understand the nature of magnetism, it is essential to recollect that more substances than iron, steel, nickel, cobalt and so forth, are magnetic.

Sir W. S. Harris, in his paper on the transient magnetic state of which various substances are susceptible has given the following table of the comparative magnetic inductive susceptibility of the following substances :—

Metals, &c.	Rolled Silver.	Rolled Copper.	Cast Copper.	Rolled Gold.	Cast Zinc.	Cast Tin.	Cast Lead.	Solid Mercury.	Fluid Mercury.	Cast Antimony.	Cast Bismuth.	Glass.	Marble.	Mahogany.	Water.
Comparative magnetic energy ..	30	29	20	16	10	6·9	3·7	2	1	1·3	½	0·35	0·37	0·37	0.27

Sir W. S. Harris found that by condensing the metals their magnetic energy was increased (Commander W. Walker's repeatedly quoted work "The Magnetism of Ships," page 17). From this table it will be seen that solid (which can only mean frozen) mercury is 100 per cent more capable of magnetism than the fluid mercury; but in solid mercury the molecules must be closed together than in the fluid, because the former comprises a smaller compass than the latter, and since we know that the attraction of bodies increases inversely as the square of the distance decreases, what possible reason could there be to suppose that the attraction between molecules should not increase at the same rate, should not obey the same law, if the body which they constitute does contract; in other words, when they are brought nearer to one another within the body? Now, if under ordinary circumstances this special

form of gravitation, the molecular affinity, is sufficient to keep the bodies together in their ordinary aggregate state, what must be the consequence, if by excessive pressure or by contraction a surplus of affinity is created more than is required for the existence of the body under ordinary circumstances? Nothing is more natural than that this surplus of disengaged affinity should make its presence known under some form or other, for instance, as magnetism; this is therefore an explanation for the increased magnetic capacity in solidified mercury. We may then say: by increased density of bodies magnetism is generated; iron is an instance when by some mechanical process (external superior force) converted into the denser steel.

If a magnet is heated, magnetism is lost, because it must be reconverted into original affinity to counteract the increasing centrifugal heat vibrations of the molecules.

In soft iron (says Mr. Merrifield in his severally cited work "Magnetism, etc., page 29) "where the magnetism must be "induced, the power increases with a rise of temperature to a "blood red heat. With other magnetical substances, as co-"balt and nickel, the effects of heat vary; and Faraday shewed "that some substances which at ordinary temperatures are not "magnetic, become so when exposed to intense cold."

This case of iron becoming more capable of magnetism until heated to a certain degree is one of those exceptions which proverbally prove rules; for Tyndall states in "The Forms of "Water," page 124: "Water is not a solitary exception to an "otherwise general law. Heat expands, cold contracts, there "are other molecules than those of this liquid which require "more room in the solid crystalline condition than in the ad-"jacent molten condition. Iron is a case in point. Solid iron "floats upon molten iron exactly as ice floats upon water. "Bismuth is a still more impressive case, and we could shiver "a bomb as certainly by the solidification of bismuth as by "that of water." This shews that iron passing from the solid to the molten state at certain degrees of heat must be contracting, thereby disengaging a certain amount of molecular affinity, manifesting itself as increased magnetic capacity. Having these facts (which I cannot express better than saying that by increased density of bodies capable of magnetism a certain amount of spare affinity must appear under the form of magnetism), vividly before our eyes, then it will easily be understood how terrestrial magnetism originated, if we throw a hurried glance at the earliest history of our planet.

"Supposing with Helmholtz that the sun originally existed "as a nebulous mass, filling the entire space presently occu- "pied by the solar system and extending into space indefinite- "ly beyond the outermost planet."—(Croll's Climate and Time, page 348.)

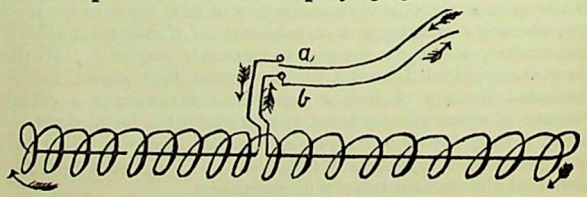
And supposing this nebulous matter sufficiently contracted, that at the outer limit or surface, mass after mass had detached itself from the parent body, forming successively the outer planets with their satellites, until our own planet was formed.

Suppose x million of years ago the diameter of the earth's body had been 10,000,000 miles, and the attraction between two neighbouring molecules=m, then y millions of years afterwards the diameter having contracted to 100,000 miles, the attraction between two neighbouring molecules must have been 100^2m, or 10,000 times greater; part of this increased power of gravitation must have manifested itself as telluric magnetism, the rest being radiated into space as heat.

It will be seen that I am trying to trace magnetism home to gravitation; in the following chapter some more weighty reasons will be produced to support this view; at present a few remarks concerning the analogy between magnetism and electricity may not be out of place.

This essay not being intended for a lesson in elementary physics, the reader is supposed to be sufficiently conversant with the action of electricity upon magnets, or of magnets upon electric currents, to understand the following deduction; but being unable to express better what I should expound first, to make the succeeding argument clearly understood, then it can be found in "Natural Philosophy," translated and edited from Ganot's Cours Elementaire de Physique, by E. Atkinson, Ph.D., F.C.S., 2nd edition, page 501.

"Structure of a solenoid.—A solenoid is a system of equal "and parellel circular currents formed of the same pieces of "covered copper wire, and coiled in the form of a helix or spi- "ral, as represented in the accompanying figure :—



"A solenoid, however, is only complete when part of the wire "passes in the direction of the axis in the interior of the helix.

"With this arrangement, when the circuit is suspended in "the mercury cups of the apparatus, and a current is passed "through, it is directed by the earth exactly as if it were a "magnetic needle. If the solenoid be removed it will, after a "few oscillations return, so that its axis is in the magnetic "meridian. Further it will be found that in the lower half of "the coils, of which the solenoid consists, the direction of the "current is from east to west; in other words the current is "descending on that side of the coil turned towards the east, "and ascending on the west. In this experiment the solenoid "is directed like a magnetic needle, and the north pole, as in "magnets, is that end which points towards the north, and the "south pole that which points towards the south."

"Mutual actions of magnets and solenoids.—Exactly the "same phenomena of attraction and repulsion exists between "solenoids and magnets as between magnets. For if to a "movable solenoid traversed by a current, one of the poles of a "magnet be presented, attraction or repulsion will take place, "according as the poles of the magnet and of the solenoid are "of contrary, or of the same name. The same phenomena "take place when a solenoid, traversed by a current and held "in the hand, is presented to a movable magnetic needle. "Hence the law of attractions and repulsions applies exactly "to the case of the mutual action of solenoids and of magnets,"

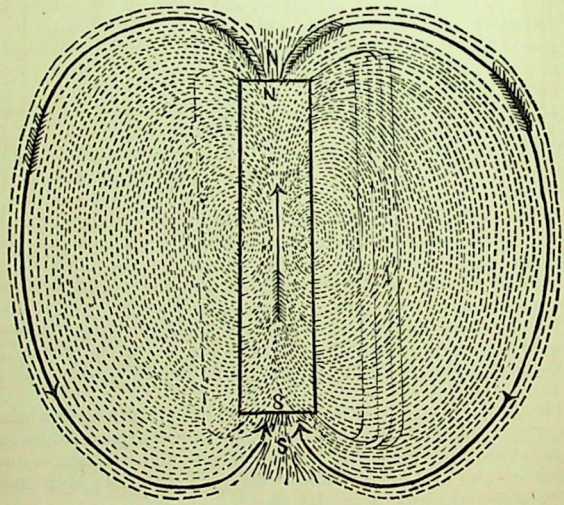
"Mutual actions of solenoids.—When two solenoids traver- "sed by a powerful current are allowed to act on each other, "one of them being held in the hand, and the other being "movable about a vertical axis, attraction and repulsion will "take place, just as in the case of two magnets. These phe- "nomena are readily explained by reference to what has been "said about the mutual actions of the currents, bearing in "mind the direction of the currents in the ends presented to "each other."

Now, if a house in all main features resembles a certain other building, both answering exactly the same purposes, then the second building must also be a house, though perhaps of another style of architecture and of different material; both must be constructed after a similar plan.

In the solenoid we see that a current traverses a wire in one direction and is conducted back spirally outside the wire beyond the opposite end, and led back again inside the spiral coil in the original direction.

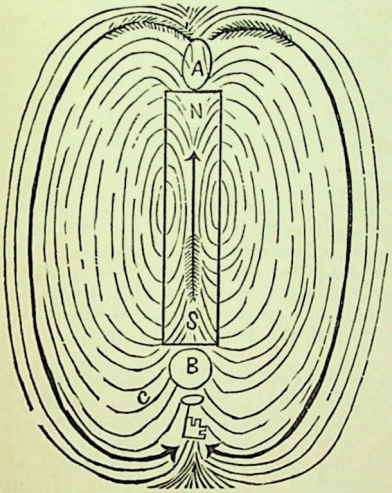
It must be the same case with the magnetic current, emanating from one pole and making its way back to the opposite pole, as best it may and as is well shewn by the familiar experiment: to cover a strong magnet by a sheet of paper and sieve iron filings on top of it; the iron filings, acted upon by the inductive currents, become arranged in regular curved filaments from one end to the other; in the centre, where the curves become so small as to neutralize one another, no action is observed; there is the magnetic equator.

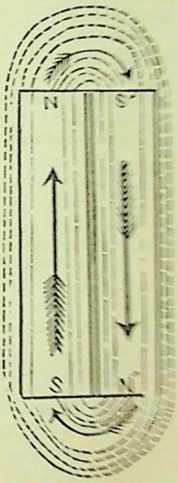
That this current from pole to pole takes place can be conclusively shewn by introducing a strong horse shoe magnet into iron filings, or amongst nails, when at once solid bridges of filings or nails will be formed, connecting both poles in regular arches (compare Faraday "On the Various Forces of "Nature," pages 50 and 170.)



N S is a magnet; the current is supposed to emanate at N and enters again at S, a continuous circulation takes place, as in a solenoid.

Place some pieces of iron A, B and C (accompanying figure) near either pole; the current will traverse them, exciting at the same time the latent magnetism of the iron to join the original current and attracting the iron towards the foci of circulation, the poles, like invisible arms of apolype; add pieces of iron ad libitum, the effect would only be to prolongate the current but every piece would be traversed by it, and become a temporary magnet.





Place a second magnet S′ N′ with reversed poles alongside the former and the circulation selects the nearest and best conductor (like a streak of lightning in a similar case), and the pieces of iron become demagnetized by the desertion of the current, and drop down, being no longer attracted. Break either of the magnets in pieces, the circulation will continue in each piece, everyone becoming an independent magnet; a flash of lightning passing through a magnet contrary to the current will reverse it and of course the poles also.

Poles of the same name repel one another until the axis of the magnets are parallel to each other (if we disregard the influence of terrestrial magnetism), and opposite poles attract

each other, to form *one* continuous current; in both cases the magnetic currents obey the law to arrange themselves parallel to one another; even in the second case, where they have the tendency to form *one* straight line, because it cannot be denied that a straight line is parallel to itself.

The attentive reader will readily observe that by this simple theory all phenomena peculiar to magnets, without a single exception, can be satisfactorily accounted for, not having recourse to Ampère's somewhat complicated artificial theory and the hypothetical two fluids: Austral and Boreal.

According to this hypothesis the earth itself would be only the vehicle of a vast magnetic current, emanating in the antarctic regions and visible under favourable circumstances as Aurora Australis, spreading towards the equator and thence converging in regular curves towards the arctic regions, where frequently visible as Aurora Borealis. It would make no difference if the current were travelling in the opposite direction; I have only assumed the former circulation, because the southern hemisphere is believed to possess more magnetic intensity, some of which might be spent by the current's passage to the northward in meteorological phenomena (thunderstorms, etc.)

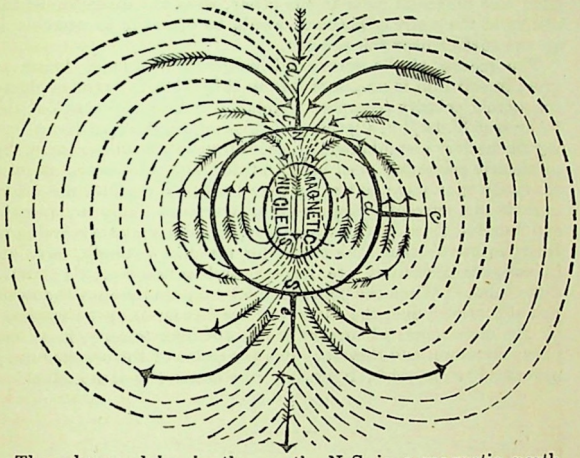
A tangent on either magnetic current curve in any place would probably be identic with the magnetic dip; might this magnetic current be the cause of atmospheric electricity and the returning current (through the earth) the cause of telluric electricity?

"Many hypothesis have been propounded to explain the ori-
"gin of the atmospheric electricity. Some have ascribed it to
"be the friction of the air against the ground, some to the
"vegetation of plants, or the evaporation of water. Some
"again have compared the earth to a vast Voltaic pile, and
"others to a thermo-electrical apparatus. Many of these
"causes may, in fact, concur in producing the phenomena."
—(Ganot's Cours élémentaire de Physique, by E. Atkinson, London, 1875, page 463.)

It would be interesting to know whether the motion of the earth's interior might be contributing to produce electricity; is it possible that the secular motion, the rotatory current and tidal action of our planets' fluid interior may produce electric currents, perhaps from east to west, according to Ampère's opinion?

The northern and southern lights probably are occurring in the highest parts of the atmospere, where it begins to become very rarified, in analogy of the electric light in vacuo, or rari-

fied vapours (compare Ganot's Natural Phylosophy, etc., etc.) page 525-526.



The above globe is the earth, N S is a magnetic north and south line; magnetic ethereal matter emanates in the southern hemisphere, probably in decentric undulations (from common centres), crosses the equator in the direction of the arrows and enters the northern hemisphere, probably in accentric undulations (towards common centres), to circulate back again through the body of the earth towards the antarctic regions, and so forth; *a b*, *c d* and *e f* represent iron masts at the poles and at the equator; they are traversed by magnetic induced currents, parallel to the nearest curves in the direction of the arrows; in the northern hemisphere *a* is the induced south pole; *b* the induced north pole of *a b*; in the southern hemisphere, *e* is a south pole and *f* a north pole of *e f* by induction from the earth; at the magnetic equator the induced magnetic current must be horizontally somewhere between *c* and *d*, like the arrow.

The arrows indicate the supposed direction of this magnetic current; the arrow heads present everywhere that end of the magnetic needle, which *on the surface of the earth is the north seeking pole.*

The tendency of all magnets below and above the surface of the earth must be to remain parrallel to this terrestrial magnetic circulation, and if there were a tunnel through the earth from one magnetic pole to the other, then the direction of the needle at the *centre of the earth* would be opposite to what it is on the surface near the equator.

The reason of the terrestrial magnetic influence being so great in soft iron is no doubt due to this metal's great capacity for atomic polarity (compare Tyndall's "Atomic Poles" in the "*Forms of Water*," p. 32) the molecules arranging and disarranging themselves instantaneously, according to prevailing magnetic or electric currents; steel being harder, the molecules do not so easily give way; but when arranged in a manner most favourable to a current's passage, they are more likely to remain so (Coercive Force.) Consequent points in a magnet are due to faulty magnetisation; the bar being touched wrongly, currents in opposite directions are formed and consequently intermediate poles. When the pole of a weak magnet touches the same pole of a strong one, the current in the former may be reversed by the more powerful current of the stronger magnet in an opposite direction, and therefore also the poles of the weaker magnet would be reversed; lightning may cause the same effect.

6.—*On the Coincidence of Periodical Maxima and Minima of Solar Spots with similar changes of Terrestrial Magnetic Variation.*

It is a fact well established by the labours of Schwabe, Wolf and others that in mean periods of about eleven years the number and size of solar spots are subject to gradual changes; while Sabine, Hornstein and Lammont very early discovered a parallelism between these changes and similar ones of the terrestrial magnetic elements; both increase during about $5\frac{1}{2}$ years, when they attain their maxima and then decrease again until they attain their minima together; therefore it has been supposed by many competent authorities that terrestrial magnetism must be influenced by a maximum or minimum of solar spots. I think it more likely, that both phenomena are independent of one another, but since they do coincide, that they must be caused by the same means, for the following reasons: Considering solar spots first, we must bear in mind that the sun

is a fiery mass in the process of cooling, the same as the earth has been in former ages. The spots are products of this cooling process, partly in the solar atmosphere (solar vapours composed of various elements condensed to solar clouds); partly floating on the surface like floes of ice upon water; or in the case of the earth's earlier age, like what then must have been the first nuclei of the forming solid crust (now primary rocks?); these slakes given, they may burst by contraction, the fiery liquid springing up between the pieces, separating and flooding them, or the pieces perhaps may sink into the fiery deep below and become melted again, after which the radiation of heat into space (temporarily suppressed by the intervening spots), will be renewed with increased force. But it would be out of place to discuss here the various theories of solar spots; my object only is to remind that they are a product of a cooling process upon the sun; this cooling process can solely occur by radiation of heat from the sun's surface into space; therefore, if this process appears enhanced during about $5\frac{1}{2}$ years, it is a direct proof that during this period the sun gradually becomes surrounded by a better heat conducting medium; this medium being the assumed allpervading universal ether, without the existence of which neither the phenomena of heat and light nor probably those of gravitation, magnetism, electricity, (and possibly those of sound) could not be explained. But since this heat conducting medium naturally must remain one and the same (the assumed ether), the change or improvement which takes place can only occur in its constitution, and I consider it possible, that during one-half of the 11 years' period its density may increase, during the other half it may decrease; during the dense ethereal periods the radiation from the sun becoming more intense, the superficial parts of the sun cool more rapidly and the maxima occur; during the rarified ethereal periods the radiation decreases, the sun's proper heat melts the products of the preceding accelerated cooling process more quickly than they can be replaced, and a minimum of spots occurs.

That during a maximum of solar spots a maximum of heat is radiated from the sun perhaps may be considered as proved by the discovery of Lockyer, that during a maximum period of solar spots the quantity of rain upon our planet is considerably more than during a minimum of spots; (compare "Kosmologische Briefe von Hermann J. Klein, Graz 1877," page 252); because more rain cannot fall, unless more water is previously evaporated from the sea; but more water cannot be evaporated, unless more heat is supplied by the sun, and more

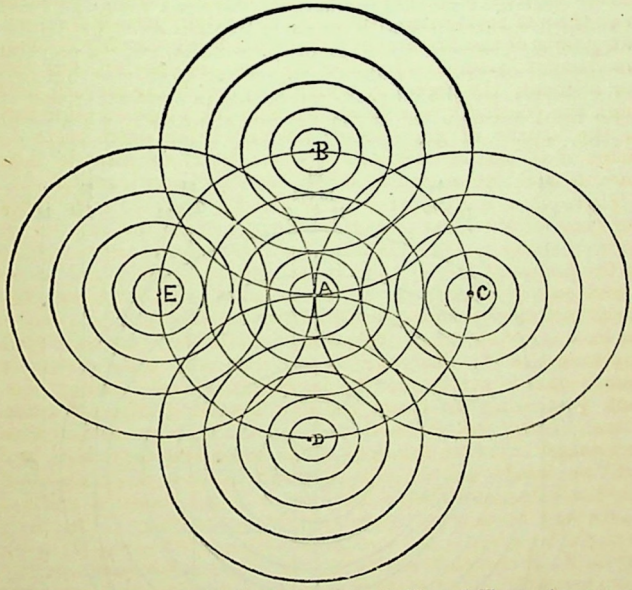
heat cannot be conducted from the sun to the earth, without the capacity of the conductor, the ether being improved; therefore the density of the ether must be subject to periodical changes corresponding to those of the solar spots, and how that is likely to effect terrestrial magnetism we shall see presently, but consider first, how this change of density possibly may happen.

If our imagination and theories fill endless space, where everything is subject to eternal motion, with assumed universal ether, we have no right to suppose that it should not participate in the motion of the stellar systems; and since all its known actions, as transmission of heat and light, are undulatory, then periodically ethereal waves of greater and lesser density may be sweeping through our planetary system, from worlds beyond and towards worlds beyond, perhaps analogue to swarms of meteorites, radiating in certain periods from certain points of the firmament; this ether being possibly not only the element in which all stellar systems are moving, but also the element, the force, by which they are being moved; for I think the possibility can be shown that the supposed ether may be the source of gravitation, the very thing which keeps the atoms of all matter near one another, leads or attracts them towards each other, and in solids, cements them together.

There is a high degree of probability that the ether filling the space of our solar system be moving round the sun in the same manner as the planets; because if the space were filled by the bodies of the system in former ages (dissolved as we might say in ether), as nebulous mass, concentrating afterwards into the various celestial bodies *rotating round the sun in the same direction*, what inducement could the ether have to do anything else?* But ours is not the only solar system in space; ours is surrounded by innumerable neighbouring ones, each possessing no doubt its own revolving ethereal atmosphere. Now, the ethereal undulations from one system must be traversing the undulations of the other systems; because if not, we would simply not be aware at all of the existence of other worlds; and that, when two or more crests of ethereal waves are co-existing (overlapping, superposing one another) in our solar system, the maximum influence of ether is manifested by increased radiation from the sun and consequently more considerable formation of solar spots and greater intensity of all terrestrial phenomena connected with the same pe-

* "Olbers maintained, that this fluid could not be at rest, but must "rotate directly round the sun." (Humboldt's Cosmos, vol. III, p. 48).

riod. But when the troughs of two or more ethereal waves occur together, then the intensity of all phenomena concerned will be less, analogue to the interference of light and other waves; this interference of ethereal waves would be acting on our system like bellows on a furnace, and from other stars possibly our sun might appear as a star of periodically variable light; or perhaps we may view our dense ethereal periods as the sum or accumulation of ethereal waves from the myriads of stars and nebulae in the milky way; or as waves overtaking or meeting the sun on his presumed passage through space. It may be remarked here that the mean periods of about 11 years are by no means very regular; (compare the tables in Dr. Klein's "Kosmologische Briefe," 2nd edition, page 220.)

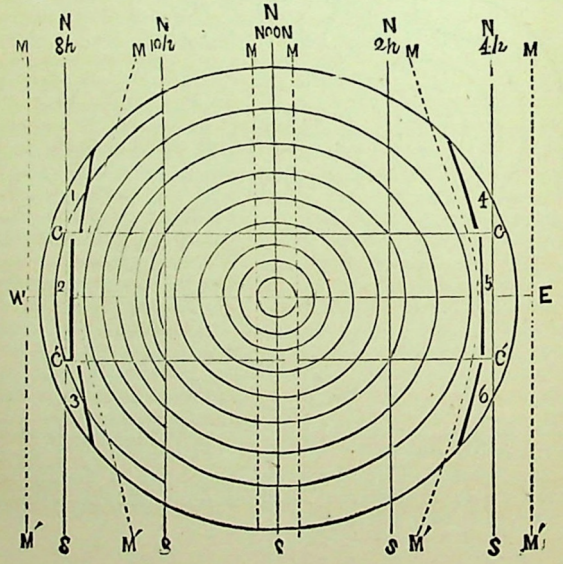


A is the solar system in space; B, C, D and E are to represent neighbouring stellar systems, and the circles ethereal undulation crests; where they coincide, maxima of density take place; where the intermediate spaces—the troughs—coincide, minima of density will happen.

How ethereal waves, therefore also maxima and minima of density, may affect the phenomena in question is well suggested by Alex. von Humboldt, in the English edition of his Cosmos, translated by E. C. Otté, London, 1868, Vol. III, pages 39 and 40 :—

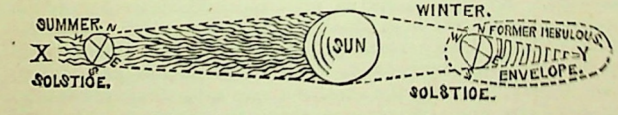
"The numerous investigations that have been made in re-
"cent times regarding the intimate relation between light, heat,
"electricity, and magnetism, render it far from improbable
"that as the transverse vibrations of the ether which fills the
"regions of space give rise to the phenomena of light, the
"thermal and electro magnetic phenomena may likewise have
"their origin in analogous kinds of motion (currents). It is
"reserved for future ages to make great discoveries in refer-
"ence to these subjects." . . . . . .

"If electricity moving in currents develops magnetic forces,
"and if in accordance with an early hypothesis of Sir William
"Herschel, the sun itself is in the condition of "a perpetual
""northern light." (I should rather say of an electro-magne-
"tic storm), we should seem warranted in concluding that so-
"lar light, transmitted in the regions of space by vibrations of
"ether, may be accompanied by electro-magnetic currents."



In preceding figure W E is the terrestrial equator, C C is the tropic of Cancer, C′ C′ the tropic of Capricorn, N S are meridians from 2 to 2 hours; for the sake of simplicity and facility of demonstration we consider these meridians also as magnetic ones; the dotted lines M M′ are to represent the magnetic curves of force between the two hemispheres, according to the theory deduced in the preceding chapter; the circles are intended to denote waves of luminiferous ether striking the equator at noon during the equinoxes immediately below the sun; the effect would be the following: under the sun the supposed lines of magnetic force being struck under a right angle can deviate neither to the eastward nor westward and no diurnal variation will shew; but to the right they would be slightly deflected by the circular (or rather spherical) solar waves and the magnet at 4 (having the tendency to remain parallel to the lines of magnetic force), would show westerly diurnal variation; at 6, easterly, and at 5, none; to the left the magnetic curves of force would be deflected the opposite way and more powerfully so, because the ethereal undulations moving with the sun from E. to W. would act on the lines of force like a vessel's bows ploughing through the seas, throwing up other waves in advance; and a magnet at 1 would shew easterly, another one at 3 westerly, and one at 2 no diurnal variation.

During the summer solstice the same phenomenon would take place at C C, during the winter solstice at C′ C′, thus accounting for annual variation and why there should be a zone near the equator, which alternately, according to the declination of the sun, exhibits the phenomena of the northern or the southern hemisphere.



In the above figure to the left is the earth at the summer solstice, and the undulatory lines connecting the earth with the sun are to indicate ethereal waves, encircling the earth by inflection round it, converging near the hour angle of 12 h., like a divided stream under the stern of a vessel at anchor, producing the second tidal wave of diurnal magnetic variation.

In former ages when the earth was a nebulous mass, comparable almost to ethereal matter itself, these undulations (or radiations?) may have carried nebulous substance along with them towards a point X, and during the winter solstice towards a point Y, forming a conical tail (like a vortex) in the direction of the radius vector, as is still the case with most comets. Now if these ethereal undulations can be allowed as producing diurnal and annual variation, it is easy to see how greater or lesser density of the ethereal medium will influence magnetic variation in the same periods with the greater or lesser frequency of solar spots.

It will be noticed that this is the 3rd suggestion advanced to account for diurnal variation; the first was displacement of the earth's internal magnetic nucleus; the second was tidal motion of the earth's fluid interior; I would be most in favour of this last explanation, provided the regular turning hours of daily variation are not subject to secular change.

The various calculations introduced in several places of this essay are only to answer the same purpose as the diagrams, which are grossly exaggerated to make them more graphic; they are intended to illustrate the principle and nothing more; the data for correct calculations not yet being given, which is much to be regretted.

Humboldt says in the Cosmos that the African node (point of intersection between geographical and magnetic meridians), has been advancing to the westward, rather less than half a degree annually, and he thinks that the magnetic North Pole might be moving from west to east, the South Pole from east to west; in the Admiralty Manual it is stated that the system of magnetic lines in the northern hemisphere appears to be moving to the westward, in the southern hemisphere towards the eastward. My opinion still is, after reconsidering carefully the limited material which gradually has come under my notice while writing these several chapters, that both magnetic poles are moving from east to west, about half a degree per annum, more or less; possibly the southern one somewhat slower than the northern one, for reasons stated in a previous chapter of this appendix.

The magnetic North Pole of the variation charts for 1860 is still placed in the same position, where Captain Ross found it 1830, though I believe in 1860, it must have been from 12° to 15° more to the westward, and perhaps it would be more practical and useful to verify its position from time to time, than to be struggling in vain after the geographical pole.

If I dare to bring this Essay before the public in spite of its imperfections and many shortcomings, it is because I cherish the hope, that some more competent authority, commanding more information, leisure, and means, than myself, might undertake and succeed to sift the erroneous from the truth, to make the latter more readily acceptable.

Note.—Dr. Herman J. Klein states in his "Kosmologische "Briefe ueber die vergangenheit, gegenwart und zukunft des "weltbaues," Graz, 1877, p. 252-253, that Zoellner tried to show the casual connection between the variations of terrestrial magnetism and the state of the sun's surface, while Hornstein at the same time demonstrated, that declination, inclination and horizontal intensity are subject to periodical changes of 26.33 days' duration, and that they can only be considered as caused by the rotation of the sun; from this period the sun's true rotation would be found to amount to about 24.55 days, as deduced by Spörer from direct observations of the sun's equatorial zone.

If this influence of the sun's rotation can be accepted as existing, than it would prove that the magnetic axis of the sun does not coincide with his axis of rotation, (analogue to our planet), and during one half solar revolution one solar magnetic pole would present itself to the terrestrial magnetic apparatus, repelling the latter's pole of the same name and attracting the opposite one; during the other half solar revolution attraction and repulsion of the terrestrial poles would of course be reversed, the whole phenomenon becoming rather complicated by the earth's daily revolution, its changing distance from the sun and the latter's changing declination. Admitting that the earth be influenced by magnetism from the sun, than we must also admit, that the earth by its revolution across the field of solar magnetism may generate electric currents (atmospheric electricity, etc.) analogue to revolving metal and other bodies across the field of terrestrial magnetism (compare Deschanel's Natural Philosophy, by Professor J. D. Everett, London 1873, pages 759-760); but then the interesting question presents itself: why should the sun's magnetic axis not coincide with the axis of rotation? perhaps the answer might be that the sun's magnetic axis has the tendency to set at a right angle to the plane through the centre of gravity of the whole solar system, the latter differing, according to Laplace nearly 1° 34' 15" from the plane of the ecliptic, and the plane of the ecliptic forming an angle of about 7° with the plane of the sun's equator. Another interesting question would be: "are the magnetic poles of

"the sun of the same nature, as the corresponding ones of the "earth and other planets, or are they opposite?"

Note.—Since the manuscript has been returned to me, to see the proofs of the woodcuts, I have had the good fortune of reading Sir W. R. Grove's Correlation of Physical Forces (London 1874), in which on page 122 the following passage occurs, which I consider highly corroborative of my views of universal ether: "Ether, which term we may apply to the highly attenu- "ated matter existing in the interplanetory spaces, being an "expansion of some or all of these atmospheres"—(of the sun and planets, etc.)—"or of the more volatile portion of them, "would thus furnish matter for the transmission of the modes "of motion which we call, heat, light," etc.

The same eminent philosopher says in the just mentioned work, page 197: "If magnetism be, as it is proved to be, con- "nected with the other forces or affections of matter, if elec- "trical currents always produce, as they are proved to do, lines "of magnetic force at right angles to their lines of action, mag- "netism must be cosmical, for where there is heat and light "there is electricity and consequently magnetism. Magnetism "then must be cosmical and not merely terrestrial. Could we "trace magnetism in other planets and sun's, etc., it would be "a great step. . . . Mr. Airy suggests that currents of "magnetic force having reference to the solar hour are de- "tected, and seem to produce vortices or circular disturbances "and he invites further co-operative observation on the sub- "ject, one of the highest interest, but at present remaining in "great obscurity."

"Messrs. De la Rue, Stewart and Loewy were publishing a "paper, in which a new theory of sunspots is discussed.—In "this paper all differences of luminosity on the surface of the "sun are referred to the same cause, namely, the presence to "a greater or less extent of a comparatively cold absorbing "atmosphere. (Guillemin's "The Heavens," p. 44.)

The Sun's Atmosphere.—"It is not at all unlikely, that it "may even turn out to have no upper limit, but to extent from "the sun indefinitely into space."—(Ibid, p. 49.)

RETROSPECT AND CONCLUSION.

It may not be out of place at the close of these chapters briefly to review the main features of the theory as follows:—

Revolution of the magnetic poles round the geographical one in about (roughly speaking) ¾ of a millennium, probably in an epicycloidal track from east to west.

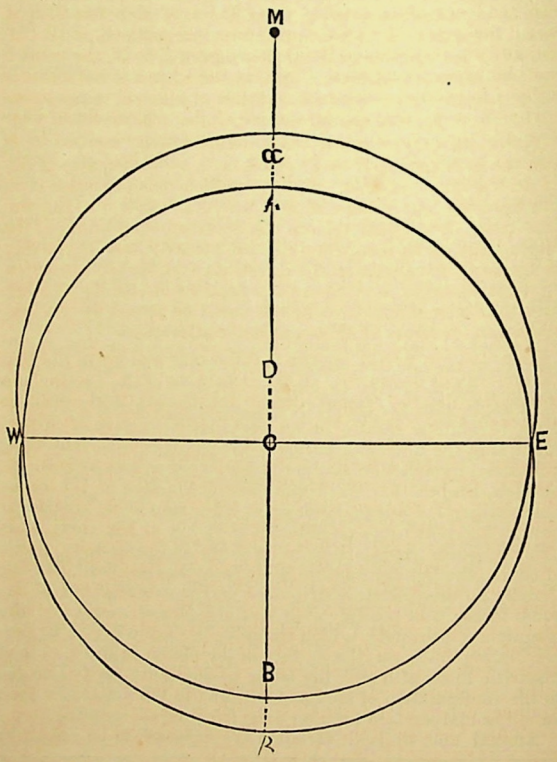
The revolution of poles is brought about similarly, as the westward tendency of the exterior ocean by the mutual attraction between the celestial bodies and the earth's interior fiery fluid conjointly with the quotidian revolution ;—the liquid portion of our planet revolving slightly slower than the solid, amounting perhaps to about ½ degree per annum.

The internal fiery fluid contains a nucleus of great density (owing to the stupendous effect of superincumbent pressure by gravity),* therefore of great magnetic capacity and coercive force, as must be inferred from Faraday's and Harris's experiments; Dr. Joule says "that steel would be compressed to ¼ of its volume at the centre of the earth." To this extremely dense, perhaps even solidified nucleus, we must look as the seat of terrestrial magnetism, round whose poles all magnetic matter collects like a liquid armature; its axis does not coincide with the axis of rotation, because again owing to the mutual attraction of the heavenly bodies and that part of the terrestrial spheroids internal molten mass, contained in the protuberance at the equator, causing a circuit of current in the fluid interior, which tends to elevate the axis of the nucleus at a right angle with the ecliptic; this tendency conjointly with the daily revolution results in an eccentric circulation of current containing the magnetic nucleus; the strength of current being influenced by aphelion and perihelion, apogee and perigee, opposition, conjunction, quadrature and declination of the celestial bodies; an unequal power of attraction being brought to bear at different times on different portions of the current, is likely to cause irregularities in its shape and motion, to which of course the liquid armature must accommodate itself, causing thereby an unsymetric distribution of the magnetic foci of unequal force; and possibly even a retardation of motion of the magnetic south pole, which irregularities are reflected by corresponding ones on the surface of the planet in the system of magnetic lines, although the latter no doubt are partly also due to the configuration of land and sea, and to the projection upon an ellipsoidal surface from an eccentric internal position.

Annual and diurnal variation are supposed to be caused by

* "It has been computed at what depth liquid, or even gaseous "substances would from the pressure of their own superimposed strata, "attain a density exceeding that of Platinum or even Iridium." (Humboldt's Cosmos, vol. I., p. 163.)

the magnetic nucleus describing a circle round its mean daily position during a revolution of the planet in the opposite direction (which former movement the magnetic poles of course must follow) in the following manner :—



Let A E B W be the earth and M the power of attraction of the celestial bodies at new moon, which will attract A most, C less, and B least; the formation of the flood wave, W a E is

the consequence, which de facto makes the terrestrial hemisphere W A E lighter, than the opposite one W B E; to restore the centre of gravity of the whole globe W A E B, some contents of the planetary shell must move and the centre of the nucleus is transferred from C to D; now if B has been attracted towards C by a centipetal force proportional to $(B C)^2$, then after the transfer of the nucleus from C to D, the point B must be attracted inversely less, as the square of the distance $(B D)^2$ has increased; the consequence of this will be the movement of B to β, and the formation of the second flood wave W β E; or supposing the excess of attraction exercised by M upon the hemisphere W A E equal to a power capable of lifting one million of tons, than $\frac{1}{4}$ million tons of matter must shift from the hemisphere W B E into the former, (or the nucleus from C to D), to restore the disturbed equilibrium of the whole. The earth revolving from west to east and D, having the tendency to remain in the direction of strongest attraction M, must describe a circle in the opposite direction; at other times than new moon, the nucleus would be moved by the parallelogram of forces of solar and lunar attraction.

From this it would appear that the centre of gravity of our planet were not geocentric, an occurrence which will seem less strange (besides the reasons already mentioned), if we consider the fact that even the position of the central body of the whole planetary system is not always in the mathematical centre of the latter, "but it actually rotates round the common centre of "gravity of the system, which occasionally falls within itself, "that is to say, remains within the material circumference of "the sun," (Ottes, Eng. transl. Cosmos, Vol. I, page 134) and "in September 1827, Schwabe discovered the eccentric posi- "tion of Saturn, afterwards confirmed by Harding, Struve, "Herschel and South," (ibid, Vol. IV, 521). Anyone acquainted with electric phenomena will conceive, that by such motion and commotion within the earth, electric currents should be generated, which joined to the probable magnetic capacity of the nucleus, will easily account for the existence of terrestrial magnetism; electric knowledge "has also thrown much light on the "internal action of terrestrial forces, since magnetism has been "recognised as one of the simplest forms under which electri- "city is manifested" (ibid, Vol. II, 727).

The description of magnetic currents given in the 5. Chap. of the Appendix as a peculiar solenoid-like closed circuit, well explaining all magnetic phenomena, I think not undeserving of

consideration, and it would be interesting to learn, if my view f tidal motion could be confirmed (4. Chap. Appendix.)

In the Journal of the North-China Branch of the Royal Asiatic Society, new series, No. X, Shanghai 1876 (Appendix II) some highly interesting remarks are contained by the Rev. Father M. Dechevreus, S. J.: "J'ai tout dernièrement reconnue que ces briques" (some building material used at the Zi-ka-wei observatory, nearly four miles from Shanghai), "provenant du Tché-kiang, sont notablement magnétiques (celles "qui vieunent de Tien-tsin ou du Tché-ly le sont au même degré) et que la correction à apporter à ces dernières observations est assez forte." . . . . . "Pendant la nuit le mouvement de l'aiguille, chaque fois que "j'ai fait des observations de 24 heures, a été excessivement "faible et difficile à saisir avec le déclinomètre;" (this would appear favourable to the view attributing diurnal variation to thermo-electricity by the sun, but Humboldt and Sabine assert, that it makes no difference in the daily turning hours, whether the sun rises very early in summer, or very late in winter; therefore I beblieve my suggestion of ethereal waves in the last chapter of the appendix a more likely explanation), In another place the able Zi-ka-wei observer states: "la declinaison magnétique à Zi-ka wei en 1874-75 aurait en moyenne, dans l'intervalle de 24 heures presente 3 minima orientaux et 3 maxima occidentaux." . . . . . "Telle est la marche générale du phénomene; en hiver le maximum du matin se présenté après 6 h.; de même le minimum du soir se rencontre avant 5 h.; de telle sorte que dans "l'intervalle de 12 heures, on peut observer dans la courbe "semi-diurne deux minima et deux maxima; bien plus j'ai été "assez étonné plusieurs fois," (on full and change of the moon ?), "entr'autres jours le 6 Fevrier 1875" (new moon about 4 p.m.), "de constater l'existence, dans le même intervalle de "temps, de trois mouvements complets de va-et-vient très-bien "marqués et presque d'égale amplitude;" are these daily fluctuations indicative of the 3 distinct influences by circular motion of the nucleus, by the daily ethereal flood wave (Chap. 5., Appendix), and by the internal tides of the molten mass (Chap. 4., Appendix), the latter dependent on a "subterranean establishment of the port"?

Humboldt, to whom the science of terrestrial magnetism owes so much, repeatedly suggests various plans for investigating thoroughly these interesting and important phenomena, a correct knowledge of which is of consequence in surveying, en-

gineering, mining, travelling, strategy, etc.; but to no one more than the navigator, the shipowner and insurance companies especially since the large introduction of iron and steel into' ship building.

The fragmentary character of these pages is due to their being written at different periods of the present S. W. monsoon (1878), as the necessary information, however, scanty, gradually became procurable, and without the valuable assistance of the gentleman already named, and the kindness of the president, secretary and council of the N.-C. B. of the R. A. S. I would not have been enabled now to submit to the test of public discussion and criticism this essay on *Periodical Change of Terrestrial Magnetism.*

SECOND APPENDIX TO PERIODICAL CHANGE OF TERRESTRIAL MAGNETISM.

Various Supplementary Remarks.

Regretting not to have been able to introduce the following remarks in appropriate places of the various preceding chapters, I must apologize for intruding them now; but I could only lately write them, after the works quoted had come into my possession from the estate of a distinguished and much lamented late member of the N.-C. B. of the R. A. S.

In the journal of the latter Society, No. 2, May 1859, page 222, Captain (Vice-Admiral Sir Charles) Shadwell, C.B., H. M. S. *Highflier*, states from personal and Sir Everard Home's observations that in Singapore, Hongkong, Shanghai and adjacent places the dip (inclination) of the magnetic needle is increasing and says page 224 "all these changes can be accounted for on the supposition of a gradual increase in the amount of the vertical component of the magnetic intensity of those places."

I beg leave to point out how the increasing magnetic dip in question is explainable by the theory which I have had the honour of bringing before the same Society. Captain Ross found the magnetic North Pole, A. D. 1830 at about 97° west of Greenwich=141½° east of Shanghai; allowing about ¼° westerly motion per annum would have placed the same pole for the year 1753 in 58½° west of Greenwich, i.e. on the meridian of

Shanghai *below* the geographical North Pole, when the dip at Shanghai probably may have been near 40 degrees, because that is the amount roughly, according to the inclination chart of the Admiralty Manual at 180° from the magnetic North Pole in Shanghai latitude, 31° north; and about the year 2113 when the magnetic pole should pass the meridian of Shanghai *above* the geographical pole, the dip will probably be about 60°, because that is at present approximately its amount due south of the magnetic pole for Shanghai latitude.

These suppositions accepted, it would be clear that since say 1753 until about 2113 the dip at Shanghai must be increasing, because the magnetic pole in its secular revolution is approaching the latter place, and the nearer the pole, the greater the inclination of the needle. The same reasoning holds good concerning Singapore, although it has southern inclination; the magnetic pole to the southward of Australia in its westerly motion is approaching the meridian of Singapore, therefore the dip must increase. Sir Charles Shadwell also calls attention to the anomaly, that at Woosung, 10 miles to the northward of Shanghai, the dip on the 26th November 1858 was 45° 2′ north, 16·17 minutes less than at the latter place on the 10th of June (45° 18′ N.) and on the 16th December (45° 19′ N.) Consulting the same Society's Journal, new series, No. X, 2nd Appendix, Shanghai 1877, it will be found that on the 3rd October 1875 the dip at the Zi-ka-wei observatory was 46° 26′ 15″ north, and next month 21st November 46° 9′ 38″ north; the actual greatest difference may probably have escaped observation, because unfortunately for 1875, from April to December, only 34 observations are recorded; the amplitude of horizontal variation, more extensively observed, has certainly been greater; for the Rev. Père M. Dechevreus, S.J., states in the same place the greatest difference to have been 21.51 minutes. From this great difference at one and the same place in less than two months' interval it appears doubtful, whether the anomaly pointed out by Sir Charles really does exist, or whether it has been only accidental; the same remark applies to the observations at Kintang and Ningpo of the same paper.

There is always a fleet of native and foreign men of war in the port of Shanghai; there is a harbour master's station and a telegraph office now at Woosung; might it not be possible to make arrangements for taking a series of dip observations near Woosung, simultaneously with the Rev. Jesuit Fathers at the Zi-ka-wei Observatory, to discover the true state of the magnetic elements in the vicinity of this influential emporium of cos-

mopolitan enterprise? It is of interest and importance to study the variation of the magnetic elements in these parts of the world, in order to understand the nature of that peculiar oval of western variation, in which Shanghai is situated, and which, judging from Bohn's edition of Humboldt's Cosmos, Vol. I, pages 174-175, at Columbus's time must have been in the North Atlantic between the Azores and the shores of the new continent: "We can with much certainty fix upon three places "in the Atlantic line of no declination for the 13th September "1492, 21st of May 1496 and the 16th of August 1498. The "Atlantic line of no variation at that time ran from N. E. to "S. W."—(corresponding to that portion of the *oval* now between the Philippine Islands and the Pacific Ocean to the eastward of Japan,)—it then touched the South American continent "a little east of Cape Codera," etc.,—which latter line may have been the one now passing through Australia. Too much reliance, however, cannot be placed on those early observations, either european or oriental, for on page 175 of the same volume we read that in Paris 1669 the variation was null, while other authorities give the year 1663; on page 174 we find on the 13th September 1492 the "line of no variation was "3° west of the meridian of the island of Flores"—and in the Vth Volume of the same work, page 54, we see that the same line on the same date was 2½° east of Corvo, Azores Islands. It is therefore all the more an important duty for the present generation to investigate the magnetic changes more minutely. From Columbus' time to its present position this interesting oasis of western declination would have performed about half a revolution round our planet from east to west in somewhat more than three centuries. Humboldt suggests repeatedly various plans for discovering the true state and nature of terrestrial magnetism; the best proceeding perhaps would be, to establish an international commission by special delegates from all civilized nations, to ascertain four or five times every century by numerous land and sea expeditions after well concerted plans the exact state of the magnetic elements all over the globe, in connection with the fixed magnetic observatories already existing; the expenses to be borne proportionally by all governments concerned. In Vol. II, No. 1 of this Society's Journal, Shanghai 1860, page 95, a supplementary memorandum by Admiral Shadwell is contained with some additional useful information concerning the magnetic elements in these regions, and I am confident, that by some more reliable observations taken in the present century the westward move-

ment of the ellipse of western declination in eastern Asia can be proved.

In No. XI of the same Society's Journal, Shanghai 1877, in a paper by Dr. J. Edkins "On the Variation of the Compass as "observed in China in the VIIIth, IXth, XIth, XIIth and XVIIth "Centuries," much valuable information is contained. Dr. Edkins says, page 140, that Mr. Wylie cited a passage from Su-kwang-ki, which states: "there is a variation for every "place. In Peking the variation is 5° 40′ east; this is found "in his work Li-yi;" page 139: "hence we learn that the va- "riation was eastern in China in A. D. 713 and at about A. D. "900. After that it became western and was so about A. D. "1080 and nearly a century later, at the time of Lai-wen- "tsiün." Dr. Edkins thinks, that since the Tang dynasty the needle may have had western declination and exchanged it again for eastern, two or three times. "Shen-kwa is quoted "as saying that in the place where he was writing the needle "persistently pointed to *ping-wei*. Transferred to our compass "this is the same as 15° to the west of north." From a remark on page 142 it seems that in 1080 and 1160 the variation in China was westerly, 7½° in the latter year.

Dr. Edkins arrives by means of Ganot's Physics, translated by Atkinson, at the same conclusion, to which I have been led by Müller-Pouillet's work. It may not be uninteresting to reproduce here, from the transactions of the China Branch of the Royal Asiatic Society, part 1st, Hongkong, 1848-50, p. 163, the following curious precept for magnetisation from the Chinese cyclopædia Tung-teen-shaou, as extracted by Dr. W. A. Harland:—

"*To make Needles point to the South.*—Take of vermillion, "orpiment and iron filings of each several fun (one fun equal "to 6.4 grains avoirdupois), reduce them to an impalpable pow- "der, and mix together with blood from the comb of a white "cock. Twenty or thirty needles are to be mixed up with this "composition, well folded in paper and placed in a furnace "where they are to be exposed to the highest heat of a char- "coal fire for seven days and seven nights. They are then to "be taken out and folded up in a piece of flesh for three days, "after which they may be removed and placed on the surface "of water to ascertain whether they turn towards the south "and are fit for use." Iron possessing the greatest magnetic capacity, when red hot, it is not impossible that the needles may acquire magnetism by induction from the earth, especially if placed parallel to the magnetic dip, which induced magne-

tism may become permanent, if the needles by the described procedure, (brisk insertion, whilst hot, into flesh), have become hardened, converted into steel. The Chinese do not seem to have discovered the magnetic inclination. It appears, that the manifestation of magnetism is more dependent on the extent of surface, than on the mass of magnetic bodies; an empty iron tank, for instance, according to Commander W. Walker, R.N., exercises the same influence on a compass, as a solid mass of iron of the same size; therefore it may perhaps be possible to give a greater directive force to the mariners' compass card by using hollow magnets in its construction, thereby increasing the magnetic surface of the apparatus, without increasing its weight.

The importance of the superficial area of magnets is further illustrated by the fact that several magnets closely joined together to form a magnetic battery, possess less magnetic intensity, than the sum of intensities of the individual magnets would amount to; simply because the battery exposes and affords less surface to the display of magnetic currents, than the surfaces of the single magnets amount to, when separated. Perhaps some desirable information concerning local magnetic changes can be derived from Japanese or Dutch authors, on account of the latter's early connection with Japan and Formosa; instructive records of these phenomena in China and Japan may also be contained in the Portuguese and Spanish archives in Macao and Manila. The following series of magnetic observations in the vicinity of the head quarters of this Branch of the R. A. S., Shanghai, are by high authorities, and extracted from the Society's Journal:

June 1843, dip by Sir E. Home, 44° 75′ N.

June 1858, dip by Sir C. Shadwell, 45° 18′ N.; declination, 2° 29′ W.—Race Course.

June 1858, dip by Sir C. Shadwell, 45° 19′ N.; declination, 2° 32′—Consular Flagstaff.

A. D. 1875, dip by Father M. Dechevrens, 46° 15.8′ N.; declination, 1° 59.82—Zi-ka-wei.

A. D. 1874-1875; intensity, horizontal, 6.94867; vertical, 7.25868. Total, 10.04850.

In Deschanel's Natural Philosophy by Professor Everett, London 1873, page 633, the following passage occurs: "As to "dip, its amount at Paris has continued to diminish ever "since it was first observed in 1671. From 75° it has fallen to "66°, its present value. As its variations since 1863 have been "scarcely sensible, it would seem to have now attained a mi-

"nimum to be followed by a gradual increase." By an inspection of the figures on page 631 of the same work, it will be remarked that the isoclinal lines form more or less regular ellipses round the magnetic poles, which in several parts of their configurations almost coincide with the parallels of latitude for some distance; such a coincidence of secular motion has probably happened in 1863 at Paris, when the dip will appear stationary for some time. A similar thing may happen in regard to the *western declination in China*; the greater axis of the oval running north and south, the northern and southern parts of the oval isogonic lines will nearly coincide with the parallels of latitude, and when the maximum of western variation is reached at any place it will remain stationary for some time, and then it will decrease. This hypothesis applied to the above table from the Society's Journal, it would appear, that since Sir Charles Shadwell's observations of the declination the north and south axis of the oval must have been passing towards the westward.

According to the international code of signals, London 1877, page 233, the magnetic declination has decreased about a quarter of a point during the last fifteen years in England. By a careful perusal of the Admiralty Manual of Scientific Enquiry, London 1871, my opinion concerning tidal motion appears confirmed by the following sentences: "With regards "to the stream of flow and ebb, they are often not merely two "streams in opposite directions at different times of the tide; "they generally turn successively into several directions, so as "to go quite round the compass in one complete tide, either in "the direction N. E. S. W. with the sun"—(in places to the northward of the sun?)—"or N. W. S. E. against the sun," pages 71-72—(in positions to the southward of the sun?)—"In "all land areas in the northern hemisphere the wave of high "water tends to revolve round the coast in the direction of the "hands of a watch and in like areas in the southern hemis-"phere against the hands of a watch; leaving out of the ques-"tion the theoretical (Mr. Carrick's) considerations, on which "are based these results, the degree of truth contained in the law, "regarded merely as empirical, *is worthy of very severe scrutiny.*"

Much less appears actually to be known yet of tidal movements than is generally supposed; "the general progress of the "tide wave along even the most frequented shores is still im-"perfectly known; and about the connection of the tides over "the general areas of large oceans we are as yet entirely in the "dark; there is therefore an ample field of important and use-

"ful discovery in this subject," (page 78) and "in the central "parts of the Pacific the tides are small and anomalous, for "they do not clearly depend on the moon," etc., etc. It is possible, that the last mentioned phenomenon may be due to the very probable fact, that the earth's solid crust covered by the Pacific may be thinner, than at other portions of our planet and therefore the outer crust, ocean and interior fiery fluid matter *together yielding more equally* "to the deforming influences of "centrifugal force and the attraction of sun and moon," (Mr. Kingmill's Borderland of Geology and History, page 5), which would certainly have the influence of letting the oceanic tides appear "small and anomalous."

The same remark applies to Batavia; "by accurate observ- "ations made in 1839 at Onrust, it seems that the tides and "rise and fall are not subject to fixed rules. The mean rise "and fall was two feet, and the maximum and minimum four "feet." (Findlay's Sailing Directory for the Indian Archipelago, China and Japan, London, 1870, page 613.)

I must acknowledge with thanks that I have been under obligation, when writing this second appendix, to the kind assistance of Mr. John Christie, chief engineer of the China Navigation Company's steamer *Chefoo*.

After the above lines had been sent to press, I have been favoured by the urbanity of the talented and zealous director of the magnetic and meteorological observatory at Zi-ka-wei, the Rev. Father Marc Deehevrens, S.J., with his reports for 1876-77 and a general resumé for 1878, from which the following facts are extracted:—

	1876	1877	1878
Declination	2° 1′ 24″ W.	2° 1′ 21″ W.	2° 0′ 04″ W.
Inclination	46° 13′ 43″ N.	46° 13′ 38″ N.	40° 13.4′ N.
Horizontal Component ...	6.95131	6.9637	6.9770
Vertical Component ...	7.25602	7.2684	7.2815
Total Intensity	10.04924	10.0656	10.0846

The learned and Reverend Father states in regard of the mean values for the inclination and intensity in 1878 that during the months of May and June the observations had to be interrupted: "les travaux d'agrandissement de notre salle

"magnetique m'ont forcé à interrompre les observations direc-
"tes d'inclinaison et d'intensité."

In his "Bulletin des Observation de 1876" Father Deehevrens describes an ingenious apparatus in use at Zikawei; "cet appareil à lui seul pourra, avec un chronomètre, consti-
"teur tout le bagage scientifique et géographique à travers la
"province, servant tout à la fois de théodolithe et de boussole
"pour l'inclinaison, la declinaison et l'intensité magnètiques." If all Meteorological Observatories were supplied with this useful instrument, the mysterious periodical changes of terrestrial magnetism in the Far East would be much sooner revealed indubitably, than can be done by the solitary efforts of a single institution, although the observations be carried on in such a careful, intelligent and skilful manner, as at the excellent Zikawei Observatory; only by many valuable observations in numerous localities and extended over *long periods of time*, this interesting and important problem can be solved; a truth, beautifully illustrated by the Hexameter, which King Ludwig of Bavaria, caused to be engraved near a picturesque waterfall in the Alps:

"Gutta cavat lapidem, non vi, *sed saepe cadendo.*"

I believe I cannot close these pages in a more appropriate manner, than by the remark from the illustrious Humboldt's Cosmos (Bohn's edition, Vol. II, page 720), that "several times
"every century an expedition of ships" (in conjunction with the fixed observatories ashore and land expeditions) "should be
"sent out to examine as nearly as possible *at the same time* the
"state of the magnetism of the earth, so far as it can be in-
"vestigated in those parts covered by its ocean. May perma-
"nent scientific institutions (Academies) impose upon them-
"selves the practice of reminding every twenty-five or thirty
"years' governments, favourable to the *advance of navigation*,
"of the importance of an undertaking, whose great cosmical
"consequence depends on its long continued repetition."

ERRATA.

Page 38—Middle of page read 1663 instead of 1163.
„ 38—21st line from bottom read "minimum" for "maximum."
„ 40—Middle of page read (Celsius) instead of (celsius.)
„ 41—14th line from top read "slag" for "slake"
„ 46—Middle of page read "do not coincide" instead of "does not coincide".
„ 46—12th line from bottom read "diurnal" instead of "diurned".
„ 47—11th line from top read "observatories" instead of "observations".
„ 48—10th line from top read "1841, angle" instead of "1841. Angle".
„ 50—10th line from top read "armature" instead of "armisture".
„ 52— 7th line from top read "elliptic" instead of "ecliptic".
„ 52—17th line from bottom read "full or new moon" instead of "full moon".
„ 56— 6th line from top read "hemisphere" for "hemispheres."
„ 57—13th line from bottom read "Sabine" instead of "Sabini".
„ 63— 2nd line from top read "Gales" for "Galese."
„ 64—16th line from top after "directions" add; *were.*
„ 65— 1st line from top read "current" for "currents."
„ 65— 4th line from top read "similar" for "singular."
„ 65—12th line from bottom read "Sn" for "SN."
„ 67— 7th line from top after "which" add: according to.
„ 68— 6th line from bottom read "Dr. Brünnow" for "Dr. Brünnout."
„ 68—12th line from bottom read "Stromboli, (volcanoe)" instead of "Stromboli (volcanse.)"
„ 69— 6th line from bottom read "relations" instead of "rotations".
„ 69— 9th line from bottom read "statical" instead of "statistical".
„ 69—17th line from bottom read "noyau" instead of "noyan".
„ 69—middle of page read "Biot, Hansteen and others have had."
„ 70— 9th line from bottom read "closer" instead of "closed".

„ 70—The sentence "On the 1st of September," etc. should have been printed as a note to the 6th Chapter of the first Appendix.

„ 72— 5th line from bottom add: "I copy as follows:"

„ 73—17th line from top read "exist" instead of "exists."

„ 85—15th line from bottom read "then" for "than."

„ 90— 6th line from top read "Dechevrens" for "Dechevreus."

„ 90— 7th line from top read "reconnu" for "reconnue."

„ 90—10th line from top read "viennent" instead of "vieunent."

„ 90—21st line from bottom read "presenté" for "presente."

„ 90—18th line from bottom read "presente" for "presenté."

„ 98— 6th line from top read "constituer" and "géographique" instead of "constiteur" and "gêographique."

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ARTICLE III.

THE FAMILY LAW OF THE CHINESE, AND ITS COMPARATIVE RELATIONS WITH THAT OF OTHER NATIONS.

By P. G. von Möllendorff, Esq.

THE following essay on the Family Law of the Chinese is the first endeavour to treat scientifically a part of Chinese law. The reason which led me to choose the family law was that in making extracts from Chinese works I found this portion of the law first completed. It may, therefore, serve as an introduction for a work to be compiled, viz., the Laws and the Legal Procedure of the Chinese.

The interesting work (in German) of Dr. Samuel Mayer on the laws of the Israelites, Athenians and Romans has furnished me with many comparisons, ideas and quotations, as have also other works on Roman law. I have in addition, found of considerable use the essays anonymously published in the *China Review*, Hongkong, vol. V. (1877) p. 404-7; vol. VI, p. 64-66.

Some sentences have been taken from Maine's Ancient Law, 6th edition, 1876, and from John Fergusson McLennan's studies in Ancient History, comprising a Reprint of Primitive Marriage, an Inquiry into the origin of the form of Capture in Marriage Ceremonies. London, 1876, especially chapter II., p. 13 ss.

I am especially indebted to my friend E. H. Parker, Esquire, of H.B.M.'s Consular Service, for some valuable notes relating to the subject.

Of the extensive Chinese literature on law, I have principally consulted the following works:—

大清律例 *Ta-ch'ing Lü-li*, the statute law and the ordinances of the present dynasty. 40 vols., 1866. The statute laws and some of the ordinances have been translated by Sir G. T. Staunton; see Manual of Chin. Bibliogr. No. 201.

說帖類編 *Shuo-t'ieh Lei-pien*, collection of decisions from the years 1821-34 (Taokwang). 32 vols. 1835. 8vo.

大清律例按語 *Ta-ch'ing Lü-li An-yü*, collection of decisions from the reigns of Yungcheng, Kienlung, Kiaking and Taokwang, 1724-1847. 80 vols., 1847. 8vo.

A manuscript collection in 14 large volumes; containing decisions from the reign of Yungcheng till Hsien-feng (1723-1851), compiled by law secretaries (師爺) of the Governors of Hunan.

Collections like this are extremely rare and valuable.

In the arrangement of the subject before me, I have taken as a basis the Roman law; as owing to its logical structure and general completeness this law has become a typical system, and has formed the foundation of the jurisprudence of all European nations.

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INTRODUCTION.

The Chinese expression for "family" (家 *chia*) embraces, like the Attic *οἶκος*, all members of the same household, which stand under one head or *pater familias* (家父 *chia fu*), without distinction, whether they have entered the family through marriage or adoption. It is obligatory that all members of the family bear the same family name (姓 *hsing*).[1] Even with adoption a kind of quasi relationship is formed with the acquisition of the clan-name.

At the oldest time of Chinese history the number of families may have been the same as the number of clans;[2] the idea that there exists a kind of relationship between families bearing the same name, has lived to the present time (see below—Impediments to Marriage).

1 As in India, Greece and Rome, McLennan, l.c., p. 217.

2 S. Wells Williams in his Syllabic Dictionary, p. 1242, dates back the beginning of family names to over 3000 years, without, however, quoting any authority.

A family is founded with the consummation of marriage and the expression 成家 *ch'eng chia* means to marry as well as to found a family.

Within the family the Chinese distinguish four grades of relationship, which follow according to the proximity of descent, without distinguishing thereby between consanguinity and affinity. A genealogical table is given in the 大清律例 vol. I., fol. 1-6.

The slaves are also counted as belonging to the family, and their name 家身子 *chia shen-tzŭ* has almost the same meaning as the Greek οἰκέτης (compare also the Latin *familiaris* and the French *maison* with the same sense).

As a relationship is always indicated by having the same family name, it may here be stated that the Manchus, whose emperors have reigned over China since 1644, have not used their family names (姓 *hsing*, Manchu *hala*) since the reign of the emperor Kanghi (1662-1723), but only their personal names (名 *ming*, Manchu *gebu*). The family names are, however, known within the clans, and the law concerning family names is the same for the Manchus as for the Chinese.[3]

A.—ON MARRIAGE.

I.—General.

Marriage is regarded by the Chinese as something necessary and indispensible: and the best proof of this is furnished by the fact that, excluding those of the priests who are not allowed to marry, it is scarcely possible to find a bachelor; and an old maid is an extraordinary rarity. Chinese law further recognises the importance of marriage by giving a long list of marriage laws. We must add, however, that marriage is not absolutely compulsory, nor is celibacy punished, as was the case under Jewish law and the Attic Code of Solon.[4]

The Chinese distinguish between two kinds of marriage which, not uncorrectly, may be termed *connubium* and *concubinatus*. In the first case they are obliged to be content with one wife (妻 *ch'i*),[5] who is chosen by the head of the family from a

3 See Williams l.c. p. 1243.

4 See Mayer l.c. vol. II., p. 286: Among the Israelites each man was obliged to marry and could be forced by the authorities to fulfil this duty until he had a son and a daughter, compare Pollux III., 48. VIII., 40.

5 Like the Roman law, § 7. J. de nuptiis 1, 10.—L. 2, C. 5, 5.

family of the same position and circumstances. Concubinage is, however, at the same time permitted, and marriage with several concubines (妾 *ch'ieh*) is allowed. The number of these, besides the one wife, is not limited by law, but only one wife is permitted.

Whilst the marriage with the wife (妻 *ch'i*) is concluded by the parents of the two parties, the man is allowed to choose himself the concubines, who may be of low rank, even slaves. The concubines, without regard to priority of marriage, have amongst themselves equal rank, but are subjected to the wife.

The husband has not the right of degrading, without sufficient reason,[6] his wife to the rank of a concubine; nor of raising a concubine to the rank of a wife while the wife is alive.

The wife is considered the mother of all the children born in the family[7]: and the reason for the greater number of marriages with concubines is barrenness of the wife.[8]

II.—Requirements for Concluding Marriages.

a.—Absolute Impediments to Marriages.

The attainment of puberty required by the Roman[9] and the Canon[10] law, or of a certain age, as prescribed by modern legislation, as a pre-requisite for concluding marriage is not known to Chinese law. It is, however, an established custom, that men marry when over twenty years of age, and that girls are rarely given in marriage before their fifteenth year. But as there are many exceptions in the laws for the benefit of persons under fifteen years of age, we may consider the latter as the age required for concluding a marriage. Non-attainment of puberty, disease, or other defects (as insanity, deafness and dumbness, etc.) are considered impediments, if when entering into the marriage contract, no notice had been given of them.

The right of having eunuchs is granted, besides to the emperor, only to the highest members of the imperial family; and

6 See Impediments of marriage.

7 The same in Jewish law, see Mayer l.c. II. p. 339 and in Mohammedan law, see G. Rosen in Zeitschr. d. Deutschen Morgenl. Ges. XXII. (1868) p. 543.

8 Compare the Jewish custom, Mayer l.c. p. 339: as it was considered a disgrace, if a wife had no children, the wife in such case induced her husband to take a maid-servant as concubine, the children born by such concubines were hers, so that she was not childless.

9 Pr. J. de nuptiis 1, 10,—l. 14 D. 23, 1, l.—4 D. 23, 2.

10 Tit. X., 4, 2. Lib. sext. Decretal, 4, 2.

as eunuchs only serve in the palace, it is, for this reason, impossible for them to conclude a marriage.

There exist, however, eunuchs at Peking, who have had children before their castration, and who are allowed to visit their families from time to time. Cases may occur in which an eunuch who, by intrigues in the palace, has arrived at a position of honour may take a wife *pro forma*.[11]

It is forbidden to take a second wife (妻 *ch'i*), as long as the first one is living.

b.—Relative Impediments.

1.—On account of Relationship.

Marriage between relatives of all grades of relationship, is prohibited, no matter whether the relationship be one of consanguinity or of adoption. For the latter, however, in contradistinction to the requirements of the Roman law, the prohibition does not hold good after the first adoption has been dissolved by a new adoption.

It may here be observed that there exists no relationship between the husband and his wife's sister, as is the case according to the canonical and, after it, the English law. Altogether there exists no relationship between the relations of the husband and those of the wife.[12]

In the Institutes of Menu it is laid down that a twice-born man (*i.e.* one belonging to the sacerdotal, military, or commercial class, Menu X., 4) might elect for nuptials "a woman not descended from his paternal or maternal ancestors within the sixth degree and who is not known *by her family name* to be of the same primitive stock with his father." Menu III. sec. 5, in McLennan p. 84. They (the American Indians) profess to consider it highly criminal for a man to marry a woman whose totem (family name) is the same as his own, and they relate instances when young men, for a violation of this rule, have been put to death by their own relatives, *eod.* p. 97.

Relationship is always implied by the fact of having the same family name, 同姓不爲婚姻 *T'ung hsing pu wei hun yin* people of the same family name do not intermarry. Considering that for a population of 400 millions only about 350 family names exist, this impediment appears severe in the highest

11 See G. C. Stent, Chinese eunuchs, Journal of N.-C. B. of the R. A. S., Shanghai, 1877, New Series, No. XI., p. 143 ss.

12 As in the Jewish law, see Mayer l.c. II. p. 284.

degree. In the course of ages[13] it happened, that whole communities in China were composed of people who had the same family name; so that men desirous of marrying had to look elsewhere for wives, and had to undertake for this purpose voyages often expensive. An expedient to mitigate this law had, therefore, to be found. During the reign of Yung-lo (1403-25) those families, who took part in the grain transport to Peking, received the name of military families (軍家 *Chün-chia*), the others being called 民家 *Min-chia* families of the people. Since that time the distinction between 軍 *Chün* and 民 *Min* has been maintained and marriages between a 軍 *Chün* and a 民 *Min* family bearing the same family name is permitted as the only exception from the above mentioned prohibition.

2.—On Account of Affinity.

Marriage is not allowed with one's step-daughter, with the father's or the mother's sister-in-law, with the cousin, with the sisters of the son-in-law, or of the daughter-in-law, with the sisters of the grandson's wife, or with nieces.

Further, marriage is forbidden with female relatives outside the fourth degree of relationship,[14] with widows of a relative of the fourth degree or with the sister of the widowed daughter-in-law. Marriages with widows of relatives of a nearer degree are considered incestuous.

Decapitation is the punishment for marriage with the father's or grandfather's former wives, or with sisters of the father. Whoever marries his brother's widow is strangled.[15]

3.—On Account of other Reasons.

To conclude marriage is prohibited during the legal time of mourning. This is

1—For near relatives of the		1st	degree:	3 years.
,, other	,,	1st	,,	3-5 months.
2— ,, relatives	,,	2nd	,,	9 ,,
3— ,, ,,	,,	3rd	,,	5 ,,
4— ,, ,,	,,	4th	,,	3 ,,

Marriage with concubines, is, however, in this case not punished, unless either the bride or the bridegroom is in mourn-

13 The prohibition occurs in books as early as the 左傳 *Tso-chuen* and 論語 *Len-yü*.

14 As in canonical law, cap. 8. X., 4., 14, Walter, Kirchenrecht § 310.

15 In contradistinction to the Jewish law.

ing for a parent, or the bride for her late husband.[16] It is considered a time of mourning for children or grand-children if father or mother, or grand-parent is confined in prison for a capital crime. In accordance with the principle of Chinese marriage, that the *pater familias* makes the marriage contract, marriage is in this case permitted, if the head of the family in prison gives his assent. The usual ceremonies and festivities are in such cases to be omitted.

Marriage is forbidden with a woman who has committed a crime and has fled for fear of punishment. In this prohibition is included marriage between an adulteress and her seducer.[17]

Whoever forces the wife or daughter of a free man to marriage, either with himself or with a son, grandson, younger brother or nephew, i.e. with a *filius familias*, is to be strangled.

According to Roman law marriage could not be concluded between persons, who stood to each other in the relation of guardianship, as *tutor* and *pupilla*.[18] In China *tutor* and *pupilla* are near relatives, as only relatives or adoptive parents are able to exercise the right of guardianship and to acquire through it the *patria potestas*. A runaway female slave is not allowed to marry, as she can be lawfully given into marriage by no one except her master.

A widow cannot remarry without consent, as she always remains under *patria potestas* and as somebody is required to whom the purchase money may be paid.

A widow, who has received an imperial reward for her faithfulness to her late husband, is not allowed to marry again.

Officials cannot hold office in their native province, perhaps for the reason that by this measure greater impartiality is secured. For the same reason it is not allowed to them to marry a woman under their jurisdiction, or out of a family that has an interest in the performance of their official duty.[19]

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16 The same in Roman law l. 1, 11 § ult.—l. 12, l. 13, pr. D. 3, 2—const. 2 C. 5, 9. Widows and their new husbands were punished, if remarried before the end of the time of mourning.

17 Also prohibited by Roman law, l. 26. D. de ritu nupt. (23, 2).—l. 13, D. de his quae (34, 9). . Nov. 134 si quis autem c. 12,—by Attic law L. 11 § 11. L. 40 D. ad leg. Jul. de adult. (48, 5), and by Jewish law, see Mayer l.c. II p. 320.

18 L. 59, l. 62 § 2, l. 66 D. de ritu nupt. (23, 2), C. 5, 6.

19 A similar thought prohibited in Rome marriage between a praeses provinciae and a woman of his province ; l. 57 pr., l. 63 D. de ritu nupt. (23, 2) ; Cod. Th. 3, 11, Cod. Just. 5, tit. 2, 7.

On account of inequality of rank marriage between officials and actresses and singing girls is prohibited. Such marriages are also forbidden to the sons or grandsons of officials of nobility with hereditary rank *(disparagium, mesalliance)*, the punishment in this case is degradation to a lower class of nobility and eventually loss of nobility.[20]

Buddhist priests (和尙 *Ho-shang*) and nuns (尼姑 *Ni-ku*), and those Taoist priests (道人 *Tao-jen*) and nuns (道姑 *Tao-ku*) who do not shave their heads, are not allowed to marry. Only those Taoist priests (道士 *Tao-shih*, also called 門祝 *Men-chu*), who shave their heads and plait their hair like other Chinese, may conclude marriages.

A priest who obtains a woman under the pretence that she shall marry another, and who then marries her himself, is severely punished.

Marriage is impossible between slaves and free women.[21] *Note.*—It is not considered decent in China for a widow to marry again.[22] Should the head of the family try to force her into marriage, she is not obliged to obey his *patria potestas*, but may remain with the family of her late husband. Should however the marriage be concluded, she shall live with her new husband, the marriage presents, or rather the purchase money paid for her being forfeited to the Government.

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20 There are in China 5 classes of nobility (爵 *chüeh*) : 公 *kung*, duke, 侯 *hou*, prince, 伯 *po*, count, 子 *tzu*, baron, 男 *nan* baronet. When the nobility conferred is not "perpetually hereditary" each descendant takes one rank lower than his father ; so that the son of a *kung* becomes *hou*, the son of a *hou* becomes *po*, and so forth, nobility ceasing altogether with the son of a *tzu*. 侯 *hou* (I may be permitted to remark here) has generally been translated by marquis. But this title is of limited use and does not express the rank of a *hou* as well as prince ; as in former times the 諸侯 *chu-hou* were feudal princes and not feudal marquises.

21 See Mayer l. c. II p. 301. According to the laws of the Longobards parents had the right to kill or sell their daughters, if they married one in socage. Leg. Long. lib. II tit. 9, § 2 ; L. Rothari c. 222.

22 Puchta, Instit. des röm. Rechts. III p. 177 : it was decent according to the Roman national feeling, that a widow should remain single, univira meant the same as castissima. She was highly esteemed and received the wreath of chastity. Val. Max. II c. 1 Propert. IV eleg. 12. The Israelites however were much in favour of a second marriage of widows, see Mayer l. c. II p. 322.

c.—Effects of the Impediments to Marriage.

Any impediment to marriage renders the marriage, as, in the time of Justinian,[23] though already concluded, null and void; the *impedimenta* are always *dirimentia*. Ignorance of them exempts the parties from punishment, but the marriage is dissolved. According to the sense of the marriage contract the parties who signed it are punished, if the marriage laws are transgressed; but the husband and wife, are not punished unless they are *sui juris*. If the father, grandfather or uncle signed the contract, they alone are punished; if it was another relative, he is punished as principal, and the husband and wife as accomplices. The purchase money is in each case forfeited, except when the parties were ignorant of the existence of the impediment.

A dispensation in cases of impediments to marriage is not admissible.[24]

Difference of religion has in China no influence upon marriage.

III.—Betrothal.

a.—The Contract.

The conclusion of a *justum matrimonium* has to be preceded by a contract,[25] in which the amount of presents (*arrhae sponsalitiae*) and the latest day for concluding the marriage is fixed. This contract is made, and if in writing, is signed by those persons, in whose *patria potestas* the bride and bridegroom stand; the latter never sign it, unless both have no older relatives; this latter condition, and the fact of the son holding office, being the only cases, in which a *filius* or a *filia familias* becomes *sui juris*. This is the chief distinction between the Chinese and the Roman marriage.

In Chinese marriage there cannot exist the *animus matrimonii*, the intention of husband and wife to form a connection for life, which is the chief requirement in the Roman marriage. According to Roman law the assent of the *pater familias* was required, but could only be refused for special reasons; husband and wife, however, were allowed free choice.

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23 § 12 J. de nupt. (1, 10). Cod. 5, 8.

24 The Israelites also did not know of such dispensations, see Mayer l.c. II, p. 315.

25 Known by the Romans, Dig. 23, 1.—Cod. 5, 1; and by the German law, Eichhorn, Rechtsgeschichte § 54, § 183, § 321.

Among the Chinese the heads of the families choose alone, and the inclination of the principal parties is not asked.

Before the signature of the marriage contract by the heads of the two families, both parties convince themselves of the truth of the statements regarding the persons of the bride and bridegroom, that they are sound in body and mind, and that they are not too old. The festivities of the betrothal then commence. As lies in the nature of the case, the age of the betrothed parties is of no consequence.[26] If often happens, that a betrothal is made between friendly families at a time, when the bride and bridegroom are not over three or four years of age.

b.—Effects of Betrothal

The contact of betrothal gives both parties a right to sue for the conclusion of marriage.[27] The party who refuses to keep the contract is punished with fifty blows, and the court enforces the marriage. Inacase in which the contract was not made in writing, the acceptance of presents is taken as an agreement to the contract.

The betrothal may even be maintained, if the family of the bride enters a second betrothal[28]; and only in case that the family of the bridegroom waives its claim, may the bride marry the second bridegroom. The presents are, in the latter case, to be returned.

A forcible abduction of the bride before the time fixed for the marriage, is punishable; as is also a delay on the part of the family of the bride beyond the term fixed for concluding the marriage.[29]

A singular situation arises, if a *filius familias* enter a betrothal during his absence from his family, his grandfather, father, uncle or older cousin, *i.e.* a person in whose *patria*

26 Not so in Roman law, l. 14 D. de spons. (23, 1): in sponsalibus contrahendis aetas contrahentium definita non est, ut in matrimoniis—si non sint minores quam septem annos.

27 The same according to canonical law, but in contradistinction to Roman law l. 2 § 2 D. de div. et repud. (24, 2): in sponsalibus discutiendis placuit renuntiationem intervenire oportere—const. 2 C. de spons. (5, 1)—l. 134 D. de verb. oblig. (45, 1)—const. 2 C. de inutil. stipul. (8, 39); actio ex stipulatu.

28 The Roman law punished this with infamy, l. 1, l. 13, pr. § 1-4 D. de his qui not. inf. (3, 2); const. 18. C. ad leg. Jul. de adult. (9, 9).

29 According to Roman law an action could be entered for delay of marriage without reason over 2-3 years, const. 16 C. de episc. aud. (1, 4)—const. 2, 5, C. de sponsal. (5, 1), const. 2 C. de repud. (5, 17).

potestas he stands, having, in the meantime, chosen a bride for him, and having signed the contract. If the son have concluded marriage, the betrothal made by the head of the family is dissolved. Otherwise the contract made by his family takes precedence over the other made by him.

c.—Dissolution of Betrothal.

If after signing the contract it appears that false statements have been made by the family of the bride, then the contract is void, the presents are returned and the *pater familias* of the the bride receives eighty blows. The punishment for a like fraud on the part of the bridegroom's family is more severe, and the bride keeps the presents. Should the fraud be discovered after marriage has been concluded, an action for divorce can be entered.

If the betrothal be dissolved before the conclusion of marriage, either through the death of bride or bridegroom, or through withdrawal of both parties (*repudium voluntarium*), or through an impediment to marriage just arisen, or only just come into notice, then the presents have to be returned. If the marriage be not concluded through the *repudium* of one party, the party innocent of the dissolution of the betrothal gets back or eventually keeps the presents.

The fact of bride or bridegroom having been punished for thefts or fornication gives a right to cancel the contract.

IV.—Conclusion of marriage.

In China the church has nothing to do with the conclusion of marriage; neither are the usual ceremonies and festivities absolutely necessary for the conclusion of a *justum matrimonium*, as long as the *consensus matrimonialis* exists between those persons who sign the marriage contract.

At the time of the conclusion of the marriage the bridegroom gives to the father[30] of the bride the so-called marriage presents, which sometimes amount to thousands of taels. The conclusion of the marriage is therefore preceded by a purchase, which is no mere sham transaction like the Roman coëmtio, but corresponds to the purchase of the ancient German laws and to that of the Jewish law.[31] By accepting the purchase money, the father of the bride sells and manumits his daughter to the bridegroom.

30 The talmud says: the matrimonial purchase money belongs to the father. See Mayer l.c. II., p. 326.

31 See Mayer l.c. II., 353.

When the marriage is celebrated; the wife leaves her family for ever (出家 *ch'u chia*) and belongs from this time to the family of her husband,[32] i.e. she considers the parents of her husband as her own, and mourns for them legally a longer time than for her own parents.

Whilst the purchase of a wife is called marriage (娶妻 *ch'ü-ch'i*) the expression for the purchase of a concubine (立 or 買妾 *li* or *mai ch'ieh*) points to the inferiority of the action. The union is concluded without festivities:[33] The punishments for transgressions against the marriage laws in the case of concubines are less severe than in the case of a wife.

V.—Relation of Husband and Wife to Each Other.

Through the marriage the wife becomes, as was the case according to the law before Justinian[34] not only *uxor*, but also comes into the *manus mariti*. "She therefore ceases to be *sui juris*, if she was it, and leaves the *patria potestas*, if she stood under it. At the same time she enters the agnatic union of her husband like an adopted daughter; and especially comes into the position of an agnatic sister to his agnatic children."[35]

It is in consequence of the way in which the wife comes into the power of her husband that she acquires very few rights with the marriage. Though she shares the rank and the position of her husband (as the Roman wives shared the *dignitas mariti*), she has no right to ask conjugal fidelity from her husband;[36] whilst she, by sinning against it, commits a heinous crime.[37]

It is a cause for divorce, if the wife beats her husband, but the husband has the right to inflict corporal punishment on her. He is however punishable, if by doing this he inflicts a wound; but he comes off with a mulct, if he and his wife are willing to divorce.

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32 According to the Jewish law, the family of the mother is not called family. See Mayer l.c. II., p. 283.

33 The same with the Israelites: wives with nuptials and with marriage bond, concubines (pillegesh) without either; the same holds good for the Greek *pallax*; it is different, however, with the Roman *pellex*, l. 144 D. de verb. signif. (50, 16.)—Nov. 18 c. 5.

34 Mackeldey, Lehrbuch des röm. Rechts, 14th edition, vol. II., p. 266; comp. Gaj. Inst. § 49, § 108 ss., II § 86 ss.

35 Mackeldey, l.c. II., p. 274, note; Gaj. Inst. III. § 14, 24. Coll. XVI., § 6.

36 Unlike the Romans, Nov. 117 c. 9 § 5: liceat mulieri propter hanc etiam causam matrimonium dissolvere.

37 See Mackeldey l.c. II., p. 274.

The wife owes the husband implicit obedience, and is not allowed to leave the house without his permission. If she act against this, her husband may sell her to another as concubine. Even after the death of her husband she remains in his family.[38]

The wife cannot possess property of her own, "everything she possessed before entering into the *manus* passes into the hands of her husband,"[39] so that even property inherited by her remains with the husband after the marriage has been dissolved.[40]

The questions therefore of *dos*, *parapherna*, *pacta dotalitia* and *donatio inter virum et uxorem* exist in Chinese law just as little as in the ancient Roman law.

As the power of the husband is transferred after his death to his wife, the Roman *donatio propter nuptias*, and the Jewish Ketubah (marriage bond) are excluded from Chinese law.

With all his power the husband is not allowed to hire out his wife to prostitution,[41] although it sometimes happens that a man whose wife has not born a son and does not allow him to purchase a concubine, hires for a time the wife of another to get a son by her.

VI.—Dissolution of Marriage.

Besides death and *maxima capitis diminutio* of husband or wife, divorce may be the cause of dissolution of marriage.

a.—A divorce *must* take place, if there exists an impediment to marriage or if the wife commits adultery. The husband has in this case the right to kill both adulterers, if he surprises them *in flagranti*.[42] If he does not kill the wife, she is punished according to law and then sold as a concubine, the purchase money for her being taken by the government. If the adulterer kills the husband, the wife is strangled.[43]

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38 Similar the Roman law, l. 22 § 1 D. ad municip. et de incol. (50, 1): vidua mulier amissi mariti domicilium retinet.

39 See Mackeldey l.c. II., p. 275; Gaj. Inst. II. § 86 ss. III. § 82 ss. Ulp. XIX, § 18.

40 Gaj. Inst. II. § 98: si quam in manum ut uxorem reciperimus, ejus res ad nos transeunt.

41 In Rome lenocinium facere was punished with infamy, l. 1, l. 4 § 2, 3 D. de his qui not. inf. (3, 2)—l. 43 §6-9 D. de ritu nupt. (23, 2).

42 Compare Leviticus 20, 10.

43 L. 43 § 12, 13 D. de ritu nupt. (23, 2).

b.—A divorce *may* take place

1.—If both husband and wife are willing to dissolve the marriage;

2.—If the wife leaves the house against the will of the husband. Should she marry whilst absent, she is to be strangled;

3.—If the wife beats her husband;

4.—If the marriage contract contained false statements;

5.—If the wife has one of the following seven faults: barrenness, sensuality, want of filial piety towards the husband's parents, loquacity, thievishness, jealousy and distrust, incurable disease.

The husband is, however, obliged to keep her in spite of one or several of the above faults; if she has kept the full term of mourning for three years after the death of his parents, or if his family, having been poor at the time of the conclusion of marriage, has since become wealthy, and, lastly, if the wife has no other relatives to whom she may return after divorce.

The effects of the dissolution of the marriage are the following: the marriage is considered as having never been concluded; the wife returns to her family, the children remain with the father and the purchase money is given back to the husband, except in the case that the latter was the cause of the divorce.

Nothing is to be found in the Chinese laws regarding any offence on the part of the husband which gives to the wife the right to enter an action for divorce.

VII.—Polygamy.

As mentioned above the wife who maliciously leaves her husband and marries another in the lifetime of her husband, is strangled.

If in the lifetime of his first wife (妻 *ch'i*) the husband marries another (妻 *ch'i*, not a concubine 妾 *ch'ieh*, as he is allowed to have as many concubines as he likes), the marriage is void; the wife returns to her family and her father keeps the purchase money, unless he knew of the existence of the first wife. In this case the money has to be paid to the government.

VIII.—Second Nuptials and Violation of the Time of Mourning.

Remarriage of the husband is permitted even without delay after the death of the first wife. The widow, however,

against whose remarrying custom generally is opposed, has to mourn three years for her husband.

If the husband has abandoned his wife, she has at the end of three years to give notice to the competent magistrate, who may then give her the permission to marry again.

B.—ON PATRIA POTESTAS.

I.—General Remarks.

As was the rule according to the Roman law of the time before Justinian, all persons, who depend on a *pater familias*, either grandfather, father, uncle, mother or husband, stand in China under *patria potestas*; such persons are therefore either the wives of the *pater familias* or his sons and daughters or more distant descendants on the male line. The *patria potestas* is the same as the *domini potestas*, the power of the master over his slaves, according to the ancient Roman law.

If a man has got a girl with child, he must marry her; in the case of his already having a wife, he must take her as a concubine. But in any case, even if he is prevented by death from marrying her, the child is considered his legitimate offspring.

Illegitimate children, who are not made legitimate *per subsequens matrimonium* (私子 *ssŭ-tzŭ*) and children of prostitutes (雜種子 tsa-chung-tzŭ, *vulgo quaesiti*) stand under the power of the mother, whose family name they bear.

II.—On the rights of both parents with regard to their children.

The *patria potestas* over children, whether legitimate or adopted, is unlimited. The father, or after death the mother,[44] can do with them as he likes; he may not only chastise, but even sell, expose or kill them.[45] The latter occurs often enough, especially with girls, if the family is too poor to bring them up. Infanticide is not prohibited, but whenever it spreads too far, the officials issue proclamations against it. Moreover it is generally considered as blamable and the voice of the people

44 Therefore not like Gaj. Inst. I. § 104.—§ 10 J. de adopt. (1, 11): feminæ—nec naturales liberos in sua potestate habent; but the same as the law of the Visigoths, Mayer l c. II. p. 416.

45 The same power was given the father by the Romans (§ 2 J. 1, 9; Gaj. Ins. I. § 55,) by the Gauls (Cæsar de Bell. Gall. VI., 19) and by the Visigoths (Mayer l.c. II. p. 416, Lex Wisig. IV., 2 § 13).

is raised against persons, who carry the abuse of the father's power thus far.

The power of the father over his son does not cease as long as the father lives, unless the son enters the government service.[46] The father, wanting to exercise his rights over him, has to obtain first the assent of the Emperor.[47] Over the daughter the power of the father exists until she comes into the *manus* of a husband.[48] If the marriage is divorced, the daughter returns into the power of her father; as widow, however, she remains in the family of her husband.

III.—On the Rights of the Husband with regard to his Wife.

The wife follows her husband, wherever he likes to go and may not leave the house without his permission. The husband has the right to chastise his wife, but not to wound her (see above, the causes for a divorce).[49] He has not the right to kill her, except in the already mentioned case, that he surprises her *in flagranti delicto*.

IV.—On the duties of the Children towards their Parents.

As long as the parents live it is the duty of the children to show them reverence and obedience (孝順 *hsiao-shun*) and if necessary to nurse and support them.[50] The son shall, if father, mother or grand parents, are over eighty years old or feeble and ill, remain at home, unless another son over sixteen years old lives with them. This command is specially in force for officials. As long as parents, grandparents, or husband are in prison on account of a capital crime, the children, grandchildren and wife are not allowed to participate in festivities and amusements of any kind. Disobedience towards parents and grand-

46 *In publicis locis atque muneribus atque actionibus patrum jura cum filiorum qui in magistratu sunt potestatibus collata interquiescere paululum et connivere, etc.*, Aulus Gellius, Noctes II, 2, see Gibbon, Rome, chapt. XLIV. (ed. 1815 vol. VIII p. 54.)

47 The same according to the ancient German law, Mayer l.c. II. p. 443.

48 The same we find in the Israelitic law, Mayer l.c. II. p. 440.

49 According to the Mosaic law the husband was not allowed to cruelly illuse his wife, Mayer l.c. II. p. 382.

50 According to the Talmud (Kidushin 31a., Joreh deah 240 § 1 and 4) the children are obliged to honor, next to God, their father and mother the most, and to nurse and support them.

parents and deficient support of them is on the motion of the concerned severely punished.[51] Descendants are not allowed to enter an action against ascendants; they are not obliged to denounce crimes committed by them or to appear as witness against them. This exemption extends to all members of the same household, even to servants and slaves.

After the death of the parents it is the chief duty of the children to strictly keep the term fixed for mourning and to rigorously perform the sacrificial ceremonies on their graves. The coffin has to be buried, if at all feasible, in the native soil.[52]

V.—Acquisition of Patria Potestas.

Patria Potestas may be acquired (*a*) through marriage, (*b*) through procreation, (*c*) through adoption, or (*d*) through purchase. If the person who acquires *patria potestas* in one of these four ways, stand himself under *patria potestas*, then he acquires it for his *pater familias*.

a.—By Marriage.—The wife belongs after marriage to the family of her husband, and stands in his, or in the *manus* of that person, under whose *patria potestas* the husband stands.

b.—By Procreation.—Children come under the *patria potestas* of their father, whether born by a wife or by a concubine.

c.—By Adoption.—To explain this institution, most important in Chinese law, we take the Roman law as a type.

A man may adopt a person as son or daughter; or if he formerly had sons, as grandchild, but not as brother, wife or concubine.[53] Ninety-nine per cent of all adoptions in China take place in childless families, and among these seventy per cent are adoptions of sons. Fifty per cent of all families in China possess adopted children (E. H. Parker).[54] The

51 According to Deuteronomy 21, 15; Leviticus 20, 9 and V. Moses 27, 16 even disesteem of the parents is to be punished by death.

52 How difficult this duty may sometimes be, was shown by the case of the late Taotai Fung, who went as far as Kansu in the North-west of China to fetch the coffin of his father and to bring it overland to Canton, his native province. The difficulties of this voyage, on which many ceremonies had to be performed, exhausted the son to such an extent that he succumbed when only half the voyage was completed. His brother took his place and continued, after the short delay prescribed by law, the voyage to Canton with the two coffins.

53 L. 37 pr. D. de adopt. (1, 7).

54 Compare the law of Menu IX., 127, 159; the Hindu considers it his religious duty, to have a son, by whose means he may pay off his debt to his forefathers. If he remains childless, he must adopt one.

same that is said with regard to the adoption of the ancient Greeks, holds good for the Chinese: "the dying out of a family was to be prevented, as by the desolation of the house the dead lost their religious honour, the gods of the family their sacrifices, the hearth its flame and the forefathers their name among the living."

Adoption, like marriage and the acquisition of slaves, rests in China upon purchase, about which a contract is made, in which only the words wife, son, daughter or slave are differently inserted. The most frequent case is the adoption of nephews by the childless uncle. But besides this direct adoption there is another way to procure descendants to such uncle. The nephew marries a concubine, and the children born by her are regarded as grandchildren of the uncle; whilst the children of the nephew's wife are the grandchildren of the nephew's father. The Chinese call this method 雙祧 *shuang-t'iao*.

It being prohibited in China for officials to hold office in their native province, adoption becomes the means of avoiding this restriction. The official in question is adopted into a family of another province, acquires a right of domicile in the province of his adopted parents, and may now hold an office in his original native province. In the same way confiscation of property is prevented by adoption, if such confiscation of property is imminent on account of the crimes of near relatives.

1—*General Requirements of Adoption.*

As the main idea of Chinese adoption may be stated, that only children may be adopted out of families, who bear the same family name; as otherwise, as the Chinese express it, the difference between families would soon cease to exist.

No special requirements are prescribed for the adopter, and the law fixes no age under which one may not adopt,[55] although it is usual, that the adopter is older than the person to be adopted. Foundlings under three years old may be adopted without further ceremony.

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55 As is the case in Roman law, § 4 J. de adopt. (1,11): minorem natu non posse majorem adoptare placet; adoptionem enim naturam imitatur et pro monstro est, ut maior sit filius quam pater. Debet itaque is qui sibi per adoptionem vel arrogationem filium facit, plena pubertate, id est XVIII annis praecedere. L. 40 § 1 D. de adopt. (1, 7).

It is permitted to emancipate the adopted, and to adopt him a second time.[56]

The wife, acquiring after the death of her husband his *patria potestas*, has therefore the right of adopting;[57] she has, however, to ask the consent of the nearest male relatives of her late husband, for adoption as well as for *datio in adoptionem*. She has further the right of preventing the legitimate or adopted sons of her husband, from giving themselves into arrogation against her wish.

It is not allowed to adopt one's younger brother or one's uncle, even if the latter is younger than the nephew; for the same reason the uncle may not adopt a nephew, who is older or of the same age as he is.

2.—*Special Requirements.* *aa.—Of Arrogation.*

Whoever wants to give himself into arrogation, must ask for the consent of the nearest male relatives of his former *pater familias*. If he has elder brothers alive, their consent must be asked. In the lifetime of his father the son may give himself, even without the consent of his father or his relatives, into arrogation, if the father is insane and poor, so that the son by the arrogation acquires the means to support him. If the father is far away, the son is allowed to be arrogated, but the father may, on his return, claim back his son.

bb.—Of the datio in Adoptionem.

According to its nature the *datio in adoptionem* is properly speaking a sale (*venditio*), to which only the consent of the *pater familias* is required; the person to be adopted is not asked except he be a son holding office. In practice however it never happens, that an adult married son is sold into adoption against his own free will. The wife of the adopted follows her

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56 Not so in Roman law, l. 37 §1 D. de adopt. (1, 7): eum quem quis adoptavit emancipatum vel in adoptionem datum iterum non potest adoptare.

57 The Roman wife had not this right, §10, J. de adopt. (1, 11): feminæ quoque adoptare non possunt. Const. 5, C. de adopt. (8, 48); mulierem quidem quæ nec suos filios habet in potestate, arrogare non posse certum est. In Egypt this right was conceded to the wife, see Mayer l. c. II p. 427.

husband, but the children remain in the family of the *pater familias.*[58]

A man having sons of his own may not adopt a stranger as their elder brother, but he may adopt grandchildren as sons of his legitimate or adopted sons. After his death the latter have the right to dissolve such adoptions.

Brothers may, after the death of their parents, give their elder or younger sisters into adoption, but not without their consent.

Even after death a *filius posthumus* may be adopted for a person by his relatives or friends, in case that this person died without leaving male descendants. By special grace the Emperor may do this for princes or high dignitaries, but in all cases with the consent of the male relatives of the deceased.[59]

3.—*Effects of Arrogation and of Adoption.*

The effects are in either case the same.[60] The adopted becomes agnate of all agnates of the arrogator or of the adopter. The adopted son has altogether a better position than the natural one, as he cannot be sold without the consent of his natural parents, unless a second adoption be of real benefit to the child. He has all the rights of a son or a daughter. In the case of inheritance, natural as well as adopted sons take precedence before all daughters.[61] Should the adopter get sons born after the adoption so that the original cause for the adoption no longer exists, he may retrograde the adoption, if the parents are willing to take back the child. The child must be kept, however, if no member of his family lives, to whom he can return; only officials may thus be left without family.

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58 According to Roman law the children of an arrogated person followed their father, the children of an adopted person remained with their grandfather, l. 2 §2 D. de adopt. (1, 7): is qui liberos in potestate habet, si se arrogandum dederit, non solum ipse potestati arrogatoris subjicitur, sed et liberi ejus in ejusdem fiunt potestate tamquam nepotes. l. 40 pr. D. de adopt. (1, 7): quod non similariter in adoptione contingit, nam nepotes ex eo in avi naturalis retinentur potestate.—l. 26, 27 D. ibid: ex adoptivo natus adoptivi locum obtinet in jure civili.

59 This adoption after death was also known to the Greeks, Demosth. c. Makartat 1053, 12; Isæus e.d. Hagnias 298, Is. e. d. Apollod. 179 (Mayer l. c. II, p. 429).

60 Not so in Roman Law, l. 1 l. 23 D. de adopt. (1, 7).—§2 J. de adopt. (1, 11).—const. 10 pr. §5 C. de adopt. (8, 48).—pr. J. de adopt. (1, 11).—§13 J. de hered. (3, 1).

The adopted child being regarded as the real child of his adopted parents, these must give their consent, if the child wants to commence a three years' mourning after the death of his natural parents. An official is not allowed to mourn twice three years, but only for his adopted father, as mourning means in this case withdrawing for the time from the official life.

VI.—Termination of Patria Potestas.

With the death of the father, his power passes over to the mother, and after her death to the eldest son, who then has also power over his younger brothers and his elder and younger sisters.

a.—Without the will of the Father.

The father's power does not cease to exist in the lifetime of the father unless the son holds office. Except with the special permission of the emperor the father in this case cannot exercise his power over his son. As mentioned above, the son becomes *quasi sui juris*, if the father is insane and at the same time poor.

b.—With the will of the Father.

(Excepting the case of the father giving himself into arrogation, so that his children come under the power of his arrogator) the father's power may cease with the will of the father:—

1.—By sale into adoption, by which the son acquires agnate rights in the family of his adopted father;

2.—By sale of a daughter into marriage, she becoming an agnate in her husband's family and coming into his *manus;*

3.—By the permission to enter a religious order. The children then lose their family name and leave the family connection altogether (出家 *ch'u chia*);

4.—By exposing the children in the tender age. The finder may lawfully adopt them, if they are under three years of age.[62] If they are older than three years, it is prohibited to expose them; and only the ways mentioned under No. 1 and No. 3 are left to the father to rid himself of his child.

In contradiction to the Roman law[63] the father may dissolve his power even against the wish of his children.

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61 See Alabaster, the law of inheritance, China Review vol. V p 191-195.

62 Const. 2, 4 C. de infant expos. (8, 52). Nov. 153 c. 1 (non gloss.)

63 Nov. 89 c. 11 pr.: solvere jus patriae potestatis invitis filiis non permissum est patribus.

An emancipation in the Roman sense, by which the emancipated person becomes *sui juris*, does not exist in China. After the death of the father, the daughter becomes *sui juris*, if she is widow and has children, the son only in case he has a family.

C.—ON GUARDIANSHIP.

If at the time of the parents' death the children are still very young (under 7 years), and no head of the family exists who has *eo ipso* a right to the *patria potestas*, the fathers' power devolves upon one of the male relatives of the same name (同姓親戚 *t'ung hsing ch'in ch'i*), if no *testamentaria tutela* has been ordered. If no such relative exist, then one among the male relatives of a different family name (外姓親戚 *wai hsing ch'in ch'i*) is chosen. To be without any such relationship, is in China an impossibility. If after the father's death the mother is unwilling to take the responsibility of the *patria potestas* upon her, such guardian has to be appointed.

The guardian has the full *patria potestas* and keeps it, like the father, as long as he lives (with the above mentioned exceptions). The property of the child, of which the guardian has the full usufruct, continues to be the child's.

ARTICLE IV.

THE STORY OF THE EMPEROR SHUN.

By Thos. W. Kingsmill.

FOLLOWING the example of the Canon of Yaou that of Shun begins in a very similar manner—"According to tradition the ancient emperor (帝 Tî) Shun was called Ch'ûng-hwa." This name is equally inexplicable with the title similarly bestowed upon Yaou, if we simply look at the Chinese characters made use of. Taking them, however, as simple phonetics, and following the usual rules of phonetic change,[1] we find that it is in correspondence with Sanscrit Sûrya—the Sun in its glory.

Shun's own name tells us a similar story. He was introduced to Yaou (Varu*n*a) as an unmarried man of the lower people called in, modern Chinese, Yu-shun; but the phonetic element in the former character 舜 points to *Wu* or *Vu* as the original pronunciation; and for the latter we find the sound *shun*, in 惇, *pure*, to *wash*, for instance, Sanscrit *snâ*; and 順, to *accord*, *complaisant*, Sanscrit *snu* to *flow*, etc., representing the inverted combination *sn*. Wûsnu or Vu-shnu we may, therefore, conclude was the most ancient pronunciation of the name, in other words Vish*n*u—the Lord of the Sun,—the wide-stepping, whose three paces comprehended in their fulness the earth, the atmosphere and the sky, in the successive forms of Agni, Vâyu and Sûrya.

How this corresponds with the mythical elements of the story I shall show further on.

The Chinese legends give us small information as to Wu-shun's antecedents. He was the son of Kûsow, literally, the blind old man, but whether to look upon this word as an

1 Cfr. sur, to shine, in Chinese 昌 *c'hang*, to illuminate, refulgent; 爽 *shwang*, light, sunny, pleasing. Hwa is simply phonetic representing *ya*.

appellative or a simple phonetic, neither the text or analogy seems to point out.[2] According to Mencius,—a good authority on the ancient myths of China, Wu-shun was born at Chû-fang (? Turvar), removed to Fu-hia (Harivartha), and died at Ming-t'iaou, (Mandara of the Indian legends) the site also of T'ang ch'eng's battle in the Shang story. He was said to have been a man of the eastern tribes (I), as was Man-wang of the western.

The name Wu-shun has, of course, by the Chinese, been divided, and he is generally known as Shun of Yu or Wu; but apart from the violence done to the legend, which calls him distinctly one of the common people, there is no need to have recourse to this interpretation. The older commentators, including the preface to the Shoo-king, apparently speak of him simply as Wu-shun. Occasionally, as in the Shû-king, V., xx. 3, he is called simply Wu, so that it was a matter of accident which portion of the name would eventually become his personal appellation.

We may, therefore, content ourselves with receiving him as of concealed or unknown ancestry, and thereby save ourselves the necessity of enquiring, according to the fancy of the native commentators, by how many degrees of relationship he was removed from his predecessor Yaou. In this respect he resembles his analogue Vishṇu in the Rigveda, who is as yet scarcely more than an abstraction, not having clothed himself with the personality of deity attributed to him in the Purâṇas. It was later in the Brâhmanas that Vishnu came to be classed with the Adityas or sons of Aditî, as great an abstraction apparently as Kûsow.

Like so many other manifestations as the solar deities, Wu-shun was not allowed to come into the world without molestation. His parents, we are told, hated him. Like Herakles he was to be set aside in favour of his half brother Siang (the Duplicate), and their main anxiety is to get rid of him. He is,

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2 The Shi ki invents a genealogy for Shun. His father was Kû sow 瞽叟, Kû sow's father was 橋牛 K'iu ngo, K'iu ngo's 句望 Ko mong, Ko mong's 敬康 King k'ang, King k'ang's 窮蟬 K'ung shan, K'ung shan's the emperor 帝 Chwan huk 顓頊 from whose father 昌意 Ch'ang i to Shun were thus seven generations. The genealogy is of the same value as that of the Hiung nû from Yü or the kings of Wû from T'ai Wang—zero.

therefore, ordered to plaster a granary, to which fire is set. Escaping from the fire, he is directed to dig a well, when at the bottom they attempt to fill it up. From these dangers he is, as becomes his character, miraculously preserved. His brother designs to possess himself of Wu-shun's peculiar attributes. "Let my parents," he says, "have his oxen and sheep; let them have his stone houses and granaries. His shield and his spear shall be mine; his lute shall be mine; his bow shall be mine; his two wives I shall make attend me to my bed. Siang then went into Shun's hall, and there was Shun on his couch playing on his lute."[3]

Wu-shun is set to plough in the channelled fields by the Lik shan, the word Lik itself denoting the path of the heavenly bodies.[4] His parents oppress him, and he cries in agony to High Heaven. His filial piety attracts notice. The emperor (Ti as before) Yaou sends his nine sons and his two daughters to wait on him, and multitudes of the scholars of the empire flock to him. He plays the potter (陶 t'ao) at the Thunder (Lui) Lake, or rather performs service (徭 yao) as the text apparently indicates. "His four limbs had not even a temporary rest, for his mouth and his belly he could not find pleasant food and warm clothing—sorrowfully came he to his death. Of all mortals never was one whose life was so worn out and embittered as his."

Such was the life of the hero whose fame now fills the pages of Chinese tradition.

He was, according to the orthodox tradition, called upon by Yaou when the latter was failing in power and influence to assist him in ruling the empire; but we find that he has little connection with the inundating waters, the management of which is still left to K'wan or Yü.

Other traditions differ from that generally accepted as to the relations between him and his predecessor. According to versions still current in the latter periods of the Djow dynasty he was rather the superseder than the simple coadjutor and helper, as finally the descendants of Herakles supersede the successors of Eurystheus on the throne of Mykenai. Ouranos, as representing the older gods has to give place to Kronos, so Yaou, his correlative has to yield the sceptre to Wushun. The Tso-

3 Mencius V. I. II. 3.; Dr. Legge's translation.

4 Cfr. Sanscrit laksh, *videre*, *observare*; lakshana, *nota*, *signum*.

chuen more than hints at the contrast between the two. The ancient emperors Kaou-yang and Kaou-sin had each eight worthy descendants who offered their services to Yaou; who was not able, adds apologetically the chuen, to raise them to office. No sooner did Wushun become Yaou's minister than he placed them in high positions, to reduce the earth to order, and to aid the influences of Heaven; to promote the proper duties of relationship, "so that in the empire was order, and beyond submission."[5] Four villains also lived in his time, apparently corresponding to those mentioned in the Shû, Hwantan, K'ung k'i, To ngat and T'o t'it, villains, slanderers, obstinate and greedy. Yaou could not find it in his heart to put them away, but when Wushun became minister and received the nobles from the four quarters, he banished these four wicked ones, thrusting them out into the four distant regions to resist the (goblin) Lîmî.

The Chinese euhemerists go beyond this. Some of them make Wushun dethrone Yaou and keep him a prisoner; raise Tanchû for a time to the throne, and then depose him, and thereafter allow no intercourse between father and son.

Turning to the Shûking we find in rough archaic metre, mixed with more modern prose, the orthodox account of Wushun's doings.

"Setting forth the excellencies of the five Canons
"The five Canons came to be observed
"Entering on the hundred rules[6]
"The hundred rules were punctually administered.
"Receiving his guests at the four portals.
"The four portals shone majestically.
"Entering on the great Loka[7]
"The impetuous winds, thunder and rain did not bewilder him.

"To him appertained the Siuenki (Chakra or Discus) and the jewelled Wang (Çangkha or Conch)
"By means of which he regulated the Seven Directors.
"He sacrificed to the gods above[8]
"He offered to the six Honoured Ones
"He sacrificed to the hills and streams
"He visited the host of spirits.

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5 Ch'un t'siu VI. year 18.

6 揆 Kwei is the equivalent of Gr. καιρός, *occasio, opportunitas temporis.*

7 The great Loka (大農 *ta lok*) seems the equivalent of the Loka-loka of the Vishnu Purâna surrounding the golden mountain Meru.

8 上帝 Shang ti *i.e. dei superi*, 帝, used later for emperor, in old

"In the second month eastward he performed his circuit
"As far as Tai tsung
"He offered burnt sacrifices to the hills and streams
"He did homage to the Regent of the East
"He harmonised the seasons and months, and regulated the day.
"He put in accord and fixed the meridians and parallels
"He regulated the five ceremonies."

Similarly at the other seasons he proceeded to the three other cardinal points represented by the remaining three Yoks, finally arriving at Ngai tsu he sacrificed? (用 yung) a bullock. "He laid the foundations of the twelve islands, piled up the twelve mountains, dug out the rivers."

He arranged the code of punishments "What reverence," adds the author, "that compassion should temper punishment." He banished Kung kung to the Dark Island (Yao or Yew-chow); drove Hwantow to Tsung-shan; hid Sam-miaou (Çambara) at Samwei; killed Kwan (κρὸνος) at Mount Yu. The number of the villains here agrees with that in the Tso chuen, and some resemblance is evidently indicated in their names; Hwantan (*cfr.* Sans. Vandi *captivus*) is in the Tso-chuen made a descendant of Hwangti, K'ungk'i (cfr. Sans. garh *maledicere*) of Shaou haou; T'o ngat of Chuen heuh; and T'o t'it of the officer Tsin yun. So in Indian legend Indra attended by his faithful comrade Vish*n*u "hurries off to encounter the hostile powers in the atmosphere who malevolently shut up the watery treasures in the clouds. These demons of drought called by a variety of names as Vrittra, Ahi, Çush*n*a, Namuchi, Pipru, Çambara, Ura*n*a, &c., &c., armed on their side also with every variety of celestial artillery, attempt, but in vain, to resist the onset of the gods."[9]

But Çambara has a personal history connecting legend with myth. Rigveda VII, 99, &c. describing the powers of Vish*n*u connects him with the overthrow of Çambara, as does the Chinese legend Wushun with that of Sam-miaou, in a manner throwing much light in the Chinese myth. "No one, O divine Vish*n*u, who is being born, or who has been born, knows the furthest limit of thy greatness. Thou didst prop up the lofty and vast sky; thou didst uphold the eastern pinnacle

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Chinese had the value of deus, Sans. deva, with which it is etymologically connected. There is no trace in the Chinese classics of the form 上帝 being used in the sense of *Deus Supremus*.

9 Muir's Original Sanscrit Texts, Vol. V. 94.

of the earth. Vishnu, thou didst prop asunder these two worlds; thou didst envelope the earth on every side with beams of light. Ye (Indra and Vishnu) have provided ample room for the sacrifice, producing the sun, the dawn and fire. Ye, O heroes, destroyed in the battles the wonderful powers of the hostile Vrishaçipra. Indra and Vishnu ye smote the ninety-nine strong cities of Çambara; together ye slew, unopposed, a thousand and a hundred heroes of the Asura Varchin."[10]

Çambara besides his mythical existence had moreover a legendary one, accounting for the second portion of his traditional name in Chinese. The Chinese commentators acknowledging the individuality of the object of the legend make him the prince of the Three Miaou, missing the phonetic form of the word as disguised by the Chinese characters. In the Indian legend, then, Çambara assumed flesh and blood as an ancient aboriginal king, a dark-skinned enemy, who dwelt forty years on the mountains and possessed a hundred impregnable cities. These cities were desired by Divodâsa who attacked them in vain; Indra came to his help and with Vishnu smote the cities and killed their ruler. In both legends exists the remembrance of a prehistoric combat with aboriginal tribes. Çambara lived in Udavraja, a country "into which the water flows" as Samwei, the latter syllable apparently corresponding to *Vraja* of the other, is mentioned in connection with the Yokshui, the Weak, or rather Dead Water of the Yukung.

To Greek mythology we must apparently go for the analogue of another portion of the story. The Canon of Yaou seems to hint at Kwan being the son of Yaou, as was Kronos of Ouranos. The jealousy evinced by Yaou of the other is not concealed. Kwan is grudgingly set to work to reduce the swelling waters. Kwan's rule, like that of Kronos, is not successful and he, like his analogue, is deposed in favour, tradition tells us, of his son; who finally succeeds in the person of Yü to the government of the Summer, 夏 Hia region, or rather apparently 霞 Hia the Bright, the kingdom of the gleaming Hari or Vishnu.

After twenty-eight years, i.e. passing through the twenty-eight lunar mansions, and so making a complete circuit of the heaven, the Emperor (Yaou) departed, the people mourning him for three years. Wushun proceeded to (the temple of) the

10 Id. Vol. IV. 86.

accomplished ancestor on the first day of the first month. Assuming the power in his own person.

"He traversed[11] the four Yok
"Burst open the four gates
"Permeated the four intelligences (聰).
"O, you twelve Herdsmen said he
"Provide our food in due season
"Be courteous to the distant and control the near.
"Honour the virtuous, confide in the good;
"Oppose the artful men,
"And the Man and I will follow submissively."

He following the example of his predecessor enquires of those around him for a capable minister. Bak, Lord, (Sanscrit pûjâ *honor*, etc.) Yü (or Manu) is presented to regulate the waters and land. Yü does obeisance and wishes to decline in favour of Dsik (Daksha), Sit (Çesha), or Kaou yaou (Kuvera), but Wushun charges him to take the office.

He appoints Dsik to sow the ground for the Lîmin, (Agricultural or Aryan men;) Sit to instruct them in their civil duties; Kaou yaou to punish the evil doers. Siu to be superintendent of works; Yik (Vaksh) his general supervisor; I (? Sara) to preside over ceremonies; K'wei (? Garga) over music; Sung to be his mouth-piece.

The emperor said "O, ye twenty-two men be reverent according to the season, trusting to the merits of Heaven."

For thirty-three years Wushun occupies the throne, when the legend shows a diversity from the corresponding Indian story. Wushun desires to be relieved and calls on Yü to lead the people. In the Indian legend Manu is saved from the inundating waters by the interposition of Vishnu, who as a fish tows the ark in which the sage has taken refuge to the northern mountains, thence to descend and populate the earth. In Chinese story Yü or Manu himself takes an active part in draining off the water.

Yü declines the proposed honour in favour of Kaou-yaou, as one in whom the Lî (Aryan) men have confidence. Wushun praising Kaou-yaou's administration as minister of justice insists on Yü's acceptance, stating that in due time the appointment of Heaven will fall on him. Yü still declines and wishes to refer the matter to divination, but Wushun, having previously consulted the tortoise and the grass, refuses. Yü after pressing

11 徇 rather than 詢.

accepts, and receives the appointment at early dawn on the first day of the first month.

Wushun charges him to attack the chief of the Miaou (Çambara). For thirty years he carries on the contest but does not succeed, till Yik (Vach) advises Yü to withdraw his troops and try persuation. In seventy days the prince comes to make submission.[1 2]

Scarcely inferior to Yü in the legend is the place occupied by Kaou yaou, and here the Greek version of the legend again comes to our assistance. Ploutôn the king of Hades cannot be separated from Ploutos the wealthy. So in the Indian story Kuvera is the god of wealth. "Hence," says Cox (Aryan mythology II. 319) "as containing the forms of all future harvests this unseen region becomes at once a land of boundless wealth, even if we take no thought of the gold, silver and other metals stored up in its secret places." Its king is the "wealthiest of all monarchs, and must be addressed not as Hades the unseen, but as Ploutôn the wealthy, the Kuvera of the Ramayana."

In the Chinese version we are not reminded of the wealth of Kaou-yaou, but the Shûking is full of his uncompromising justice. He employs, as minister of Wushun, the five punishments, and the five banishments with their several places of detention, for which three localities are assigned. He is closely associated with the Sze-yok; apparently the Ruler of Hades, though from similarity of sound seemingly confounded with the Sze-yok, the four sacred mountains.

Wushun in many other particulars recalls the legends of the west. Like his analogue he must be wived, and accordingly Yaou bestows on him his two daughters; a proceeding which seems unaccountable to the Chinese, but readily explained when we find that the legend is but one of a series, each marked by the same peculiarity. These names, we are told, were Wo wang the literal equivalent of Sanscrit Ahar, the

12 Yik, the correlative of Vach the goddess of speech, equivalent to the Greek Peitho, appears here in his natural character. Like Vach Yik has other parts to fill. He is, above, the lieutenant of Wushun, calculating and selecting, and having authority over all living things (grass, trees, birds and beasts). In a somewhat similar capacity, while Yü drains off the waters Yik teaches the people to eat flesh. So Vach is instrumental as the helpmate of Prajâpati in the creation of all things, traversing and pervading the universe.

day, and Nüying apparently connected with Νύξ, Nakta, the night; both naturally daughters of Ouranos, the overarching heaven. So Herakles is matched with the fifty daughters of Thespius, and Appollôn pursues the gentle Daphne nor is constant to her. The Hindoo legends of Krishna and the maidens recall the same tale of the ever vivifying sun.

The Chinese myth is, however, broken off abruptly by the entrance of Yü on the scene. The celestials (Ti) give place to the human progenitor of the race, and Yü and his successors appear as simple Wang's. Hence Wushun's son Shang K'iuen retires into obscurity.

Nor do we learn much of the death of Wushun. The halo surrounding the departure of Herakles is not here repeated. He ascended, we learn, to the upper regions and there died. Before his death he dwelt in Ming ti'aou, *i. e.* Mandara one of the buttresses of the golden mountain Meru, and died in Mount Tsang-wu, the Śringi of the Indian cosmogany.

Indeed nothing is more conclusive as to the extra-Chinese origin of the early legends than the evident coincidence of the geography of the Chinese stories and that of Indian tradition. The Vishnu Purâṇa gives a scheme of cosmography in which we can detect many resemblances too close to be occidental. In the centre of the universe is the golden mountain Meru, the Mûng of the Yükung. North lie mounts Nîla, Sweta and Śringi, the latter the place of Wushun's decease. South we have Himavat, Himakûta and Nishadha. Between the ranges we have the different varthas; Bhârata; Kunpurusha; Harivartha, Fuhia of Wushun; and north of Meru, Ramyaka; Hiranyuga and Uttarakuru.

Butressing Meru are to the east Mandara, Mingti'aou of the legend, famous again as the site of T'ang ch'eng's great battle; south, Gandhamâduna; west, Vipula; and north Saparvça, from which flow respectively the four rivers Çitâ, Alakananda, Chaksu and Bhadra.

The attributes of Wushun are equally clear. The Siuen-ki, revolving disk, and the Yuk hang, gemmous balance, tell themselves of the discus and conch of Vishnu. His shield and spear, lute and bow are as characteristic of Appollôn or Krishna as of the Chinese hero. Strangely enough he is absent from the Book of Poetry. Wu wang and Chow kung in it adorn the dawn legends of the conquering race. Wushun in fact appears to have belonged more especially to the elder Aryan tribes who

had effected a settlement before the battle of Mûkyo gave the opportunity of founding the first Chinese kingdom; and the legend was probably worked into the tangled net of so called Chinese history, when the policy of the Chows dictated an amalgamation of all the immigrant tribes to found the first Chinese empire.

If any trace of legend, characterizing by that term the first remembrance of actual events as opposed to myth, still survived at that period, it has long disappeared. The tale of Wu shun affords no historic ground to assist in building up the fabric of history. Our messenger sent forth most fain return, for the swelling waters of forgetfulness still prevail, and in the words of the Shûking overtop the mountains.

Next, however, to reconstructing history is the advantage of shattering false beliefs. The unquestioning faith placed in the credibility of the so called early records of China has not a little tended to confuse our notions of early history. It is at least something to know that beyond a certain point we cannot go. The very knowledge that the early stories were myths, and the experience gained in comparing them with their analogues, will serve us in good stead when we come to enquire what light is really thrown on the early history of mankind by the archaic records of China.

PUBLICATIONS OF THE SOCIETY.

A Catalogue of the Library of the North-China Branch of the Royal Asiatic Society (including the Library of Alex. Wylie, Esq.) systematically classified, by Henri Cordier, Esq. *Shanghai*, 1872, *roy.* 8*vo.*

Journal of the North-China Branch of the Royal Asiatic Society, First Series, II, III and IV.

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Reports for 1864, 1865, 1866, 1867, 1868 and 1869.

Notes sur quelques-unes des Récherches que l'on pourrait faire en Chine et au Japon au Point de vue de la Géologie et de la Paléontologie, par M. G. Eug. Simon. 1869, 8*vo.* (few copies.)

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