地質調査所報告

第百一號

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昭和三年七月

目次

臺灣油田產ノ介化石

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（昭和三年七月稿）

商工省囑託 理學博士 横山又次郎

昭和二年中臺灣油田ノ地質調査ノ擧アリ、當時其ノ中ニ産スル介化石ヲ採集スルコト甚多ク、且之ニ賴リテ始テ油田構成ノ地層ノ時代ヲ考察シ得ベキヲ以テ、予ハ之ガ鑑識ノ任ニ當リ、之ニ從事スルコト半歲餘、茲ニ之ヲ終ヘタルヲ以テ、其ノ結果ヲ英文ニテ著シ、之ヲ世ニ公ニスルコトヽセリ、是レ他ナラズ、化石ノ記事ハ專ラ學術上ニ關係シテ、廣益上ヨリ謂ヘバ、汎ク之ヲ列國ノ學者ニ紹介スルヲ以テ得策トスレバナリ、而シテ本篇ハ其ノ拔萃ニ過ギザルナリ

油田ハ之ガ調査ニ從事シタル大井上、飯塚、佐藤、村山ノ四學士ニ據レバ、上ヨリ順次左ノ諸層ヨリ成レリ

一、觸口山層

二、苗栗層上部

三、同　下部
四、阿里山層上部
五、同　中部
六、同　下部

化石ハ、第五ノ阿里山層中部ヲ除キ、他ハ皆多少之ヲ產出セリ

一、觸口山層

本層ヨリ得タル介化石ハ僅ニ左ノ四種アルノミ

一、Pecten aurantiacus Ad. et Rve.
二、Ostrea gigas Thunb.
三、Arca suberenata Lke.
四、Pectunculus formosanus 新種

此ノ四種ヲ以テシテハ、地層ノ時代ヲ確定スルコト難シ、或ハ第三紀トモ云フベク、或ハ第四紀トモ云フベシ、故ニ更ニ多數ノ化石ヲ得テ之ガ決定ヲ見ル迄、四學士

ノ意ニ隨ヒ、之ヲ第三紀鮮新期ノ最新部ト見ルモ、敢テ不可ナカルベシ

二、苗栗層上部

本層中ニ産シタル化石ハ其ノ數最モ多ク、確實ニ種名ヲ決定シ得タルモノ七十七アリ、今之ヲ地質的分布ニ依リテ別テバ左ノ如シ

現世ノ外未ダ化石トシテ産セザルモノ	一七
現世ト房州ノ珊瑚層トニ産スルモノ	二
現世ト武藏野系上部トノ間ニ産スルモノ	九
現世ト武藏野系下部トノ間ニ産スルモノ	三
現世ト鮮新期トノ間ニ産スルモノ	一八
現世ト中新期トノ間ニ産スルモノ	四
武藏野系上部ニノミ産スルモノ	一
武藏野系上部ト鮮新期トノ間ニ産スルモノ	一
鮮新期ニノミ産スルモノ	一

鮮新期ト中新期トニ産スルモノ　三
新種（未ダ曾テ他ニ産シタルコトナキモノ）　一八
計　七七

是ニ因テ之ヲ觀レバ、現世産五十三種ニ對シ、化石トシテノミ産スルモノ二十四種アリ、是レ全數ノ約三割ナリ、又現世産ニシテ珊瑚層ニ遡ルモノ二種、武藏野系上部ニ遡ルモノ九種、同下部ニ遡ルモノ三種、鮮新期ニ遡ルモノ十八種、中新期ニ遡ルモノ四種アリ、更ニ化石トシテノミ産スルモノヽ中、新種ヲ除キ、殘餘六種中、武藏野系上部ニ産スルモノ合計二種、鮮新期ニ産スルモノ合計五種、中新期ニ産スルモノ三種アリ、以上彼是相參酌シテ考案ヲ下スニ、蓋シ苗栗層上部ハ第三紀ノ鮮新期ニ屬スベキモノナリ

上記化石ノ特ニ吾人ノ注意ヲ惹クハ、之ヲ氣候學上ヨリ見タル時ニ在リ、臺灣ハ北回歸線下ニアリテ、全島熱帶ナリト云フモ不可ナキナリ、然ルニ現世産五十三種ヲ、其ノ今ノ分布區域ニ依テ別ツトキハ略次ギノ如シ

熱帶産　七

溫帶產（日本內地）

溫熱兩帶產

熱帶產ト稱スルモノハ四國九州ノ南端以南ニ產スルモノニシテ、其ノ地理學上ノ熱帶以北ニ溯ルハ、此ニ黑潮アリテ甚シク之ヲ溫暖ナラシムルニ由レリ、種名ハ左ノ如シ

一、Conus sinensis Sow.

二、Mitra sphaerulata Mart.

三、Nassa canaliculata Lam.

四、Distortio cancellinus Rois.

溫帶產卽チ日本內地產ハ左ノ如シ

一、Terebra naumanni Yok.

二、Hemifusus ternatanus Gm.

三、Rapana bezoar L. var. thomasiana Cr.

四、Cassis japonica Rve.

五、Cypraea carneola L.

六、Area auriculata Lam.

七、Area tortuosa L.

五、Polinices sagamiensis Pils.

六、Sigaretus undulatus Lke.

七、Umbonium costatum Val.

八、Corbula erythrodon Lam.

九、 Dosinia gruneri Phil.

一〇、 Meretrix czoensis Yok.

一一、 Sunetta excavata Hanl.

一二、 Chione casinaeformis Yok.

一三、 Tapes undulatus Born.

一四、 Venericardia cipangoana Yok.

一五、 Astarte sulcata Dac.

一六、 Crassatellites heteroglyptus Pils.

一七、 Anomia lischkei F.et D.

一八、 Plicatula cuneata Dkr.

一九、 Pecten laetus Gld.

二〇、 Pecten laqueatus Sow.

以上二十種中、獨リ Astarte sulcata ハ北大西洋産ニシテ、未ダ曾テ本邦ニ出テタルヲ聞カズ、然レドモ化石トシテハ、既ニ之ヲ佐渡ノ武藏野系上部ニ産セリ斯クノ如ク化石産地ノ位置ヨリ推考シテ、熱帶産ノ甚シク多カルベキ場合ニ、其ノ數少ナク、反テ少カルベキ溫帶産ノ殆ド之ニ三倍スルモノアルハ吾人ノ聊意外トスル所ニシテ、是レ固ヨリ理由アリテ然ル者ナラザル可ラズ、蓋シ化石種尙生存ノ當時、臺灣近海ノ今ヨリ冷ニシテ、大ニ內地ニ似タルモノアリシハ幾ト疑ヒナキガ如ク、而シテ是ハ內地ノ化石ヲ研究シテ得タル結果ト亦符合スルモノナリ、乃チ內地鮮新期ノ化石中ニハ、現在ノ產地以北ニノミ產シテ、化石產地附近ノ往古今ヨ

リ稍冷涼ナル時代アリシヲ追想セシムルモノアリ、而モ苗栗層ノ化石ハ一層切實ニ其ノ然リシ所以ヲ語ルモノヽ如シ

三、苗栗層下部

本層ニ産シタル種數モ亦甚ダ多ク、上部ニ比シ稍少ナキノミ、地質的分布ニ依リ別ツコト左ノ如シ

現世種ニシテ未ダ化石ナキモノ	一四
現世乃至武藏野系上部ニ産スルモノ	六
現世乃至武藏野系下部ニ産スルモノ	二
現世乃至鮮新期ニ産スルモノ	一四
現世乃至中新期ニ産スルモノ	三
武藏野系上部ニノミ産スルモノ	二
鮮新期ニノミ産スルモノ	三
中新期ニノミ産スルモノ	二

新種　一九

計　六五

是ニ由テ全數六十五種中、今尚生存スルモノ三十九、生存セザルモノ二十六アルヲ知ル、二十六ハ全數ノ約四割ニ當レリ、故ニ苗栗層上部ニ比シテハ稍多キノミ、又生存セザルモノ二十六ヨリ、新種十九ヲ除ケバ、自餘ノ七種ハ左ノ如シ

一、Conus kikaiensis. Pils.　五、Pecten javanus Mart.

二、Mitra gembaeana Mart.　六、Pecten praesignis Yok.

三、Cadulus gordonis Yok.　七、Cucullaea pamotanensis Mart.

四、Corbula substriata Yok.

Cadulus gordonis(三)ト Corbula substriata(四)トハ内地武藏野系上部ニ、Conus kikaiensis(一)ト Pecten praesignis(六)トハ同鮮新層ニ、Pecten javanus(五)ハ瓜哇ノ鮮新層ニ、Mitra gembaeana(二)ト Cucullaea pamotanensis(七)トハ同嶋中新層ニ産出ス

現世種ニシテ同時ニ化石ニモ産シタルモノ二十五種中、武藏野上部ニ遡ルモノ六、同下部ニ遡ルモノ二、鮮新期ニ遡ルモノ十三、中新期ニ遡ルモノ三アリ

以上開陳シタル所ニ因テ觀ルトキハ、本層モ亦蓋シ鮮新期ナルベシ、而シテ氣候上ヨリ觀タル化石ノ性質復上部ト大ニ相似タルモノアリ、乃チ三十九種ノ現世種中、熱帶産ト認ムベキモノ僅ニ四種アルニ反シテ、溫帶内地産ハ十四種アリ

熱帶産ハ左ノ如シ

一′ Turritella terebra L.

一一′ Dentalium subrectum Jeffr.

一三′ Hemicardium hemicardium L.

四′ Arca tortuosa L,

溫帶産ハ左ノ如シ

一′ Terebra lischkeana Dkr.

一一′ Cassis japonica Rve.

一三′ Polinices sagamiensis Pils.

四′ Umbonium costatum Val.

五′ Corbula erythrodon Lam.

六′ Dosinia troscheli Lke.

七′ Meretrix ezoensis Yok.

八′ Sunetta excavata Hanl.

九′ Diplodonta japonica Pils.

一〇′ Venericardia cipangoana Yok.

一一′ Corbula sandaiformis Yok.

一一一′ Unio nipponensis v. Mart.

一三′ Anomia lischkei F. et D.

一四′ Pecten laetus Gld.

是ニ依テ、苗栗層下部成立ノ當時臺灣ノ氣候ハ、上部時代ト、略同一ナリシヲ推測スベシ

茲ニ苗栗下部ノ、上部ト同ジク、鮮新期ナラントノ前ノ推定ニ對シテ一考ヲ要スルコトアリ、輓チ米國ノヂツケルソン氏ハ向キニ非律賓ノ介化石ヲ研究シテ、同嶋産ノ中新層ト認ムベキモノハ、現世種ヲ含ムコト歐米ニ於ケルヨリハ甚シク多ク、最大七割五分ニモ及ブヲ以テ、歐米ニ於テ採用スル時代査定ノ割合ノ標準ハ熱帶地ニハ適用スベカラズト言ヘルコトアリ、果シテ然ルヤ否ヤ、又然リトスルモ、臺灣ヲ非嶋ト同區域ト見テ可ナルヤ否ヤ容易ニ之ヲ知ルベカラザル者アリ、然リト雖モヂ氏ノ言モ亦一顧ノ要ナキモノトハ云ヒ難シ、是ニ於テ用意ノ周到ヲ期センニハ或ハ苗栗層下部ノ時代ヲ鮮新期ナリト確定セズ、今暫ク未定トシテ後ノ研究ヲ俟テ決定スル方可ナルニハアラザルカ

四、阿里山層上部

本層産ノ化石ハ二十三種ニ及ビタルモ、多クハ保存不良ニシテ、種名ヲ知リ得タ

ルハ左ノ八種ニ過ギズ

一、 Dolium olearium Brug.

二、 Cypraea cinctoides 新種

三、 Meretrix meretrix L.

四、 Circe scripta L.

五、 Loripes goliath 新種

六、 Venericardia cipangoana Yok.

七、 Pecten satoi 新種

八、 Pecten praesignis Yok.

Dolium olearium ハ現世種ニシテ、未ダ曾テ化石トシテ産シタルコトナシ、Meretrix meretrix ハ現世ニ産シテ又鮮新期ニ遡ル、Circe scripta モ現世種ニシテ苗栗層上部ニ産出ス、Venericardia cipangoana モ現世ニ産シテ且中新期ニ遡ル、Pecten praesignis ハ從來內地ノ鮮新層ニ産セシノミ、他ノ三種ハ皆新規ノモノニ係レリ

以上八種ヲ以テ地層ノ時代ヲ確定スルコト甚ダ難シ、然レドモ幸ニシテ本層中ニハ、曾テ英國ノニウトン、ホランド二氏ノ鑑識シタル有孔蟲 Lepidocyclina verbeeki N. et H. 及ビ石灰藻 Lithothamnium ramosissimum Reuss アリ、此ノ二種ハ中新期特有ト稱スルモノナレバ、是ニ依テ阿里山層上部ノ盖シ中新期ナルベキヲ知ル

五、阿里山層下部

本層ノ産シタル化石ハ上部層ヨリ一層少シ、乃チ八種アリテ、種名ヲ明ニシタモノハ左ノ四種ノミ

一、Pyrula taiwanica 新種　　三、Tapes(?) taiwanicus 新種

二、Venus(?) arisanensis 新種　　四、Crassatellites nipponensis Yok.

前ノ三種ハ新種ナルヲ以テ、時代ノ考定ニ用フベカラズト雖モ、最後ノ Crassatellites nipponensis ハ予ガ嚮ニ Crassatella fusca ト稱ヘタルモノニシテ、内地ノ九州及ビ中國ノ舊成期ニ産ス、故ニ阿里山層下部ハ舊成期ニシテ、蓋シ其ノ始新期ニ屬スルモノナラン

能登國ニ産スル半化石貝

能登國ニ産スル半化石貝

商工省囑託 理學博士 横山又次郎

（昭和三年七月稿）

能登國七尾港ノ西側ニ方テ丘陵アリ、第三紀鮮新期ノ傾斜層ヨリ成リ、之ヲ蔽フニ丘麓諸所ニ砂層アリ、位置平ニシテ、厚サ數尺、上ニ土壤ノ層ヲ乘セ、介殻ヲ含ムコト甚ダ多シ、昭和二年ノ秋予ハ之ヲ採集シテ八十九種ヲ得タリ、今之ヲ地質的分布ニ據テ別ツトキハ次ノ如シ

新種	四	
計	八九	

是ニ由テ觀ルトキハ、全數八十九種中、現世産ハ八十種ニ及ンデ、實ニ其ノ九割ヲ占ム、而シテ此ノ九割モ將來增加スト見テ可ナリ、如何トナレバ九種ノ化石種中、將來現世産アルヲ發見スルコトナシトセザレバナリ

此クノ如ク多數ノ現世種ヲ混ズル介化石ノ、地質學上極メテ新近ノ者ナル事疑フベクモアラズ、想フニ其ノ時代ハ更新期最後ノ部分ナルカ、又ハ現世(正新)舊期ナルベシ、何レニセヨ、介層ノ、房州珊瑚層ト略其ノ時期ヲ同フスルコトハ、疑ナキモノヽ如シ、此ノ珊瑚層中現今房州以南ノ外産セザル介數種アルコトハ、予ガ前ニ該層ニ關スル論文中ニ述ベタル所ナリ、故ニ七尾層中ニモ、同樣ノモノアルヤ否ヤハ兩層ノ同時代ナルヤ否ヤヲ定ムル一鎖鑰タラザルベカラズ、乃チ現世種八十ヲ、其ノ現在ニ於ケル分布區域ニ依テ、分ツトキハ左ノ如シ

日本中部西部(中部ト略同緯度)ノ産	三二
日本中部西部及ビ以南ノ産	一七

日本中部西部及ビ以北ノ產　一六
日本中部西部及ビ以北以南ノ產　七
日本南部及ビ以南ノ產　四
日本北部ノ產　四
計　八〇

上記中最多數ヲ占ムルモノハ中部西部ノ產ニシテ、其ノ數三十二卽チ四割ニ及ベリ、是レ理ノ然ラシムル處ナリ、如何トナレバ七尾ハ予ガ稱シテ中部ト云フ區域內ニアレバナリ、次ギハ中部西部ノ外其ノ以南ニモ亦產スルモノニシテ、其數十七卽チ約二割一分アリ、次ギハ中部西部及ビ其ノ以北ニ產スルモノニシテ、其ノ數十六卽チ約二割アリ、以北以南雙方ニ產スルモノハ七種ニシテ、是レ謂ハヾ中立性ノモノナリ、最後ノ二類卽チ以北ニノミカ、又ハ以南ニノミ產スルモノハ各四種卽チ五分アリ、乃チ分布ノ上ヨリ觀ルトキハ、介類ハ特ニ著シキ異性ヲ帶ビザルガ如シ、其ノ故ハ性ノ異同ヲ決定スベキ以北ノミノ產ト、以南ノミノ產ト同數ニシテ一見相殺スレバナリ

然リト雖モ爰ニ鑑ミザル可ラザルコトアリ、是レ他ナラズ、七尾ノ位置ノ、予ガ北部ト中部トノ界トスル北緯三十八度ニ甚ダ近ク、僅ニ緯一度ヨリ遠カラズシテ、尚又日本海沿岸ニ在ルコトナリ、此ノ沿岸ノ太平洋岸ニ比シテ、低溫ナルハ喋々ヲ俟タザルナリ、是ニ於テカ以北産ノ四種ガ甚シク其ノ價値ヲ失フト同時ニ、以南産ノ四種ガ之ニ應ジテ其ノ價値ヲ增スコト明ナリ、以南産ノ名稱左ノ如シ

Clathurella centrosa Pils.

Meretrix tigrina Lam.

Lucina bella var. delicatula Pils.

Cardita crassicosta Lam.

此ノ四種ハ皆房州ノ珊瑚層ニ産スレドモ、現今ニ在テハ、大隅以北ニ未ダ之ヲ發見シタルヲ聞カズ、大隅ハ七尾ニ比スレバ緯度ニシテ約六度ノ南ニシテ、此ノ地ニ産スルハ Meretrix tigrina ナリ、他ハ皆一層南ニ産シテ、Clathurella centrosa ハ小笠原島ニ Lucina bella delicatula ハ沖繩ニ、Cardita crassicosta ハ非律賓ニ生存セリ

夫レ吾ガ邦産ノ介類中、新石器時代以來、南下シタル者アル事ニ創メテ氣附キタ

ルハ故エドワード・モース先生ナリ、先生ハ今ヲ去ルコト五十年前、今ノ大森停車場附近ニ介墟ヲ發見シ、其ノ中ニ甚ダ多キ魁介ノ一種ノ Arca granosa ノ、今ハ附近一帶ノ海ニ產セザルコトヲ知レリ、此ノ介ハモース先生ハ之ヲ九州以北ニ見ズト言ヒシガ其ノ後之ヲ房州ニ發見セリ、然リト雖モ其ノ東京灣ノ、殊ニ大森沿岸ニ產セザルハ、今尙事實ナリ、顧フニ介類ノ南下ハ珊瑚層時代ニ次イデ始マッテ、石器時代以後ニ繼續シタル事明ナリ而シテ、或ハ今尙繼續シツヽアルヤモ知ルベカラズ、此ノ問題ハ氣候ノ變化ニ關係シテ、學術上趣味多キヲ以テ今後尙研究ヲ積ムノ必要アリ

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IMPERIAL GEOLOGICAL SURVEY OF JAPAN

REPORT No. 101

CONTENTS

IMPERIAL GEOLOGICAL SURVEY OF JAPAN

REPORT No. 101

Mollusca from the Oil-Field of the Island of Taiwan

By

MATAJIRO YOKOYAMA, *Rigakuhakushi*

I. General Remarks

The island of Taiwan, generally known under the name of Formosa among Westerners, when geologically considered, was almost a *terra incognita* prior to its occupation in 1895 by the Japanese, brief references made on its coal-field and the fossils found therein by Corner, Guppy, Kleinwächter, Tyzack and Lebour[1] having been insufficient to form any adequate idea about the geology of the whole island. Since then many of our geologists have travelled through it, and at present its geology is tolerably well known.

Concerning the fossils, however, very little has been written until now. What the above named authors have written are only enumerations of the names of some corals, echinoids and molluscs. In 1900 Newton and Holland published a short note[2] on the results of the examination of microscopic sections of some

1) About the writings of these authors, I refer to the paper of Newton and Holland named below.

2) R.B. Newton and R. Holland. Notes on Microscopic Sections of Limestones from Formosa: Collected by Dr. Koto of Japan. Jour. Geol. Soc. Tokyo, Vol. 7, 1900.

limestones from the island sent by Professor Koto and two years later a more lengthy paper[1] on the Foraminifera, Bryozoa and Nullipora contained in limestones collected in the island as well as in Ryukyu by Professor S. Tokunaga of the Waseda University, then a student of the University Hall of the Imperial University of Tokyo. The fossils of the island treated in these two papers are very few, although they are very valuable, giving hints to the age of the rocks containing them. About the higher Invertebrates, no important paper has appeared until present.

In 1927 our Imperial Geological Survey, at the request of the Department of Navy, undertook the investigation of the oil-field of the island. For this purpose four geologists were sent. They are Messrs. Y. Ōinouye, Y. Iizuka, H. Sato and K. Murayama who brought back a large number of fossils, mostly Mollusca, collected in the field. These fossils I was entrusted to examine, the results of which are laid in the following pages.

The rock-layers constituting the oil-field of Taiwan are grouped by the above geologists into several beds which in descending order are as follows :

I. *Shokkōsan Beds.* Mainly composed of conglomerate with subordinate layers of sandstone, shale and limestone. Fossils present.

II. *Upper Byoritz Beds.* Consisting either of sandstone alone or of alternations of sandstone and shale. Rich in fossils.

III. *Lower Byoritz Beds.* Made up of shale and shaly sandstone with some limestone. Rich in fossils and also oil-bearing.

1) On Some Fossils from the Islands of Formosa and Ryukyu (Loochoo). Jour. Coll. Sci., Imp. Univ. Tokyo, Vol. XVII, Art. 6, 1902.

IV. *Upper Arisan Beds.* Chiefly made up of sandstone and shale, but also intercalating some limestone layers, coal-seams and basalt-sheets. Fossiliferous as well as oil-bearing.

V. *Middle Arisan Beds.* Consisting of alternating layers of sandstone and shale with some coal-seams. Oil-bearing. Fossils absent.

VI. *Lower Arisan Beds.* Also called *Karisan Beds* and composed of slaty shale and sandstone. Fossiliferous.

Above the uppermost or Shokkōsan Beds there are layers of gravel and clay of the Pleistocene and Holocene epochs unconformably overlying them, whilst below the lowest, the Lower Arisan Beds, there are the so-called *Hori Beds* which consist of black slates intercalating some sandstone layers and are separated from the Arisan Beds, usually by a fault. But geologists assume the presence of a line of unconformability between. Between the Shokkōsan and Upper Byoritz Beds, there is a distinct and undoubted one.

As to the thickness of the respective beds, some estimations have been made. The figures ran very high, though differing at places. For the Shokkōsan Beds 1300 metres to 1900 meters were obtained, for the Upper and Lower Byoritz together 3000 metres to 4000 metres, and for the whole Arisan 2500 metres to 5000 metres.

The fossils treated in this paper are from all of the fossiliferous beds. Their names and distribution are given in the following table :

I. Gastropoda	Shokkōsan	Upper Byoritz	Lower Byoritz	Upper Arisan	Lower Arisan	Geological Occurrence
Fam. Ringiculidae						
1. Ringicula foveolata n. sp.		+				
2. Ringicula globulifera n. sp.			+			
Fam. Terebridae						
3. Terebra lischkeana Dkr.			+			Recent (C.W. Japan). Up. Musashino, Pliocene
4. Terebra naumanni Yok.		+				Rec. (C. Japan). Up. Musashino
5. Terebra subvariegata n. sp.		+				
6. Terebra formosana n. sp.		+				
7. Terebra sp.		+				
Fam. Conidae						
8. Conus sinensis Sow. var.		+				Rec. (China, Philippines, South Sea)
9. Conus kikaiensis Pils.			+			Pliocene
10. Conus comatosaeformis n. sp.			+			
11. Conus oinouyei n. sp.			+	?		
Fam. Pleurotomidae						
12. Pleurotoma oxytropis Sow.		+				Rec. (C.W. Japan, China). Up. Musashino
13. Pleurotoma carinata Gr. var. woodwardi Mart.		+				Pliocene of Java. Miocene of Philippines
14. Drillia pseudoprincipalis Yok.		+				Up. Musashino
15. Surcula javana (L.)		+	+			Rec. (W. Japan, China, Java)

16. Mangilia perparva n. sp.	+			
Fam. Olividae				
17. Oliva mustellina Lam.	+	+		Rec. (C.-S. Japan, Singapore). Pliocene
18. Olivella spretoides Yok.	+			Up. Musashino—Pliocene
Fam. Mitridae				
19. Mitra isabella Swains.	+			Rec. (Japan, China, Australia)
20. Mitra sphaerulata Martyn	+			Rec. (Philippines). Pliocene of Java.
21. Mitra gembacana Martin		+		Miocene of Java
Fam. Fasciolariidae				
22. Fascioloria iizukai n. sp.	+			
23. Hemifusus ternatanus Gm.	+			Rec. (N.C.W. Japan). Up. Mus.-Pliocene
24. Siphonalia kellettioides n. sp.		+		
25. Eburna sp.		+		
Fam. Nassidae				
26. Nassa (Niotha) gemmmulata (Lam.)	+	+		Rec. (C.W. Japan, Philippines). Pliocene of Java
27. Nassa (Hima) verbeeki Mart.	+			Pliocene of Java
28. Nassa (Zeuxis) canaliculata (Lam.)	+			Rec. (Philippines, Indian Ocean)
Fam. Muricidae				
29. Murex ternispina Lam.	+			Rec. (C.W. Japan, Philippines)
30. Ocinebra sp.			+	
31. Rapana bezoar L. var. thomasiana Cr.	+			Rec. (N.C.W. Japan). Up. Mus.-Pliocene
Fam. Tritonidae				
32. Triton (Simplum) costatus (Born).	+			Rec. (C.W. Japan, Indian Ocean). Pleistocene

	Shokkōsan	Upper Byoritz	Lower Byoritz	Upper Arisan	Lower Arisan	Geological Occurrence
33. Distortio cancellinus (Rois.)		+				Rec. (Japan? Philippines, Indian Ocean)
34. Gyrineum scelestum n. sp.		+				
Fam. Cassididae						
35. Cassis japonica Rve.		+	+			Rec. (C. W. Japan)
36. Cassis gracilenta n. sp.			+			
Fam. Doliidae						
37. Dolium olearium Brug.				+		Rec. (Philippines, Indian Ocean)
38. Dolium sp.			+			
39. Pyrula taiwanica n. sp.					+	
Fam. Cypraeidae						
40. Cypraea carneola L.		+				Rec. (W. S. Japan, Philippines, Moluccas). Pleistocene
41. Cypraea cinctoides n. sp.			+	+		
42. Cypraea sp.		+				
Fam. Strombidae						
43. Strombus sp.			+			
44. Rostellaria spinifera Mart. formosana n. v.		+				The type is Pliocene in Java

45. Rostellaria sp.		+			
Fam. Cerithiidae					
46. Cerithium satoi n. sp.		+	+		
47. Cerithium sp.			+		
48. Potamides (Tympanotomus) fluviatilis P.		+	+		Rec. (W. C. Japan, Philippines). Up. Mus.-Pliocene
49. Potamides (Batillaria) murayamai n. sp.		+	+		
50. Potamides muritus n. sp.			+		
Fam. Cerithiopsidae					
51. Cerithiopsis (?) shikoensis n. sp.		+			
Fam. Vermetidae					
52. Vermetus sp.			+		
Fam. Turritellidae					
53. Turritella terebra L.			+		Rec. (Philippines, Java). Pliocene (Java)
54. Turritella bacillum Kien.			+		Rec. (N.-S. Japan, China, Ceylon)
55. Turritella filiola n. sp.		+	+		
56. Turritella sp.				+	
57. Turritella sp.					+
Fam. Melaniidae					
58. Melania scabroides n. sp.		+			
59. Melania submadiunensis n. sp.			+		
60. Melania saigoi n. sp.		+			

	Shokkōsan	Upper Byoritz	Lower Byoritz	Upper Arisan	Lower Arisan	Geological Occurence
61. Melania glabelliuscula n. sp.		+				
62. Melania grossula n. sp.			+			
Fam. Solariidae						
63. Solarium perspectivum L.		+				Rec. (W. Japan, China, Indian Ocean). Pliocene (Java)
Fam. Naticidae						
64. Polinices sagamiensis Pils.		+	+			Rec. (C. W. Japan). Up. Musashino
65. Natica colliei Recl.		+	?			Rec. (C. W. Japan, Australia)
66. Natica sp.					+	
67. Sigaretus undulatus Lke.		+				Rec. (C. Japan)
Fam. Turbidae						
68. Turbo marmoratus L. laevis n. v.		+				The type is recent in Japan, Philippines, etc.
69. Turbo argyrostomus L. var. margaritacea L.		+				Rec. (N.-S. Japan, Indian Ocean
Fam. Trochidae						
70. Gibbula (?) tainanica n. sp.			+			
71. Umbonium costatum (Val.)		+	+			Rec. (N-W. Japan). Up. a. Low. Musashino
Fam. Fissurellidae						
72. Scutus unguis (L.)		+				Rec. (C. W. Japan, Philippines, etc.)

II. Scaphopoda					
Fam. Dentaliidae					
73. Dentalium octogonum Lam.	+	+	?		Rec. (N.-W. Japan, Ceylon). Up. Mus.-Pliocene
74. Dentalium vernedei Hanl.	+	?			Rec. (W. Japan, China)
75. Dentalium subrectum Jeffr.		+			Rec. (Philippines)
76. Dentalium sp.			+		
77. Dentalium sp.				+	
78. Cadulus gordonis Yok.		+			Up. Musashino
III. Lamellibranchiata					
Fam. Pholadidae					
79. Pholas sp.	+				
80. Pholas sp.		+			
Fam. Corbulidae					
81. Corbula erythrodon Lam.	+	+			Rec. (C. W. Japan). Up. Mus.-Pliocene
82. Corbula substriata Yok.		+			Up. Musashino
Fam. Mactridae					
83. Mactra banbakoensis n. sp.		+			
84. Mactra sp.		+			
Fam. Solenidae					
85. Solen sp.	+				
86. Siliqua intoshiana n. sp.		+			
87. Solecurtus sp.	+				

	Shokkōsan	Upper Byoritz	Lower Byoritz	Upper Arisan	Lower Arisan	Geological Occurence
Fam. Tellinidae						
88. Tellina taiwanica n. sp.		+				
89. Tellina sp.			+			
Fam. Veneridae						
90. Dosinia gruneri Phil.		+				Rec. (C. W. Japan)
91. Dosinia angulosa Phil.			+			Rec. (C. W. Japan, Philippines). Up. Mus.-Pliocene
92. Dosinia troscheli Lke.			+	?		Rec. (C. W. Japan). Up. Musash.-Pliocene
93. Meretrix meretrix (L.)		+	+	+		Rec. (N-W. Japan, Philippines, etc.) Up. Mus.-Pliocene
94. Meretrix indecoroides n. sp.			+			
95. Meretrix (Macrocallista) ezoensis Yok.		+	+			Rec. (N. Japan). Up. Musash.-Miocene
96. Sunetta excavata (Hanl.)		+	+	·		Rec. (N. C. W. Japan) Up. Musashino
97. Clementia sp.		+				
98. Clementia (?) sp.				+		
99. Venus (?) arisanensis n. sp.					+	
100. Chione casinaeformis Yok.		+				Rec, (C. Japan). Pliocene, Miocene
101. Chione foliacea Phil.			+			Rec. (C. W. Japan, Philippines). Up. Mus.-Pliocene
102. Cryptogramma kaneharai n. sp.		+				
103. Circe scripta (L.) var.		+	+	+		The type is recent in C. W. Japan and Australia. Up. Musashino.
104. Tapes undulatus Born.		+				Rec. (C. W. Japan). Up. Musash.-Pliocene
105. Tapes sp.		+	+			

106. Tapes (?) taiwanensis n. sp.				+	
107. Gomphina sp.			+		
Fam. Cardiidae					
108. Cardium muticum Rve.			+		Rec. (N-W. Japan, Philipp.). Up. Mus.-Pliocene
109. Cardium burchardi Dkr.		+			Rec. (C. W. Japan). Up. Musash.-Pliocene
110. Hemicardium hemicardium (L.)			+		Rec. (Philippines)
Fam. Diplodontidae					
111. Diplodonta japonica Pils.			+		Rec. (C. Japan). Up. a. Low. Musashino
112. Diplodonta murayamai n. sp.		+	?		
Fam. Lucinidae					
113. Loripes goliath n. sp.				+	
Fam. Carditidae					
114. Venericardia cipangoana Yok.		+	+	+	Rec. (C. W. Japan). Up. Musash.-Miocene
115. Venericardia sp.				+	
Fam. Astartidae					
116. Astarte sulcata Dac.		+			Rec. (N. Atlantic). Up. Musashino
Fam. Crassatellitidae					
117. Crassatellites heteroglypta Pils.		+			Rec. (N.-W. Japan). Up. Musash.-Pliocene
118. Crassatellites nipponensis Yok.				+	Palaeogene
119. Crassatellites oinoayei n. sp.			+		
120. Crassatellites sp.			+		

	Shokkōsan	Upper Byoritz	Lower Byoritz	Upper Arisan	Lower Arisan	Geological Occurence
Fam. Cyrenidae						
121. Corbicula sandaiformis Yok.			+			Rec. (C. Japan). Up. Musashino
Fam. Unionidae						
122. Unio nipponensis v. Mart. var.			+			The type lives in N. C. a. W. Japan.
Fam. Anomiidae						
123. Anomia lischkei F. et D.		+	+			Rec. (N. C. W. Japan). Up. a. Low. Musashino.
124. Placenta placenta (L.)			+			Rec. (C. Japan, Philippines.) Plioc.-Mioc. (Java, Philippines)
Fam. Spondylidae						
125. Plicatula cuneata Dkr.		+				Rec. (C. W. Japan). Up. Musashino
Fam. Pectinidae						
126. Pecten (Chlamys) laetus Gld.		+	+			Rec. (N. C. W. Japan). Up. Musashino-Pliocene
127. Pecten (Chlamys) aurantiacus A. et R.	+					Rec. (China)
128. Pecten (Chlamys) satoi n. sp.		+	+	+		
129. Pecten (Chlamys) sp.				+		
130. Pecten (Chlamys) sp.				+		
131. Pecten (Amusium) japonicus (Gm.)		+				Rec. (C. W. Japan, China)
132. Pecten (Amusium) praesignis Yok.			+	+		Pliocene
133. Pecten (Vola) laqueatus Sow.		+				Rec. (N. C. W. Japan). Up. Musashino
134. Pecten (Vola) sinensis Sow.		+	+			Rec. (N. Japan, China). Up. Musash.-Pliocene.

135. Pecten (Vola) javana Mart.		+	+		Pliocene of Java
136. Pecten sp.				+	
137. Pecten sp.			+		
Fam. Ostreidae					
138. Ostrea gigas Thunb.	+	+	+		Rec. (N.-S. Japan, China). Up. Musash.-Pliocene
139. Ostrea denselamellosa Lke.			+		Rec. (C. W. S. Japan). Up. Musashino.
140. Ostrea sp.				+	
Fam. Arcidae					
141. Arca (Barbatia) symmetrica Rve.			+		Rec. (C. W. Japan, Philippines). Up. Musashino
142. Arca (Anomalocardia) granosa L.		+	+	?	Rec. (C. W. Japan, Indian O.) Up. Mus.-Mioc. (Philippines)
143. Arca (Scapharca) inflata Rve.		+	+		Rec.(C.W.Japan,Philippines). Up.Mus.-Pliocene
144. Arca (Scapharca) subcrenata Lke.	+	+	+	?	Rec. (C.-S. Japan). Up. Musash.-Pliocene
145. Arca (Scapharca) philippiana Dkr.		+	+		Rec. (C. Japan, China)
146. Arca (Argina) auriculata Lam.		+			Rec. (Indian Ocean, W. Indies)
147. Arca (Parallelopipedum) tortuosa L.		+	+		Rec. (Indian Ocean)
148. Arca sp.				+	
149. Arca sp.				+	
150. Pectunculus formosanus n. sp.	+	+	+		
151. Pectunculus sp.			+		
Fam. Macrodontidae					
152. Cucullaea pamotanensis Mart.			+		Miocene of Java
Fam. Limopsidae					
153. Limopsis woodwardi Ad.		+			Rec. (C. Japan, Singapore). Musashinos.

I. Shokkōsan Beds.

From the Shokkōsan Beds we have only four species, namely: *Pecten* (*Chlamys*) *aurantiacus* Ad. et Rve., *Ostrea gigas* Thunb., *Arca* (*Scapharca*) *subcrenata* Lke. and *Pectunculus formosanus* n. sp., of which the first three are still living. From these four it is not possible to draw any conclusion respecting the age of the beds in which they occur. It may be *Tertiary* (*Pliocene*) as the geologists of the Geological Survey think, or *Quaternary* (*Pleistocene*). The decision must be postponed for the future.

II. Upper Byoritz Beds.

The total number of the species obtained from the *Upper Byoritz Beds* amounts to eighty-five of which, however, eight are not accurately determined. The remaining seventy-seven consist of the following elements:

1. Species hitherto found only Recent. 17
2. Species hitherto found Recent as well as Youngest Pleistocene. 2
3. Species hitherto found between Recent and Upper Musashino (Pliocene or Pleistocene). 9
4. Species hitherto found between Recent and Lower Musashino (Upper Pliocene). 3
5. Species hitherto found between Recent and Pliocene older than Lower Musashino. 18
6. Species hitherto found between Recent and Miocene. . . 4
7. Species hitherto found only in Upper Musashino. 1
8. Species hitherto found between Upper Musashino and Pliocene. 1

9. Species hitherto found only in Pliocene. 1
10. Species hitherto found in Pliocene as well as in Miocene. 3
11. Species entirely new. 18

77

From this we see that the species hitherto not known to be living are twenty-four in number, making up about 30% of the whole fauna. And of the living species, those which go up to the Pliocene are twenty-five, far outnumbering those which are older (Miocene four) or younger (Pleistocene and Upper Musashino eleven). From these considerations I believe that the beds in question can safely be placed in the *Pliocene*.

What is quite noteworthy about the whole fauna as considered from the climatolagical point of view is its much stronger affinity to that of temperate Japan than to that of the tropical regions. As every one knows, the island of Taiwan lies under the Northern Tropic. Consequently we are naturally led to expect that its younger Tertiary fauna would be quite tropical in character.

But this is far from being the case. Among the fifty-three living species, only the following seven (about 13%) may be said to be purely tropical:

1. Conus sinensis Sow.
2. Mitra sphaerulata Martyn.
3. Nassa canaliculata Lam.
4. Distortio cancellinus (Rois.)
5. Cypraea carneola L.
6. Arca (Argina) auriculata Lam.
7. Arca (Parallelopipedum) tortuosa L.

The remaining forty-six species consist of those which live either only in temperate seas, or in temperate as well as in tropical seas. And the former or purely temperate forms amount to twenty (about 38%), a number which is more than twice as many as the tropical ones. They are the following:

1. Terebra naumanni Yok.
2. Hemifusus ternatanus Gm.
3. Rapana bezoar L. var. thomasiana Gr.
4. Cassis japonica Rve.
5. Polinices sagamiensis Pils.
6. Sigaretus undulatus Lke.
7. Umbonium costatum (Val.)
8. Corbula erythrodon Lam.
9. Dosinia gruneri Phil.
10. Meretrix (Macrocallista) ezoensis Yok.
11. Sunetta excavata Haul.
12. Chione casinaeformis Yok.
13. Tapes undulatus Born.
14. Venericardia cipangoana Yok.
15. Astarte sulcata Dac.
16. Crassatellites heteroglyptus Pils.
17. Anomia lischkei Fisch. et Dautz.
18. Plicatula cuneata Dkr.
19. Pecten (Chlamys) laetus Gld.
20. Pecten (Vola) laqueatus Sow.

These forms are found only in Japan Proper (Western, Central and Northern Japan) except one, *Astarte sulcata*, which has not yet been found living in our seas, though fossil in the

Upper Musashino of Sado, an island in Japan Sea. The find of this species is very interesting, as it is now known as a boreal form. And so is also *Meretrix* (*Macrocallista*) *ezoensis* which at present lives only in Northern Japan.

Looking into the exclusively fossil (extinct) forms which amount to twenty-four, those which have already been found in tropical regions are again few. They are only the following four:

1. Pleurotoma carinata Gray var. woodwardi Mart.
2. Nassa verbeeki Mart.
3. Rostellaria spinifera Mart.
4. Pecten javanus Mart.

These have been described from the Pliocene of Java. The remaining twenty species consist of eighteen new and two Japanese.

The strong Japanese affinity shown by the fauna of the Upper Byoritz can only be explained by assuming that the seas around Taiwan during the deposition of the said beds had been more temperate than at present. And this is quite in accordance with the conclusion arrived at by me by studying the Pliocene Mollusca of Japan. Repeatedly I said in my papers previously published that the Pliocene molluscan fauna of our country represents that of a somewhat *cooler sea* than that of the present. And this *cooler character*, I may say, is more deeply, and therefore more clearly, impressed on the Taiwan fossils than on those of Japan Proper.

III. Lower Byoritz Beds.

These beds have yielded eightly species, of which the accurately determined are sixty-five, consisting of the following elements:

1. Species hitherto found only Recent. 14
2. Species hitherto found Recent as well as in Upper Musashino. 6
3. Species hitherto found between Recent and Lower Musashino. 2
4. Species hitherto found between Recent and Pliocene older than Lower Musashino. 14
5. Species hitherto found between Recent and Miocene. . . 3
6. Species hitherto found only in Upper Musashino. 2
7. Species hitherto found only in Pliocene. 3
8. Species hitherto found only in Miocene. 2
9. Species entirely new. 19

65

From this we see that the species which at present are not known to be living are twenty-six, or 40% of the whole, a percentage somewhat greater than that of the Upper Byoritz, as is naturally to be expected. Of these twenty-six, if we leave out nineteen which are new, there remain seven whose names are as follows:

1. Conus kikaiensis Pils.
2. Mitra gembacana Mart.
3. Cadulus gordonis Yok.
4. Corbula substriata Yok.
5. Pecten (Vola) javanus Mart.
6. Pecten (Amusium) praesignis Yok.
7. Cucullaea pamotanensis Mart.

Cadulus gordonis and Corbula substriata occur in the Japanese *Upper Musashino*, Conus kikaiensis and Pecten praesignis in the Japanese *Pliocene*, Pecten javanus in the Javan *Pliocene* and

Mitra gembacana and Cucullaea pamotanensis in the Javan *Miocene*.

Of the thirty-nine living species, those which have already been found fossil are twenty-five, of which six go up to the *Upper Musashino*, two to the *Lower Musashino*, thirteen to the *Pliocene* and three to the *Miocene*.

From these considerations the Lower Byoritz Beds seem also to be *Pliocene*, inasmuch as the general faunistic character, climatologically viewed, is similar to that of the overlying beds. That character is as follows:

Of the thirty-nine living species, those which are to be looked upon as purely tropical are only four (10%), while those which are purely temperate or Japanese are fourteen (36%). The purely tropical forms are the following:

1. Turritella terebra L.
2. Dentalium subrectum Jeffr.
3. Hemicardium hemicardium (L.).
4. Arca (Parallelopipedum) tortuosa L.

The purely temperate or Japanese forms are the following:

1. Terebra lischkeana Dkr.
2. Cassis japonica Rve.
3. Polinices sagamiensis Pils.
4. Umbonium costatum Val.
5. Corbula erythrodon Lam.
6. Dosinia troscheli Lke.
7. Meretrix (Macrocallista) ezoensis Yok.
8. Sunetta excavata Hanl.
9. Diplodonta japonica Pils.

10. Venericardia cipangoana Yok.
11. Corbicula sandaiformis Yok.
12. Unio nipponensis v. Mart.
13. Anomia lischkei Fisch. et Dautz.
14. Pecten (Chlamys) laetus Gld.

Thus the great preponderance of temperate forms over tropical ones is quite as evident as in the fauna of the Upper Byoritz. From this we may assume that the strata composing the Lower Byoritz had been deposited in a sea in which climatically the same or similar condition prevailed as in the Upper Byoritz time. This of course does not compell us to assume the age of the Lower Byoritz to be Pliocene, for it is not at all unnatural to suppose that a climatically similar condition had also prevailed in the preceding Miocene. Besides, there is a reason of the danger of laying too much weight on the percentage of the living species, especially in the fossil fauna found in tropical regions. R. E. Dickerson in his "Fauna of the Vigo Group, Philippine Islands" states that the European percentage system usually employed in determining the age of the Tertiary beds of the temperate regions does not apply to those of the tropics, and he considers the Vigo Group, whose molluscan fauna contains seventy-five percent of the living species and should therefore be Pliocene according to the European scale, to be *Miocene* in age. And this he bases on the presence of a large foraminifer called *Lepidocyclina* which is said to serve as an index fossil in Indo-China and Java. Of course I am not certain whether what Dickerson says applies also to the island of Taiwan. But its position is not far from the Philippines and lies also in

the tropics. Accordingly, although we are not yet informed of the occurrence of the above said foraminifer in the beds of the Lower Byoritz, I should prefer to put off the exact determination of their age for the future.

IV. Upper Arisan Beds

The number of the species yielded by these beds amounts to twenty-three, of which the specifically determined ones are only eight. They are the following:

1. Dolium olearium Rrug.
2. Cypraea cinctoides n. sp.
3. Meretrix meretrix L.
4. Circe scripta L.
5. Loripes goliath n. sp.
6. Venericardia cipangoana Yok.
7. Pecten (Chlamys) satoi n. sp.
8. Pecten (Amusium) praesignis Yok.

Dolium olearium is hitherto only *Recent*. Meretrix meretrix is *Recent* as well as *Upper Musashino* and *Pliocene*. Circe scripta is *Recent* and also occurs in the *Upper Byoritz*. Venericardia cipangoana ranges between *Recent* and *Miocene*. Pecten praesignis is hitherto only *Pliocene* in Japan. The remaining three are new.

From these few it is hardly possible to judge the age of the beds in which they were found. But fortunately Newton and Holland have found a *Lepidocyclina* which they called *Lepidocyclina verbeeki* in a limestone intercalated between the beds at Shinkōkai, south of the city of Taihok. They also found a

calcareous sea-weed called *Lithothamnium ramosissimum* Reuss of the *Miocene* of Japan as well as of Europe in the Upper Arisan limestones of Reisuikō and Shokōkō, places also not far from Taihok.

On the evidence of these fossils, it is tolerably certain that the beds are *Miocene*.

V. Middle Arisan Beds

As these beds have not yet yielded fossils, the age is still uncertain.

VI. Lower Arisan Beds

The fossils obtained from these beds are less than those of the Upper Arisan. They are only eight, of which the determinable species are the following four :

1. Pyrula taiwanica n. sp.
2. Venus(?) arisanensis n. sp.
3. Tapes(?) taiwanensis n. sp.
4. Crassatellites nipponensis Yok.

The first three are new, and therefore not available for the determination of the age. The fourth has already been found at several places in Japan and in the *Palaeogene* or *Lower Tertiary* beds. It is probable that we have here a complex which approximately corresponds to that of the *Eocene* of Europe.

About the geological age of the *Hori Beds* which underlie the Lower Arisan, I am at present not able to utter any definite opinion. I know only that in the beds some broad-leaved plants were discovered, besides a faint impression of a shell spirally wound and presenting an ammonitic appearance. Therefore the age may possibly be *Cretaceous*.

Description of the Species

I. GASTROPODA

Family Ringiculidae

1. Ringicula foveolata, n. sp.

Pl. I. Fig. 1

A single example lacking the outer lip of the aperture.

Shell small, with spire equal to about one-fifth of shell-height, broadly ovate in form. Whorls six and a half, the first one and a half embryonal, rounded and smooth, the succeeding only slightly convex except the last which is globular, ornamented with distant, finely punctured spiral grooves which number seventeen on the body-whorl, seven on the penultimate and six on each of the two preceding ones. Columellar callus thick, roof-like in shape with the median ridge running almost longitudinally, while the callus covering the caudal end of the shell is flat; the anti-apertural slope of the columellar callus as well as the whole caudal one is covered with course irregular pits, while the apertural side of the former is smooth. Columellar folds three, the two lower being prominent, elevated, sharp and oblique, with the lowest more oblique than the middle; the uppermost fold is very weak, almost horizontal and situated on the same level as the middle portion of the roof-like callus.

This shell, as a species of *Ringicula*, is unusually large. It is 10 millim. in height and about 6 millim. in diameter.

Fossil occurrence.—*Upper Byoritz Beds:* Shikō near Kōshun in Takao Province (高雄州恒春郡恒春四溝).

2. Ringicula globulifera, n. sp.

Pl. I. Fig. 2

Shell minute, globular, with spire very short and consisting of two whorls and a half, smooth and slightly convex. Body-whorl very large, globular and smooth (by friction?). Aperture narrow, elongated, bent in the middle. Inner lip covered with a callus which posteriorly swells into a large triangular plate directing one of its angles towards the outer lip as well as somewhat downward. Below the plate there are two strong subparallel columellar plaits. Outer lip thickened, swollen in the middle.

Only one specimen. It measures 2.1 millim. in height and 2 millim. in diameter.

In the possession of the triangular callus-plate, this species resembles *Ringicula glabra* Martin (Tiefbohrungen in Java, Samml. Geol. Reichsmuseum in Leiden, Bd. III, p. 44, pl. IV, fig. 44) which, however, is more slender in shape.

Fossil occurrence.—*Lower Byoritz Beds:* Wankyō in Province Tainan (臺南州嘉義郡灣橋).

Family Terebridae

3. Terebra lischkeana, Dunker

Pl. I. Fig. 9

Terebra lischkeana, Yokoyama, Foss. Miura Penin., p. 31, pl. I, Fig. 10. Foss. Up. Musash. Kaz. Shim., p. 30. Tert. Moll. South. Totomi, p. 326. Foss. Moll. Kaga, p. 166.

A large broken specimen with the last two whorls intact. On the base there are five distinct spiral threads which in the specimens hitherto found in Japan are either absent or only indicated by faint striae. The diameter of the present specimen measures 9 millim., being the largest hitherto found.

Fossil occurrence.—*Lower Byoritz Beds:* Injurin, Shinchik Province (新竹州大溪郡員樹林). Upper Musashino and Pliocene of Japan.

Living.—Central and Western Japan.

4. **Terebra naumanni,** Yokoyama

Pl. I. Fig. 3

Terebra naumanni. Yokoyama, Foss. Miura Penin., p. 32, pl. I, fig. 12. Moll. Up. Musashino Tokyo, p. 393.

Only two specimens, neither quite perfect. The two spiral bands of this species are both below the suture, and not suprasutural and subsutural as erroneously stated in one of my papers above cited.

Fossil occurrence.—*Upper Byoritz Beds*: (1) Enri, Shinchik Province (新竹州苗栗郡苑裡); (2) Shikō, Kōshun, Takao Province (高雄州恒春郡恒春四溝). Upper Musashino of Japan.

Living.—Central Japan.

5. **Terebra subvariegata,** n. sp.

Pl. I. Fig. 4

A single specimen with the apex broken, the whorls intact being twelve. It is 14.5 millim. in height and 3.2 millim. in diameter. The whorls are flat and provided with a broad,

elevated, rounded, subsutural band somewhat narrower than the remaining portion of the whorl and bearing tubercles. These tubercles are about sixteen in number, longitudinally and somewhat obliquely elongated and more or less roof-like in shape with the ridge blunt. Below the band, the surface of the whorl is longitudinally plicate on the younger whorls, while on the older it is at the same time provided with a spiral groove, dividing it into two unequal parts, with the upper only one-half as broad as the lower. The plicae are equal in number to the band-tubercles, similarly shaped and also oblique, and are not cut by the spiral groove, though often made narrower or more depressed. On the body-whorl there are two such grooves. Periphery rounded. Base abruptly narrowed, with several faint spiral striae. Canal narrow, bent. The outer lip is broken.

This species closely resembles *Terebra variegata* Gray (Tryon, Man. Conch., vol. VII, p. 14, pl. I, figs. 5, 7, 8, pl. II, figs. 15, 19, pl. VI, figs. 31, 37, 38). Among the several species which Tryon unites with Gray's, *Terebra interstincta* Hinds (pl. III, fig. 37 of Tryon) seems to be closest to ours, though not quite identical.

Fossil occurrence.—*Upper Byoritz Beds:* Hōtosak, Rinkōshō, Taihok Province (臺北州新莊郡林口庄寶斗厝).

6. **Terebra formosana,** n. sp.

Pl. I. Fig. 6

Shell moderate in size, turrete. Whorls many, flat, with three engraved spiral lines whose lowest is close to the lower suture, while the other two divide the surface into three somewhat unequal parts with the uppermost broadest and the lowest

narrowest. On the body-whorl, the lowest engraved line is somewhat distant from the suture. Below the sutures, there are many sinuous shallow longitudinal incisions on the surface making its upper margin appear serrate. These incisions are unequal in length, generally short except the third or the fourth which usually reaches the middle portion of the whorl, though occasionally they reach the lower suture. Periphery rounded. Base rapidly narrowed downward with three spiral grooves and a strong fold which is situated at the lower end of the inner lip. Canal short, somewhat bent.

The original colour-bands are still preserved, though in a faded condition. They are purplish and two in number. The upper is subsutural and the lower just below the uppermost engraved spiral line.

One example only with the apex and outer lip broken. The whorls intact are ten in number. The entire number may have been about fifteen. Height 55 millim. without the broken apex. Diameter 14 millim.

Fossil occurrence.—*Upper Byoritz Beds:* Shikō, Kōshun, Takao Province (高雄州恒春四溝).

7. **Terebra** sp.

Pl. I. Fig. 5

Only one specimen with the last four whorls intact. These whorls are shouldered and step-like with the surface above the shoulder narrow and horizontal, below flat and vertical. The longitudinal plicae which ornament the vertical surface number thirteen on the ultimate and penultimate whorls and are straight,

elevated, narrow though rounded, separated by broad and shallow valleys. There are also two spiral cords, one on the shoulder and one immediately below it. On the older whorls several faint spiral striae are present below the second cord, with the points of intersection with the cords tubercular. The periphery is rounded, while the base is abruptly narrowed below, the surface being decorated with about four distant spiral cords. The caudal end shows a spiral ridge. Diameter 5 millim.

Fossil occurrence.—*Upper Byoritz Beds:* Taihanrok, Takao (高雄州恒春郡大板薙).

Family Conidae

8. **Conus sinensis,** Sowerby, var.

Pl. I. Fig. 8

Conus sinensis var. Martin, Foss. v. Java, p. 13, pl. I, figs. 13-15.

An almost perfect specimen, 28.5 millim. in height and 14 millim. in diameter, lacking the apex only. The whorls which are provided with several flat spiral cords are somewhat concave with the peripheral angle slightly projecting above the suture. The only difference from the Javan fossil lies in the absence of crenulations on the peripheral angle. The flat cords of the body-whorl are many and separated by intervals of about equal breadth. The incremental lines are prominent and striae-like.

Tryon (Man. Conch., VI, p. 76) unites *Conus sinensis* Sow. with *Conus sowerbyi* Rve. which he believes to be identical with *Conus undatus* Kien.

Fossil occurrence.—*Upper Byoritz Beds:* Enri, Shinchik (新竹州苗栗郡苑裡). Pliocene of Java.

Living.—China. Philippines. South Sea.

9. **Conus kikaiensis,** Pilsbry

Pl. I. Fig. 7

Conus kikaiensis. Pilsbry, New Jap. Mar. Moll., Gastr., Proc. Acad. Nat. Sci. Philad., Jan., 1904, p. 6, pl. I, fig. 8.

A specimen of a small slender *Conus* with the apex and front-end broken. The whorls intact are five with the peripheral angle slightly projecting above the suture. Those forming the spire which is somewhat concave in lateral outlines are ornamented with a few spiral cords. The body-whorl is nearly straight in lateral outlines and possesses many spiral grooves (about eighteen) crossed and striated by lines of growth. Height, if perfect, about 18 millim. Diameter 6 millim.

Fossil occurrence.—*Lower Byoritz Beds:* West end of Fukki, Shinchik (新竹州苗栗郡福基). Pliocene of Japan (Ōsumi).

10. **Conus comatosaeformis,** n. sp.

Pl. I. Fig. 10

Shell narrow and elongated, the height being almost three times the diameter. Spire elevated, conical somewhat concave in lateral outlines and occupying more than one-fourth of the shell-height. The apex is lacking, and the whorls intact are seven. They are slightly concave with the peripheral angle somewhat projecting above the suture and furnished with a few (usually three) incised spiral lines, equally distributed on the surface. The body-whorl is almost straight in lateral outlines, showing a slight curvature only near the shoulder, smooth in the upper one-third and spirally grooved in the lower two-thirds.

The grooves gradually grow in breadth as they go downward and are cross-striated by lines of growth.

Only one example with the height (without apex) 30 millim. and the diameter 14 millim.

This species closely resembles *Conus comatosa* Pilsbry (*Conus dormitor* Pils.) described in a paper entited "New Japanese Marine Mollusca" already cited (p. 6 pl. I, fig. 9) and found fossil in Osumi together with the preceding species. But the latter has the spiral grooves on the whole surface.

Fossil occurrence.—*Lower Byoritz Beds:* South of Kwan-in San, Taikei Gai, Shinchik (新竹州大溪郡大溪街觀音山).

11. Conus oinouyei, n. sp.

Pl. I. Fig. 16

Shell rather small, obconical, with spire low and concave in lateral outlines. Whorls about nine, either flat or slightly excavated, with peripheral angle projecting above the suture more on the younger whorls than on the older; spirally striate, with striae several in number and close together. Periphery angular. Body-whorl almost straight when laterally viewed, the curvature being very slight, apparently smooth on the upper two-thirds and spirally grooved on the lower one-third. Aperture narrow, parallel-sided.

A single example which we possess is about 35 millim. in height and 12 millim. in diameter.

The species which shows the closest affinity to the present is *Conus sieboldi* Rve. (Yokoyama, Foss. Miura Penin., p. 34, pl.

I, fig. 14), especially when it is young, which, however, has the peripheral angle more projecting and the whorls more concave.

Fossil occurrence.—*Lower Byoritz Beds:* South of Kwan-in San, Taikei Gai, Shinchik (新竹州大溪郡大溪街觀音山).

A fragment of a *Conus* resembling this species was picked up from the *Upper Arisan Beds* at Kōtei, Sansōshō, Shinchik (新竹州大溪郡三層庄坑底).

Family Pleurotomidae

12. Pleurotoma oxytropis, Sowerby

Pl. I. Fig. 11

Pleurotoma oxytropis. Yokoyama, Moll. Up. Musash. Tokyo, p. 409, pl. XLVI, fig. 7. Tryon, Man. Conch., VI, p. 168, pl. IV, figs. 37-39.

The spiral striae found on the surface of the whorls are very distinct, though such is not the case in the Musashino fossil of Japan hitherto found.

Pleurotoma gendinganensis Martin (Foss. v. Java, p. 32, pl. V, figs. 79–84) which the author says is quite like *Pleurotoma leucotropis* Ad. et Rve. (Voyage Samarang, p. 40, pl. X, fig. 7) is probably identical with the present species.

Specimens rare.

Fossil occurrence.—*Upper Byoritz Beds:* (1) Jōnanseikō, Shiko Shō, Shinchik (新竹州苗栗郡四湖庄上南勢坑); (2) Kyushōkō, Enri Shō, Shinchik (同州同郡苑裡庄芎蕉坑); (3) Sankō, Injurin, Shinchik (同州大溪郡員樹林三坑). Upper Musashino of Japan.

Living.—Central and Western Japan. China. Gulf of California. Panama.

13. Pleurotoma carinata, Gray, var. woodwardi, Martin

Pl. I. Fig. 17

Pleurotoma carinata var. woodwardi. Martin, Foss. v. Java, p, 37, pl. VI, figs. 91-96.

A single example, agreeing quite well with the description and figures given of the above named species.

Fossil occurrence.—*Upper Byoritz Beds:* Shikō, Kōshun, Takao (高雄州恒春郡恒春四溝). Pliocene of Java. Miocene (Vigo Group) of the Philippines.

The typical form, *Pleurotoma carinata* Gray, is a recent species whose habitat, however, is given by Tryon as unknown. But probably it is somewhere in the tropical seas.

14. Drillia pseudoprincipalis, Yokoyama

Pl. I. Fig. 15

Drillia pseudoprincipalis. Yokoyama, Foss. Miura Penin., p. 37, pl. I, fig. 21.

This fossil species has already been described by me from the neighbourhood of Tokyo.

Three examples, one from each locality.

Fossil occurrence.—*Upper Byoritz Beds:* (1) Hōtosak, Rinkō Shō, Taihok (臺北州新莊郡林口庄寶斗層); (2) Kizan, Byoritz Gai, Shinchik (新竹州苗栗郡苗栗街龜山); (3) Kyushōkō, Enri Shō, Shinchik (同州同群苑裡庄芎蕉坑). Upper Musashino of Japan.

15. **Surcula javana,** (Linné)

Pl. I. Fig. 12

Surcula javana. Tryon, Man. Conch., VI, p. 237, pl. V figs. 63-65.
Pleurotoma lurida. Adams and Reeve, Voyage Samarang, p. 40, pl. X, fig. 5.

Somewhat resembling the preceding in sculpture, the present species is readily distinguished by its longer canal and tubercle-like plicae.

Tryon unites this species with *Surcula coreanica* (Ad. et Rve.) of Western Japan.

Fossil occurrence.—*Upper Byoritz Beds:* (1) Hōtosak, Rinkō Shō, Taihok (臺北州新莊郡林口庄寶斗厝); (2) Kyushōkō, Enri Shō, Shinchik (新竹州苗栗郡苑裡庄芎蕉坑); (3) Kwashōhei, Shiko Shō, Shinchik (同州同郡四湖庄火燒坪); (4) Kizan, Byoritz Gai, Shinchik (同州同郡苗栗街龜山); (5) Shikō, Kōshun, Takao (高雄州恒春四溝). *Lower Byoritz Beds:* (1) Hok'ho, Sanwan, Shinchik (新竹州竹南郡三灣北埔); (2) a doubtful specimen at a place south of Kwan-in San, Taikei Gai, Shinchik (同州大溪郡大溪街觀音山).

Living.—Western Japan. China. Java.

16. **Mangilia perparva,** n. sp.

Pl. II. Fig. 2

Shell small, solid, fusiform. Spire shorter than body-whorl, blunt at apex. Whorls about nine and a half, longitudinally plicate and spirally striate. Longitudinal plicae about ten on the ultimate whorl and nine on the penultimate, somewhat oblique, rounded, separated by broad and shallow valleys, the fifth or

sixth from the last on the body-whorl being coarse and varix-like. Spiral striae many (about ten), equidistant, becoming fainter towards the upper suture; on the body-whorl several finer striae are present between. Aperture elongated, pointed behind. Outer lip thickened, with sinus shallow. Two examples, one measuring 15 millim. in height and 5.5 millim. in diameter, and the other 13.5 millim. in height and 4.1 millim. in diameter.

This species closely resembles *Mangilia parva* Tok. (Yokoyama, Moll. Up. Musashino Tokyo, p. 411, pl. XLIV, fig. 12) in shape which, however, has the shell much smaller, the outer lip not thickened, and no varix. Moreover, the spiral sculpture consists of engraved lines and not of striae.

Fossil occurrence.—*Upper Byoritz Beds:* Shikō, Kōshun, Takao (高雄州恒春四溝).

Family Olividae

17. Oliva mustellina, Lamarck

Pl. II. Fig. 5

Oliva mustellina. Lamarck, Ann. d. Mus., XVI, p. 316. Pilsbry, Cat. Mar. Moll. Japan, p. 23. Tryon, Man. Conch., V, p. 78, pl. XX, figs. 6-14. Syst. Conch. Cab. Mart. Chem., Oliva, p. 92, pl. 24, figs. 10, 11.

Oliva irisans. Yokoyama Tert. Moll. So. Tôtômi, p. 333, pl. XXXVIII, fig. 12.

A cylindrical shell with the spire very low, the whorls convex and the sutures deeply channelled. The inner lip presents about fifteen folds, of which the lower five are longer than the others. A specimen from the Asuka Beds of Tōtōmi which I erroneously called *Oliva irisans* Lam. is to be brought here. Frequent.

Fossil occurrence.—*Upper Byoritz Beds:* (1) Hōtosak, Rinkō Shō, Taihok (臺北州新莊郡林口庄竇斗厝); (2) Kwashōhei (火燒坪), (3) Jōnanseikō (上南勢坑), (4) Kōdenkō (鴨田坑), and (5) Goko (五湖), all in Shiko Shō, Shinchik (新竹州苗栗郡四湖庄); (6) Kizan, Byoritz Gai, Shinchik (同州同郡苗栗街龜山); (7) Ubikō, Tsūshō Shō, Shinchik (同州同郡通宵庄烏眉坑); (8) Chōhōkan, Shinchik Gai, Shinchik (同州同郡新竹街鳥崩崁); (9) Sankō, Injurin, Shinchik (同州大溪郡員樹林三坑). *Lower Byoritz Beds:* (1) Intōshi (員埔子) and (2) Banbakō-keikō 蕃婆坑溪口, both in Chiktō Gun, Shinchik (新竹州竹東郡); (3) Nankō, Kōzan Shō (香山庄南港) and (4) Shōdōraken, Sauwan Shō (三灣庄小銅鑼圈) in Shinchik (新竹州竹南郡); (5) South as well as at the foot of Kwan-in San, Shinchik (同州大溪郡觀音山). Pliocene of Japan.

Living.—C· ntral, Western and Southern Japan. Singapore.

18. **Olivella spretoides,** YOKOYAMA

Pl. I. Fig. 14

Olivella spretoides. Yokoyama, Foss. Up. Musash. Kazusa a. Shimosa, p. 47, pl. II, fig. 4. Tert. Moll. So. Tôtômi, p. 334, pl. XXVIII, figs. 14, 15. Moll. Up. Musash. Tokyo, 393.

One example only.

Fossil occurrence.—*Upper Byoritz Beds:* Hōtosak, Rinkō Shō, Taihok (臺北州新莊郡林口庄竇斗厝). Upper Musashino and Pliocene of Japan.

Family Mitridae

19. **Mitra isabella,** SWAINSON

Pl. II. Fig. 1

Mitra isabella. Swainson, Zool. Illustr., 2, Fasc. 11, pl. V, fig. 1. Tryon, Man. Conch., IV, p. 137, pl. 39, figs. 159, 162, pl. 40, figs. 185, 169. Iwakawa, Catal. Jap. Moll. Nat. Hist. Departm., Tokyo Imp. Mus., p. 143. Syst. Conch. Cab. Mart. Chem., Mitra, p. 61, pl. XI, figs. 12, 13.

This beautiful shell has already been found as a fossil in the Upper Musashino of Shimōsa, Japan, though not yet published. It is tolerably large in size, fusiform in shape and has the spire shorter than the body-whorl. The whorls are flattish, with numerous spiral cords crossed by incremental lines which are prominent and striae-like. The columellar plaits are five in number, the lowest being very weak.

A single specimen.

Fossil occurrence.—*Upper Byoritz Beds:* Shikō, Kōshun, Takao (高雄州恒春四溝). Upper Musashino of Japan.

Living.—Japan (Iwakawa). China. Australia.

20. **Mitra sphaerulata,** Martyn.

Pl. II. Fig. 4.

Mitra sphaerulata. Martin, Foss. v. Java, p. 75, pl. XI, fig. 168. Tryon, Man. Conch., IV, p. 134, pl. 39, fig. 149.

A specimen of an immature individual with the apex broken, 9 millim. in height and 5.6 millim. in diameter. It is fusiform in shape with whorls somewhat convex and ornamented with elevated spiral ridges whose number is four on the body-whorl, three on the penultimate and two on the preceding ones. These ridges are deeply cut by engraved longitudinal lines making them appear tuberculate. In the valleys between the ridges, there is usually an engraved spiral line at their bottom. The columellar plaits are four in number and quite distinct.

Fossil occurrence.—*Upper Byoritz Beds:* Kyushōkō, Enri Shō, Shinchik (新竹州苗栗郡苑裡庄芎蕉坑). Pliocene of Java.

Living.—Philippines. Polynesia.

21. Mitra gembacana, Martin

Pl. II. Fig. 6

Mitra (Turricula) gembacana. Martin, Samml. Geol. Reichsmus. Leiden, vol. III, p. 91, pl. V, fig. 92. Foss. v. Java, p. 81, pl. XII, fig. 181.

A fossil shell fusiform in outline, but varying in shape, some being more slender than others. The whorls are somewhat gradate and furnished with about fifteen longitudinal plicae whose interspaces are crossed by several spiral threads. Columellar plaits four, the lowest being the thinnest and shortest.

Only one example with the outer lip broken. It is 12.5 millim. high and 4.4 millim. in diameter.

Fossil occurrence.—*Lower Byoritz Beds:* Nijūkei, Tombokō-kei, Tainan (臺南州新營郡豚母坑溪二重溪). Miocene of Java.

Family Fasciolariidae

22. Fasciolaria iizukai, n. sp.

Pl. II. Fig. 3

The only specimen we possess has the apex and outer lip broken.

It is fusiform in shape with spire very short and body-whorl very long. The whorls intact are five, angulate in the middle with the surface above the angle somewhat concave and sloping, below flattish and vertical. The angle is provided with rounded tubercles, twelve on the body-whorl and ten on the two preceding ones, separated by shallow, though narrower, valleys. The whorls are also spirally striate, with striae subequal and intercalating a finer one between. The body-whorl below the angle is

convex and rapidly narrowed below into a long straight canal, the convex surface as well as the canal being covered with spiral striae. Columella with a strong oblique fold. Height 35 millim. Diameter about 16 millim.

Among the hitherto described fossil species, the one which most resembles in shape to the present is *Fusus burdigalensis* Bast (Hörnes, Foss. Moll. Tertiärbecken v. Wien, Gastropoda, p. 296, pl. 32, figs. 13, 14) of the Vienna Basin which, however, has no columellar fold.

Among the living forms, *Fasciolaria trapezium* (Linné) (Tryon, Man. Conch., III, pl. 61, figs. 24–26, pl. 62, figs. 27, 28) may be brought into comparison, especially those forms whose angle-spines are reduced to tubercles. But the canal is not so long as in the fossil.

Fossil occurrence.—*Upper Byoritz Beds:* Shikō, Kōshun, Takao (高雄州恒春四溝).

23. **Hemifusus ternatanus,** (Gmelin)

Pl. II. Fig. 12

Hemifusus ternatanus. Yokoyama, Tert. Moll. So. Tôtômi, p. 336. Foss. Shells Atsumi Penin., p. 372, pl. XLIII, fig. 1. Moll. Up. Musash. Tokyo, p. 393.

A large and almost perfect specimen.

Fossil occurrence.—*Upper Byoritz Beds:* Between Hakshaton (白沙屯) and Futōkōbi (斧頭坑尾), Shinchik (新竹州苗栗郡). Upper Musashino and Pliocene of Japan.

Living.—Northern, Central and Western Japan.

24. **Siphonalia kellettioides,** n. sp.

Pl. II. Fig. 11

Shell fusiform with spire considerably shorter than body-whorl. Whorls about seven, angulate near the middle, with the surface above the angle flat and sloping, below vertical, longitudinally plicate and spirally corded. Longitudinal plicae eleven or twelve, most distinct at the angle, indistinct above, weakening below, though reaching the lower suture. Spiral cords five or six above the angle, two below, with one or two finer ones between. Body-whorl occupying about seven-tenths of shell-height. Aperture oval, pointed behind. Canal rather straight, short.

In form this shell reminds us of *Siphonalia kelletti* (Forbes) (Yokoyama, Foss. Up. Musash. Kazusa a. Shimosa, pl. V, fig. 1) which, however, has a much longer canal.

Fossill occurrence.—*Lower Byoritz Beds:* (1) Taiko, Shinchik (新竹州苗栗郡大湖). (2) At the mouth of the Banbakō-Kei of the same province (新竹州竹東郡蕃婆坑溪).

25. **Eburna** sp.

Two specimens of the apical portion of young individuals channelled along the sutures. They may belong either to *Eburna elata* Yokoyama (Tert. Moll. South. Totomi, p. 9, pl. I, figs. 16, 17) or to *Eburna chrysostoma* Sow. (Syst. Conch. Cab. Mart. Chemn., Buccinum, pl. 71, figs. 4, 5).

Fossil occurence.—*Lower Byoritz Beds:* Sairyō, Tainan (臺南州新化郡菜寮).

Family Nassidae

26. Nassa (Niotha) gemmulata, (Lamarck)

Pl. II. Fig. 8

Nassa gemmulata. Pilsbry, Catal. Mar. Moll. Japan, p. 35. Tryon, Man. Conch., IV, p. 55, pl. XVII, figs. 312-315. Martin, Foss. v. Java, p. 106, pl. XVII, fig. 237.

Buccinum gemmulatum. Lamarck, Anim. sans Vert., Vol. X, p. 169. Küster, Syst. Conch. Cab. Mart. Chemn., Buccinum, p. 10. pl. III, figs. 10, 11.

This shell resembles *Nassa* (*Niotha*) *livescens* Phil., so widely spread in the young Tertiary strata of Japan, but is more globose, and also flatly channelled along the sutures. The longitudinal plicae which are cut by incised spiral lines and appear like the rows of tubercles vary greatly in number. In the specimens we possess, they are between fifteen and twenty-five.

Fossil occurrence.—*Upper Byoritz Beds:* (1) Goko, Shiko Shō (四湖庄五湖), (2) Kyūshōkō, Enri Shō (苑裡庄芎蕉坑), (3) Kizan, Byoritz Gai (苗栗街龜山), all in Byoritz Gun, Shinchik; (4) Shikō, Kōshun, Takao (高雄州恒春郡恒春四溝). *Lower Byoritz Beds:* Nijūkei, Tainan (臺南州曾文郡二重溪). Pliocene of Java.

Living.—Central and Western Japan. Philippines. Sunda Straits.

27. Nassa (Hima) verbeeki, Martin

Pl. II. Figs. 9, 13

Nassa (Hima) verbeeki. Martin, Foss. v. Java, p. 110. pl. XVII. figs. 247-255.

Among the many fossil species of *Nassa* described by Martin from Java, there is one which agrees in all of its essential

characters with the specimens found in Formosa. That is *Nassa verbeeki* Mart. It has an ovately conical form with the whorls somewhat step-like and provided with longitudinal plicae crossed by incised spiral lines numbering five on the penultimate whorl and one less on the preceding ones. The uppermost of these lines is especially coarse and groove-like, so that the upper end of the longitudinal plicae separated by it from the remaining portion looks like a tubercle. On the base, the lines grow coarser as they go downward, finally appearing like furrows. Aperture oval, with a canal behind on the inner side of which there is a large tubercle. Inner and outer lips transversely ridged, with the margin of the latter serrate. Canal short. The number of the longitudinal plicae is variable. Height 18 millim. Diameter 9 millim. Rare.

Fossil occurrence.—*Upper Byoritz Beds:* (1) Hōtosak, Rinkō Shō, Taihok (臺北州新莊郡林口庄寶斗厝); (2) Jōnanseikō, Shinchik (新竹州苗栗郡上南勢坑); (3) Shikō, Kōshun, Takao (高雄州恒春郡恒春四溝).

Pliocene of Java.

28. **Nassa (Zeuxis) canaliculata,** (LAMARCK)

Pl. III. Fig. 1

Nassa canaliculata. Tryon, Man. Conch., vol. IV, p. 31, pl. IX, figs. 83-86.

Buccinum canaliculatum. Küster, Syst. Conch. Cab. Mart. Chem., Buccinum, p. 32, pl. VII, figs. 10, 11. Lamarck, Anim. sans Vert., vol. X, p. 161.

Distinguished by a smooth shell with the sutures channelled, and an incised spiral line below them. The whorls, when

the shell is young, are closely longitudinally ribbed. Base spirally furrowed. Only two examples.

Fossil occurrence.—*Upper Byoritz Beds:* Shikō, Kōshun, Takao (高雄州恒春四溝).

Living.—Philippines. Indian Ocean.

Family Muricidae

29. **Murex ternispina,** LAMARCK

Pl. III. Fig. 2

Murex ternispina. Lamarck, Anim. s. Vert., vol. IX, p. 567, no. 6. Tryon, Man. Conch., vol. II, p. 178, pl. IX, fig. 110, pl. X, figs. 111, 114. Syst. Conch. Cab. Mart. Chem., Murex, p. 57, pl. XXII, figs, 3, 4.

A shell characterized by three varices bearing spines, a clathrate sculpture and a long canal. Rare.

Fossil occurrence.—*Upper Byoritz Beds:* (1) Goko, Shiko Shō (四湖庄五湖) and (2) Kizan, Byoritz Gai (苗栗街龜山), both in Shinchik (新竹州苗栗郡); (3) Shikō, Koshun, Takao (高雄州恒春四溝).

Living.—Central and Western Japan. China. Philippines.

30. **Ocinebra** sp.

Pl. I. Fig. 13

A small pyriform shell with about ten longitudinal plicae on the body-whorl and resembling *Ocinebra tsuzurensis* Yok. (Moll. Rem. Lowest Part Jōban Coalf., pl. I, figs. 1–3) from the Miocene of Iwaki, Central Japan.

Fossil occurrence.—*Upper Arisan Beds:* Shokōkō, Nantō Gun, Tainan (臺南州南投郡初口坑).

31. Rapana bezoar, Linné var. thomasiana, Crosse

Rapana bezoar thomasiana. Yokoyama, Foss. Up. Musash. Kazusa a. Shimosa, p. 66, pl. III, fig. 6. Moll. Up. Musash. Tokyo, p. 304. Moll. Up. Musash. W. Shimosa a. So. Musashi, p. 441.

Two small broken examples.

Fossil occurrence.—*Upper Byoritz Beds:* Sankō, Injurin, Shinchik (新竹州苗栗郡員樹林三坑). Upper Musashino and Pliocene of Japan.

Living.—Northern, Central and Western Japan.

Family Tritonidae

32. Triton (Simpulum) costatus, (Born)

Pl. III. Fig. 9

Triton (Simpulum) costatus. Yokoyama, Moll. Coral Bed Awa, p. 17, pl. I, fig. 16.

Murex costatus. Born, Mus. Caes., p. 297.

A single almost perfect example, readily recognized by strong flat spiral ribs and threads. The ribs which show an imperfect tuberculation are two on the penultimate whorl, three on the ultimate and about ten on the base, the last becoming gradually weaker towards the caudal end.

Fossil occurrence.—*Upper Byoritz Beds:* Shikō, Kōshun, Takao (高雄州恒春四溝). Pleistocene of Japan.

Living.—Central and Western Japan. South Sea. Indian and Atlantic oceans.

33. **Distortio cancellinus,** (Roissy)

Pl. III. Fig. 8

Distortio cancellinus. Iwakawa, Cat. Jap. Moll. Nat. Hist. Dep., Tokyo Imp. Museum, p. 106, Tryon, Man. Conch., III, p. 35, pl. XVII, figs. 175-178.

Murex cancellinus. Roissy, Buff. Moll., 6, p. 56, no. 12.

Triton cancellinus. Küster, Syst. Conch. Cab. Mart. Chem., Purpurschnecken, p. 200, pl, 57, fig. 56.

A specimen much worn, yet easily recognized by the shell-surface being divided into net-like squares by longitudinal and spiral sculptures. Aperture contracted and narrowed, with teeth both on the inner lip as well as on the inner surface of the outer.

Fossil occurrence.— *Upper Byoritz Beds:* Shikō, Kōshun, Takao (高雄州恒春四溝).

Living.—Philippines, Indian Ocean. The species seems to be living somewhere also in Japan (Southern?), as it is mentioned in Iwakawa's Catalogue above cited under the local name of "Ibobora", without stating its exact locality.

34. **Gyrineum scelestum,** n. sp.

Pl. III. Figs. 5, 6

Shell subfusiform with body-whorl much longer than spire. The latter consists of about seven whorls of which three are nuclear, smooth and rounded. Postnuclear whorls angulate either in the middle or somewhat below it, with the surface above the angle flat and sloping, below vertical. The sculpture consists

of many unequal spiral cords of which five are especially coarse; of these five, two are on the upper shelf, one on the angle, and two on the vertical wall. All the cords, large and small, are crowned with pointed tubercles whose size corresponds to that of the cords. The pointed tubercles, when large, look like spines, the largest being on the angle. The tubercles are also often longitudinally elongated and assume the appearance of weak plicae as those of the angle. Varices two, wall-like, prominent, present on the body-whorl as well as on the two preceding ones, each provided with a spine. On the body-whorl, there is a narrow eave-like horizontal projection formed by the lateral union of tubercles, and situated between the posterior angle of the aperture and the left-side varix. Base also corded down to the caudal end, with cords tuberculate and one or two unequal finer ones between. Aperture broadly fusiform. Inner lip transversely corrugated. Outer lip thin, transversely ridged within, though ridges are not always distinct. Canal long, somewhat bent. Rather frequent.

There are several species which resemble the present one, such as *Gyrineum albivaricosum* Rve. (Tryon's Manual, III, pl. XVIII, fig. 6), *G. subgranosum* Sow. (Ibid. pl. XVIII, fig. 7), *G. crumenum* Lam. (Ibid. pl. XVIII, fig. 3), etc. But the Formosan form differs from all of them by the much longer canal.

Fossil occurrence.—*Upper Byoritz Beds:* (1) Kizan, Byoritz Gai (苗栗街龜山), (2) Nankwa (南窩), (3) Tenshi, Shiko Shō (四湖庄店仔), (4) Goko, Shiko Shō (四湖庄五湖), (5) Kyushōkō, Enri Shō (苑裡庄芎蕉坑), all in Shinchik Province (新竹州苗栗郡).

Family Cassididae

35. Cassis japonica, Reeve

Pl. III. Fig. 3

Cassis japonica. Pilsbry, Cat. Mar. Moll. Jap., p. 48.

Cassis saburon var. japonica. Tryon, Man. Conch., VII, p. 275, pl. V, fig. 76.

A perfect example and two imperfect ones. Tryon considers this species as a variety of *Cassis saburon* Adams. Our example has only a single varix which is on the penultimate whorl, if we except the one found outside the outer lip. The sculpture is in general clathrate by the incremental lines; but on the last part of the last whorl these lines are indistinct and the surface is simply spirally grooved.

Fossil occurrence.—*Upper Byoritz Beds:* Shikō, Kōshun, Takao (高雄州恒春四溝). *Lower Byoritz Beds:* (1) Mouth of the Banbakōkei (蕃婆坑溪) and (2) a doubtful specimen at Intōshi (員燈子), both in Shinchik (新竹州竹東郡).

Living.—Central and Western Japan.

36. Cassis gracilenta, n. sp.

Pl. III. Fig. 4

Shell small, with spire cemparatively high. Whorls about six, convex, ornamented with longitudinal folds which in the single specimen we possess number twelve. Body-whorl twice as long as spire, transversely grooved. Canal short, bent strongly sideward. Height 18 millim. Diameter 10.5 millim.

Fossil occurrence.—*Lower Byoritz Beds:* Intōshi, Shinchik (新竹州竹東郡員燈子).

Family Doliidae

37. **Dolium olearium,** BRUGUIÈRE

Pl. III. Fig. 11

Dolium olearium. Tryon, Man. Conch., VII, p. 262, pl. 11, figs. 8-10.

A cast having about twenty narrow spiral grooves on the body-whorl.

Fossil occurrence.—*Upper Byoritz Beds:* Babukutz, Taitō (臺東廳新港支廳馬武屈).

Living.—Philippines. Indian Ocean.

38. **Dolium** sp.

A fragment of a large *Dolium* with flat spiral ribs separated by broader interstices, each pierced with an interstial thread. It looks like *Dolium costatum* Menke (Tryon's Manual, Vol. VII, pl. IV, figs. 19–20) living in Japan and China.

Fossil occurrence.—*Lower Byoritz Beds:* Injurin, Shinchik (新竹州大溪郡員樹林).

39. **Pyrula taiwanica,** n. sp.

Pl. VI. Fig. 4

Shell pear-shaped, with a very low spire consisting of about four convex whorls separated by channelled sutures. Surface with widely separate spiral threads crossed by fine lines of growth. The body-whorl which is broken at the lower end shows about twelve spiral threads.

Only one example.

A shell figured as *Pyrula mammillata* (Gabb) in Arnold and Anderson's Geological and Oil Resources of Santa Maria Oil District, California (pl. XII, fig. 5) seems to resemble the present species, though the Californian has a greater number of spiral threads.

Fossil occurrence.—*Lower Arisan Beds:* Hagioka, Shinchik (新竹州大湖郡萩岡).

Family Cypraeidae

40. Cypraea carneola, Linné

Pl. IV. Fig. 4

Cypraea carneola. Yokoyama, Moll. Coral Bed Awa, p. 18, pl. II. fig. 11.

Two perfect examples, one adult and one young.

Fossil occurrence.—*Upper Byoritz Beds:* (1) Kizan, Byoritz Gai, Shinchik (新竹州苗栗街龜山); (2) Kontei, Kōshun, Takao (高雄州恒春郡墾丁).

Pleistocene of Japan.

Living.—Southern Japan and southern part of Western Japan (Satsuma and Tosa). Philippines. Moluccas.

41. Cypraea cinctoides, n. sp.

Pl. III. Fig. 10

A nearly perfect example and an imperfect one.

Shell subcylindrical, somewhat narrowed toward both ends. Dorsal side convex, front flattish with dorso-ventral diameter less than lateral. Aperture narrow, parallel-sided. Inner lip smooth. Outer lip transversely coarsely ridged, with ridges short. At the

apical end, the outer lip protrudes a little above the inner. Height about 38 millim. Lateral diameter 21 millim. Dorso-ventral diameter 16.5 millim.

This species is closely allied to *Cypraea cincta* Mart. (Foss. v. Java, pl. XXVIII, fig. 402) from the Pliocene of Java which, however, has the inner lip also ridged.

Fossil occurrence.—*Lower Byoritz Beds:* Gyunikki, Tainan (臺南州新營郡牛肉崎). *Upper Arisan Beds:* Babukutz, Taito (臺東新港支廳馬武屈).

42. Cypraea sp.

Pl. IV. Fig. 8

This is a fragment belonging to the apical portion of a shell closely resembling *Cypraea erosa* L. (Tryon, Man. Conch., VII, pl. XVIII, figs. 90, 100, 1) living in Central, Western and Southern Japan as well as further south.

Fossil occurrence.—*Upper Byoritz Beds:* Hōtosak, Rinkō Shō, Taihok (臺北州新莊郡林口庄竇斗厝).

Family Strombidae

43. Strombus sp.

An imperfect specimen with only body-whorl intact. It is pyriform, with the lower half rapidly tapering downward. The lower half of the surface is provided with many spiral grooves. The inner lip of the aperture has a thick callus spread over it, suggesting that the shell belongs to the genus *Strombus*. Outer lip broken.

Fossil occurrence. — *Lower Byoritz Beds:* Shōshikyak, Tainan (臺南州新豐郡松仔脚).

44. Rostellaria (Rimella) spinifera, Martin var. formosana

Pl. IV. Fig. 9

Shell ovately fusiform. Spire high, pointed. Whorls eleven and a half, of which first two and a half are nuclear, smooth and rounded. Postnuclear whorls bluntly angulate in the middle in the younger ones, convex in the older (last five). The sculpture consists of longitudinal plicae crossed by regular engraved spiral lines. Plicae about sixteen on the body-whorl and a few more on the penultimate, both excluding the varices which are two on the former and one on the latter. Of the two varices of the body-whorl, one is at the outside of the outer lip and the other diametrically opposite to it. The varix of the penultimate whorl is on its back-side, and weak and indistinct. Aperture narrow, subfusiform. Inner lip covered with a smooth thick glaze throughout, having four unequal transverse notches in the upper part of its lower half. These notches are not quite parallel, and the upper two larger and deeper than the lower two, the largest and deepest being the second one. Outer lip thickened with the inner side transversely corrugately plicate and the outer transversely dentate. Anterior canal short, posterior very narrow and long, going up to the third whorl from below. Only one specimen, but perfect.

This species is quite close to *Rostellaria spinifera* Martin (Foss. v. Java, p. 192, pl. XXX, figs. 447, 448), so close that I can

not but consider it as belonging to the same species, in spite of some slight difference present between the two. This difference lies in the more pointed spire and the indistinctness of varices on the whorls above the penultimate in the Formosan fossil, which I consider as merely varietal.

Fossil occurrence.—*Upper Byoritz Beds:* Jōwan, Shiko Shō, Shinchik (新竹州苗栗郡四湖庄上灣). In Java, the species occurs in the Pliocene.

45. **Rostellaria** sp.

Pl. IV. Fig. 2

A spire of a *Rostellaria* very slender in shape, with younger whorls longitudinally plicate and spirally striate, and the older rather smooth. It resembles that of *Rostellaria fusus* L. (Dickerson, Rev. Philip. Palaeontology, pl. V, fig. 1 ab) from the Vigo Group (Miocene) of the Philippines and also living in the Chinese seas.

Fossil occurrence.—*Upper Byoritz Beds:* Jōwan, Shiko Shō Shinchik (苗栗郡四湖庄上灣).

Family Cerithiidae

46. **Cerithium satoi**, n. sp.

Pl. III. Fig. 7

Shell small, turrete. Whorls about eleven, the first one nuclear, smooth and rounded. Postnuclear whorls flattish, almost without a curvature, though sutures are well marked.

Longitudinally plicate and spirally threaded. Longitudinal plicae more than twenty with one of them usually varicose, distant, rounded, straight or somewhat curved with concave side directed towards front reaching from upper suture to lower, generally narrower than interspaces. Spiral threads three, with a finer stria between and also below the lowest one, which latter on the body-whorl grows large and is prominent. Intersection points of plicae and threads tuberculous. Periphery angulate. Base abruptly narrowed, flattisth, with several spiral cords of which the uppermost is the largest; longitudinal plicae present only in the uppermost portion, soon vanishing below. Aperture ovate. Inner lip with peristome sharp and elevated. Outer lip with a few shallow transverse grooves within and a strong varix outside. Several examples, one of which measures 12.3 millim. in height and 4.6 millim. in diameter; while another measures 12.6 millim. in height and 5.1 millim. in diameter.

Fossil occurrence.—*Upper Byoritz Beds:* Shikō, Kōshun, Takao (高雄州恒春四溝). *Lower Byoritz Beds:* Nijūkei, Tainan (臺南州曾文郡二重溪).

47. **Cerithium** sp.

An imperfect example resembling *Cerithium kochi* Phil. (Yokoyama, Foss. Up. Musashino Kazusa a. Shimosa, pl. III, fig. 13), but differing by the shell being varicose.

Fossil occurrence.—*Lower Byoritz Beds:* Nijūkei, Tainan (臺南州曾文郡二重溪).

48. **Potamides (Tympanotomus) fluviatilis,**
POTIEZ et MICHELIN

Potamides (*Tympanotomus*) *fluviatilis.* Yokoyama, Foss. Miura Penin., p. 68, pl. IV, fig. 14. Foss. Up. Musash. Kazusa Shimosa, p. 71. Moll. Up. Musash. Tokyo, p. 395.

Not rare.

Fossil occurrence.—*Upper Byoritz Beds:* Hōtosak, Rinkō Shō, Taihok (臺北州新莊郡林口庄竇斗厝). *Lower Byoritz Beds:* (1) Nijūkei, Tombokōkei, Tainan (臺南州新營郡豚母坑溪二重溪); (2) Rokjūkei, Haksha Shō, Tainan (同州同郡白沙庄六重溪); (3) Bansha, Tainan (同州新豐縣蕃社); (3) east of Shōshikyak, Takao (高雄州旗山郡松仔脚). Upper and Lower Musashino of Japan.

Living.—Central and Western Japan. Philippines. Indian Ocean.

49. **Potamides (Batillaria) murayamai,** n. sp.

Pl. IV. Figs. 5, 6

Shell moderate in size, many whorled. Whorls somewhat convex with sutures distinct. Longitudinally plicate and spirally corded. Plicae coarse, rounded, mostly vanishing near the lower suture, although occasionally reaching it, strongest in the middle of the whorls, about ten in number on the body-whorl. Spiral cords six or seven, close, flat. Intersection-points of plicae and cords often tuberculous. Periphery rounded. Base convex with several spiral cords like those of the whorls. Aperture roundish, provided with a posterior canal. Rare.

This species is akin to *Potamides multiformis* Lke. (Yokoyama, Foss. Miura, Penin., p. 69, pl. IV, fig. 9), but is more slender with the whorls greater in number and plicae coarser.

Fossil occurrence.—*Upper Byoritz Beds:* Jōwan, Shiko Shō Shinchik (新竹州苗栗郡四湖庄上灣). *Lower Byoritz Beds:* Kwan-in San, Shinchik (同州大湫郡觀音山).

50. **Potamides muritus,** n. sp.

Pl. IV. Fig. 11

Shell turrete. Whorls many, flat, shouldered, somewhat gradate, longitudinally plicate and spirally grooved. Longitudinal plicae about seventeen on the body-whorl and thirteen on the preceding, straight, vertical, reaching from suture to suture except on the last two whorls in which they are distinct only at the shoulders where they are present as tubercles. A strong varix is present on the last whorl midway between its anterior and posterior ends. Spiral grooves two, dividing the surface into three parts which resemble flat cords, the lowest being situated just at the periphery which is angulate. Base flattened, with several spiral cords on it. Aperture lacking the outer lip, so that its shape is not exactly known, though presumably quadratic. Only one specimen with the last six whorls intact, 27 millim. in height and 12 millim. in diameter.

The shell somewhat resembles a Javan Miocene fossil *Potamides herklotsi* Martin (Foss. v. Java, pl. XXXIII, fig. 492), though not quite identic.

Fossil occurrence.—*Lower Byoritz Beds:* between Sekibyō (石廟) and Rokjūkei (六重溪), Tainan (臺南州新營郡).

Family Cerithiopsidae

51. Cerithiopsis (?) shikoensis, n. sp.

Pl. IV. Fig. 10

A broken specimen with the last four whorls intact.

The shell is small and many whorled, the whorls are angulate a little above the lower suture with the surface above the angle flat and steeply sloping, below somewhat receding. There are two spiral rows of tubercles, one below the suture and one on the angle, the surface between being usually smooth, though now and then there are indistinct plicae parallel to growth-lines and connecting the tubercles of the two rows. The base is flattish. The aperture is broken. Diameter 6 millim., the height being presumably more than twice the diameter.

This shell shows a striking resemblance to *Cerithiopsis* (*Lovenella*) *whiteavesii* Verrill (Tryon's Manual, p. 176, pl. XXXVI, fig. 73) of East Atlantic, which, however, has the longitudinal plicae connecting the tubercles well developed and prominent, besides being much smaller. Anyhow, there is a close affinity between the two.

Fossil occurrence.—*Upper Byoritz Beds:* Shikō, Kōshun, Takao (高雄州恒春四溝).

Family Vermetidae

52. Vermetus sp.

Only fragments, more or less roundish in section and quite worn.

Fossil occurrence.—*Lower Byoritz Beds:* Rokjūkei, Haksha Shō, Tainan (臺南州新營郡白沙庄六重溪).

Family Turritellidae

53. Turritella terebra, Linné

Pl. IV. Fig. 3

Turritella terebra. Tryon, Man. Conch., vol. VIII, 195, pl. LIX, figs. 32, 33. Martin, Foss. v. Java, p. 232, pl. XXXV, fig. 548.
Turbo terebra. Linné, Syst. Nat., ed. 12, p. 1239.

A shell with convex whorls which usually have six main spiral ridges and one to several interstial ones. Rather frequent.

Fossil occurrence.—*Lower Byoritz Beds:* (1) Rokjūkei, Haksha Shō, Tainan (臺南州新營郡白沙庄六重溪), (2) Sekibyo, Tainan (同州同郡石廟); (3) Nijūkei, Tainan (同州曾文郡二重溪). Pliocene of Java.

Living.—Philippines. Java.

54. Turritella bacillum, Kiener

Pl. IV. Fig. 1

Turritella bacillum. Tryon, Man. Conch., vol. VIII, p. 196, pl. LIX, figs. 34, 35. pl. LX, fig. 42.

Closely related to the preceding species, but differing from it by having flattened whorls. Very frequent.

Fossil occurrence.—*Lower Byoritz Beds:* (1) South of Kwanin San, Shinchik (新竹州大溪郡觀音山); (2) Tōhozei, Taichu (臺中州竹山郡東埔蚋); (3) Sōrok, Tainan (臺南州善化郡双六); (4) Nijūkei, Tondenkōkei, Tainan (同州新營郡豚田坑溪二重溪); (5) Rokjūkei, Haksha Shō, Tainan (同州同郡白沙庄六重溪); (6) between Sekibyo (石廟)

and Rokjukei (六重溪) (同州同郡); (7) Bansha, Tainan (同州新豐郡蕃社); (8) Gyunikki, Tainan (同州斗六郡牛肉崎). Upper Arisan Beds: A doubtful specimen at a place between Yōyōrin (幼葉林) and Kyukyuhei (九芎坪), Tainan (臺南州嘉義郡).

Living.—Northern, Central, Western and Southern Japan. Ceylon.

55. **Turritella filiola**, n. sp.

Pl. IV. Fig. 7.

Shell small. Whorls about sixteen, flattish, receding near the sutures, spirally ridged. Ridges several, of which three are especially strong, equally distributed. Of the weaker ridges, the one above the uppermost main ridge and the one below the lowest may grow large and become prominent on the older whorls. Incremental lines coarse, often making the ridges appear tuberculate on crossing them. Aperture quadratic. Frequent. One of the specimens measures 19 millim. in height and 4.5 millim. in diameter; while another measures 18 millim. in height and 4 millim. in diameter.

Closely related to *Turritella facialis* Menke (Tryon, Man. Conch., III, p. 197, pl. LIX, figs. 36, 37) of China and Japan, though the whorls are less in number and more flattened.

Fossil occurrence.—*Upper Byoritz Beds:* (1) Kizan, Byoritz Gai (新竹州苗栗郡苗栗街龜山); (2) Shikō, Kōshun, Takao (高雄州恒春四溝).

Lower Byoritz Beds: (1) Sairyo, Tainan (臺南州新化郡菜寮); (2) Nijūkei, Tondenkōkei, Tainan (同新營郡豚田坑溪二重溪); (3) Ginjōzan, Takao (高雄州旗山郡銀錠山).

56. **Turritella** sp.

Only impressions which, however, show that the whorls are convex.

Fossil occurrence—*Upper Arisan Beds:* Rampokō, Yōyōrin, Tainan (臺南州嘉義郡幼葉林埤埔坑).

57. **Turritella** sp.

A rather flat-whorled form in fragments.

Fossil occurrence.—*Lower Arisan Beds:* Hagioka, Shinchik (新竹州大湖郡萩岡).

Family Melaniidae

58. **Melania scabroides**, n. sp.

Pl. V. Fig. 1

Shell small, narrowly ovate. Spire shorter than body-whorl. Apex more or less eroded, the whorls intact being not greater than seven. They are angulate at the upper third, with the surface above the angle slightly concave and inclined, below somewhat convex and vertical. The sculpture consists of longitudinal plicae and spiral striae; the plicae are about thirteen in number, rounded, narrower than interspaces, tuberculate at the angle and becoming weak and indistinct towards the last part of the body-whorl. The spiral striae are several above the angle as well as below it, equal except the two near the lower suture which are stronger than the others. On the older whorls there is often a fine stria just above the suture. The periphery is rounded with the base gradually narrowed downward and furnished with coarse

striae down to the caudal end, usually with a finer interstial between. The aperture is ovate, pointed behind, with outer lip thin.

The shell-form is somewhat variable, some being broader than others. In general the height is slightly greater than twice the diameter. We possess four examples, the largest being 16.5 millim. in height.

This species resembles *Melania scabra* Müller (Syst. Conch. Cab. Mart. Chem., Melaniidae, pl. 27, figs. 14, 14a) of the Moluccas as well as *Melania armillata* Lea (Ibid., p. 309, pl. 32, fig. 5) of Ceylon, though the former is more slender, and the latter has the whorls more flattened.

Fossil occurrence.—*Upper Byoritz Beds:* Shikō, Kōshun, Takao, (高雄州恒春四溝).

59. **Melania submadiunensis,** n. sp.

Pl. V. Figs. 2-5

Shell small, ovately conical. Spire considerably shorter than body-whorl. Whorls nine, flat, shouldered, longitudinally plicate and spirally grooved. Longitudinal plicae numerous, varying from fifteen to twenty-five in number, though usually about twenty, rounded, oblique, curved with concave side directed to front, separated by interspaces of about equal breadth. Spiral grooves usually three, cutting the plicae into rows of tubercles of different forms, some being round, some quadratic, some elongated, with the uppermost tubercle often larger than the others. Periphery rounded. Base convex, with many spiral grooves cutting the plicae in the same way as on the whorl-surface. Aperture elongato-ovate with posterior corner pointed.

Inner lip covered with a layer of glaze. The outer lip is broken in all of the many specimens we possess, probably on account of its thin state. The largest specimen measures 23 millim. in height and 11 millim. in diameter.

This shell closely resembles a Pliocene form of Java, *Melania madiunensis* Mart. (Foss. v. Java, p. 242, pl. XXXV, figs. 578–580) which, however, has the sculpture finer.

Fossil occurrence.—*Lower Byoritz Beds:* (1) The west end of Fukki, Shinchik (新竹州苗栗郡福基); (2) Rokjūkei, Haksha Sho, Tainan (臺南新營郡白沙庄六重溪); (3) between Sekibyo (石廟) and Nijūkei (二重溪) (同州同郡); (4) Wankyo, Tainan (同州嘉義郡灣橋); (5) Denshi, Tainan (同州曾文郡田仔); (6) the upper course of the Nairin, Tainan (同州斗六郡內林川).

60. **Melania saigoi,** n. sp.

Pl. V. Fig. 10

Only one specimen with the aperture broken.

The shell is rather thin, ovato-conical and pointed. The whorls number about nine and a half, of which the first one and a half are nuclear, smooth and rounded; postnuclear whorls flatly convex with the first four longitudinally coarsely plicate, the penultimate indistinctly plicate and the ultimate without any plicae. There are also spiral striae which are close together and usually alternately large and small. Incremental lines coarse, making the spiral striae on crossing them more or less granular. The aperture seems to have been ovate. Diameter 13.3 millim. Height about 30 millim. (?)

The shell shows some resemblance to *Melania arthurii* Brot. (Syst. Conch. Cab. Mart. Chem., Melaniidae, pl. 23, fig. 1) of the South Sea.

Fossil occurrence.—*Upper Byoritz Beds:* Shikō, Kōshun, Takao (高雄州恒春四溝).

61. **Melania glabelliuscula** n. sp.

Pl. V. Fig. 9

A single specimen lacking the apex and aperture.

Shell small, ovato-conical. The six whorls intact are flattish, with the upper margin somewhat protruding above the sutures, finely and unequally spirally striate on the body-whorl, the striae being visible only under a magnifier. Periphery rounded. Base convex, furnished with five or six spiral striae with several finer ones between. The aperture seems to have been ovate. Diameter 5.7 millim. Height about 11 millim.

Fossil occurrence.—*Upper Byoritz Beds:* Shikō, Koshun, Takao (高雄州恒春四溝).

62. **Melania grossula,** n. sp.

Pl. V. Fig. 8

A small shell lacking the apical portion, the whorls intact being four and a half.

The shell is ovato-conical with the body-whorl longer than the spire. The whorls are in the upper third slightly excavated and sloping, while in the lower two-thirds they are somewhat convex and vertical, without any distinct angulation between the two surfaces. The sculpture consists of longitudinal ribs and

spiral cords. The ribs are eleven on the penultimate and ultimate whorls, prominent, rounded and somewhat curved, with interspaces much broader. The cords are five, one being subsutural, one at the boundary between the concave and convex surfaces and three on the vertical wall. The intersection-points of ribs and cords are subtubercular. On the body-whorl, there is a sixth cord just above the suture. Base convex, ornamented only with spiral cords which are five in number, elevated, distant, and separated by broader intervals. Aperture oval, pointed behind. Height about 7 millim. Diameter 3.3 millim.

Fossil occurrence.—*Lower Byoritz Beds:* The upper course of the Nairin, Tainan (臺南州斗六郡內林川).

Family Solariidae

63. Solarium perspectivum, Linné.

Pl. V. Fig. 7

Solarium perspectivum. Linné, Syst. Nat., Ed. 10, p. 727. Martin, Foss. v. Java, p. 246, pl. XXXVII, figs. 591-597. Tryon, Man. Conch., vol. IX, p. 8, pl. II, figs. 18-21.

This is a well known shell still living in the Eastern seas. We possess three fine specimens and a fragment.

Fossil occurrence.—*Upper Byoritz Beds:* (1) Kizan, Byoritz Gai, Shinchik (新竹州苗栗郡苗栗街龜山); (2) Jōnanseikō, Shiko Shō, Shinchik (同州同郡四湖庄上南勞坑); (3) Shikō, Koshun, Takao (高雄州恒春四溝). Pliocene of Java.

Living.—Western Japan. China. Indian Ocean.

Family Naticidae

64. Polinices sagamiensis, Pilsbry

Pl. VI. Fig. 2

Polinices sagamiensis, Pilsbry, New. Jap. Mar. Moll., Gastr., Proc. Acad. Nat. Sci. Philad., Jan., 1904., p. 23, pl. IV, figs. 37. 37a.

Polinices powisianus. Yokoyama, Foss. Up. Musash. Kazusa a. Shimosa, p. 83, pl. IV, fig. 13.

This shell was first taken by Pilsbry for *Polinices powisianus* Recl. (Pilsbry's Catalogue, p. 71) to which I followed in my paper above cited. But finding that he had afterwards recognized in it a new species, I denominate it by the new specific name he had chosen.

The Formosan fossil has the spire more depressed than most of the living specimens. But as such depressed forms are also occasionally found among the latter, this character, I believe, is only a varietal one, Common.

Fossil occurrence.—*Upper Byoritz Beds:* (1) Kyushōkō, Enri Shō, Shinchik (新竹州苗栗郡苑裡庄芎蕉坑); (2) Kōdenkō, Shiko Shō, Shinchik (同州同郡四湖庄鴨田坑). *Lower Byoritz Beds:* (1) The mouth of the Banbakōkei, Shinchik (新竹州竹東郡蕃婆坑溪口); (2) Intōshi, Shinchik (同州同郡員崠子); (3) Nijūkei, Tainan (臺南州曾文郡二重溪). Upper Musashino of Japan.

Living.—Central and Western Japan.

65. Natica colliei, Recluz

Pl. VI. Fig. 1

Natica colliei. Pilsbry, Cat. Mar. Moll. Jap., p. 71, Tryon, Man. Conch., vol. VIII, p. 26, pl. VII, figs. 30-34. Recluz, Ann. Mag., 1875, p. 427.

Closely related to *Natica janthostoma* Desh. (Yokoyama, Foss. Miura Penin., pl. V, figs. 3, 4), this shell has its rounded central callus entering into the umbilicus. Not rare.

Fossil occurrence.—*Upper Byoritz Beds:* (1) Kizan, Byoritz Gai, Shinchik (新竹州苗栗郡苗栗街龜山); (2) Shikō, Kōshun, Takao (高雄州恒春郡恒春四溝). Several, though doubtful, specimens were also found in the *Lower Byoritz Beds.* The localities are: (1) The mouth of the Banbakōkei (新竹州竹東郡蕃婆坑溪口), (2) west end of Fukki (同州苗栗郡福基) and (3) Katōkō, Rōdenryō Shō (同州同郡老田寮庄茄苳坑).

Living.—Central and Western Japan.

66. **Natica** sp.

A small form with whorls more or less flattened near the suture. Apparently different from the two preceding species, but imperfectly preserved and indeterminable.

Fossil occurrence.—*Lower Arisan Beds:* Hagioka, Shinchik (新竹州大湖郡萩岡).

67. **Sigaretus undulatus,** Lischke

Pl. VI. Fig. 5

Sigaretus undulatus. Lischke, Jap. Meeresconch., vol. III, p. 54, pl. III, figs. 11-14.

A depressed shell with many undulating spiral furrows separated by equally broad, flat, spiral ribs. Tryon thinks that it is probably identical with *Sigaretus incisus* Rve (Manual, VIII, p. 58). of the Moluccan seas. A single specimen, rather imperfect.

Fossil occurrence.—*Upper Byoritz Beds:* Jōnanseikō, Shiko Shō, Shinchik (新竹州苗栗郡四湖庄上南勢坑).

Living.—Central Japan.

Family Turbidae

68. Turbo marmoratus, Linné, var. laevis

Pl. IV. Fig. 12

This is what I consider as a variety of *Turbo marmoratus* Linné (Tryon's Manual, vol. X, p. 191, pl. XLI, fig. 23). The shell is large, and its whorls are spirally keeled with transversely elongated tubercles on the keel. On the body-whorl there are three rows of such tubercles, one on the keel, one at the same level as the last end of the suture, and one on the base, the distance between being nearly equal, though the tubercles are not so, being weak and often faint in the middle row. The remaining portion of the surface is quite smooth; while in the typical form of the species it is spirally striate. Two specimens, not quite perfect.

Fossil occurrence.—*Upper Byoritz Beds:* Kontei, Takao (高雄州恒春郡墾丁).

The typical form lives in Central as well as in Southern Japan. Philippines, etc.

69. Turbo (Senectus) argyrostomus, Linné var. margaritacea, Linné.

Pl. V. Fig. 11

Turbo argyrostomus var. margaritacea. Tryon, Man. Conch., vol. X, p. 198, pl. XLV, fig. 100.

Turbo margaritaceus. Linné, Syst Nat., Ed. XII, p. 1 236, no. 625.

A species with a thick solid shell ornamented with spiral grooves whose interspaces resemble flat ribs alternately large and small. Two perfect examples.

Fossil occurrence.—*Upper Byoritz Beds:* Kontei, Takao (高雄州恒春郡墾丁).

Living.—Northern, Central, Western and Southern Japan. Indian Ocean.

Family Trochidae

70. Gibbula (?) tainanica, n. sp.

Pl. VI. Fig. 3

Shell small, depressed-conical, umbonium-like in form. Whorls about seven, ornamented with three strong spiral ribs separated by deep and narrower valleys. Ribs on the older whorls divided into two by a median impressed spiral line, so that the number of the ribs becomes double-that is to say, six. There are also oblique incised lines parallel to the growth-lines which on crossing the ribs make them granulate. On the body-whorl, the number of double ribs are four, the lowest lying on the rounded periphery. Base convex, furnished with about five double-ribs which are also granulate. Umbilicus large and deep. The aperture is broken in all the specimens which are frequent, though more or less deformed; but it seems to have been subrhomboidal in form. Height 7 millim. Diameter 9 millim. The largest specimen we possess is 14 millim. in diameter.

Fossil occurrence.—*Lower Byoritz Beds:* (1) Sairyō, Tainan (臺南州新化郡菜寮); (2) Nijūkei, Tainan (同州曾文郡二重溪).

71. Umbonium costatum, (Valencienne)

Umbonium costatum. Yokoyama, Foss. Miura Penin., p. 95, pl. VI, fig. 6. Foss. Up. Musash. Kazusa a. Shimosa, p. 114.

Most of the specimens possess as usual several spiral grooves as well as a subsutural row of tubercles. But, now and then, we find those in which the grooves are reduced to only two or three, or are even absent. Not frequent.

Fossil occurrence.—*Upper Byoritz Beds:* (1) Hōtosak, Rinkō Shō, Taihok (臺北州新莊郡林口庄賓斗厝); (2) Kōdenko, Shiko Shō, shinchik (新竹州苗栗郡四湖庄鴨田坑). *Lower Byoritz Beds:* (1) Wankyō (嘉義郡灣橋), (2) Nijūkei (曾文郡二重溪), (3) Gyūnikki (六斗郡牛肉崎), all in Tainan. Upper and Lower Musashino of Japan.

Living.—Northern, Central and Western Japan.

Family Fissurellidae

72. Scutus unguis, (Linné)

Pl. V. Fig. 6

Scutus unguis. Pilsbry, Cat. Mar. Moll. Japan, p. 100, Tryon, Man. Conch., XII, p. 289, pl. XL, figs. 4–8.

A nearly perfect example, 22 millim. long, 10.4 millim. broad, and 2.6 millim. high. It is depressed, oblong, almost parallel-sided, only slightly narrowed towards front, with the pointed apex on the posterior third of the shell and directed backward. The surface is wavy-striate and obliquely corrugated.

Fossil occurrence.—*Upper Byoritz Beds:* Kizan, Byoritz Gai, Shinchik (新竹州苗栗郡苗栗街龜山).

Living.—Central and Western Japan. Philippines. Australia.

II. Scaphopoda

Family Dentaliidae

73. Dentalium octogonum, LAMARCK

Dentalium octogonum. Yokoyama, Foss. Miura Penin., p. 103, pl. VI, figs. 22-24. Foss. Up. Musash. Kaz. Shim., p. 118. Tert. Moll. South. Totomi, p. 347.

A few fragments.

Fossil occurrence.—*Upper Byoritz Beds:* Kizan, Byoritz Gai, Shinchik (新竹州苗栗郡苗栗街龜山). *Lower Byoritz Beds:* (1) Intoshi (員崠子) and (2) the mouth of the Banbakōkei (蕃婆坑溪口), both in Shinchik (新竹州竹東郡). *Upper Arisan Beds:* A six-sided tubular shell very much like this species at Shokokō, Taichū (臺中州南投郡初口坑). Upper Musashino to Pliocene in Japan.

Living.—Northern, Central, and Western Japan. Ceylon.

74. Dentalium vernedei, HANLEY

Pl. V. Fig. 12 (?) Pl. VI. Fig. 6, 6a

Dentalium vernedei. Sowerby, Thes. Conch., vol. III, p. 101, pl. 223, fig. 3. Tryon, Man. Conch., XVII, p. 80, pl. III, figs. 35, 43,

A solid shell, gently curved, with numerous rounded longitudinal ribs. Aperture circular. A deep ventral slit is found at the apical end. Numerous examples.

Fossil occurrence.—*Upper Byoritz Beds:* (1) Tanbunko, (新竹州苗栗郡淡文湖); (2) Shikō, Kōshun, Takao (高雄州恒春四溝). *Lower Byoritz Beds:* A doubtful specimen at Yaryūkō, Banri Shō, Taihok (臺北州基隆郡萬里庄野柳岬).

Living.—Western Japan. China.

75. **Dentalium subrectum**, JEFFREYS

Pl. VI. Fig. 11

Dentalium subrectum. Tryon, Manual, vol. XVII, p. 119, pl. 18, fig. 5.

A small, slender, acicular, smooth shell, slightly curved and gradually tapering into a acuminate apex. The cross-section is circular. Numerous, scattered on the rock-surface.

Fossil occurrence.—*Lower Byoritz Beds*: Yaryukō, Banri Shō, Taihok (臺北州基隆郡萬里庄野柳岬).

Living.—Philippines.

76. **Dentalium** sp.

Fragments of a tubular shell round in section and smooth on surface.

Fossil occurrence.—*Upper Arisan Beds:* Shokōkō, Taichū (臺北州南投郡郡初口坑).

77. **Dentalium** sp.

A worn specimen rapidly tapering towards one end. No surface sculpture, which may perhaps be due to friction.

Fossil occurrence.—Lower Arisan Beds: Hagioka, Shinchik (新竹州大湖郡萩岡).

78. **Cadulus gordonis**, YOKOYAMA

Cadulus gordonis. Yokoyama, Foss. Miura Penin., p. 104, pl. VI, figs. 25, 26.

Several specimens, though in fragments.

Fossil occurrence.—*Lower Byoritz Beds:* Wankyo, Tainan (臺南州嘉義郡灣橋).

III. Lamellibranchiata

Family Pholadidae

79. **Pholas** sp.

Pl. VI. Fig. 7

A right valve lacking the posterior end and also broken at antero-dorsal and ventral borders.

The shell is transversely elongated, convex, coarsely concentrically grooved and radiately costellate, the costellae vanishing near the posterior end.

Fossil occurrence.—*Upper Byoritz Beds:* Ubikō, Tsūshō Shō, Shinchik (新竹州苗栗郡通宵庄烏眉坑).

80. **Pholas** sp.

A left valve resembling the preceding species, but not quite identical. Indeterminable on account of its imperfect and deformed state.

Fossil occurrence.—*Lower Byoritz Beds:* Shōmon, Shinchik (新竹州竹東郡照門).

Family Corbulidae

81. **Corbula erythrodon**, LAMARCK

Corbula erythrodon. Yokoyama, Foss. Up. Musashino Kaz. a. Shim., p. 122, pl. VI, figs. 8, 9. Tert. Moll. So. Totomi, p. 348, pl. 40, fig. 3.

This shell frequently found in the Neogene beds of Japan is also common in Formosa.

Fossil occurrence.—*Upper Byoritz Beds:* (1) Hōtosak, Rinkō Shō, Taihok (臺北州新莊郡林口庄竇斗厝); (2) Kōdenkō, Shiko Shō (四湖庄鴨田坑), (3) Kyushōkō, Enri Shō (苑裡庄芎蕉坑) and (4) Shūtō, Sankyaksui (山腳水圳頭), in Shinchik (新竹州苗栗郡). *Lower Byoritz Beds:* Kyūkyūrin, Sanwan Shō, Shinchik (新竹州竹南郡三灣庄九芎林); (2) south of Kwan-in San, Taikei Gai, Shinchik (同州大溪郡大溪街觀音山); (3) Sekibyō, Tainan (臺南州新營郡石碑). Upper Musashino and Pliocene of Japan.

Living.—Central and Western Japan.

82. **Corbula substriata,** Yokoyama

Corbula substriata. Yokoyama, Foss. Up. Musash. Kaz. Shim., p. 125, pl. VII, fig. 3.

This is a small form, swollen, as long as high, concentrically grooved on the surface and with a dorsal edge. Quite frequent, often filling the rock, but difficult to isolate, so brittle is the shell.

Fossil occurrence.—*Lower Byoritz Beds:* (1) Intōshi (員塘子) and (2) the mouth of the Banbakōkei (蕃婆坑溪口), both in Shinchik (新竹州竹東郡). Upper Musashino of Japan.

Family Mactridae

83. **Mactra banbakoensis,** n. sp.

Pl. VII. Fig. 8

A left valve only. It is convex, roundly trigonal, nearly as high as long, rounded both in front and behind, though somewhat more broadly in the latter. Surface smooth. A weak dorsal edge runs from the beak toward the postero-ventral corner,

though it vanishes on the way. Beak small. Length 22 millim. Height 20 millim, Depth 7.3 millim.

Fossil occurrence.—*Lower Byoritz Beds:* The mouth of the Banbakōkei, Shinchik (新竹州竹東郡蕃婆坑溪口). A similar shell occurs also at Intoshi (同郡員崠子).

84. **Mactra** sp.

A species somewhat broader than the preceding. Too badly preserved to be determined.

Fossil occurrence.—*Lower Byoritz Beds:* Shōdōraken, Sanwan Shō, Shinchik (新竹州竹東郡三灣庄小銅鑼圈).

Family Solenidae

85. **Solen** sp.

A fragment resembling that of *Solen grandis* Dkr. (Yokoyama, Foss. Up. Musash. Kaz. Shim. pl. IX, fig. 1).

Fossil occurrence.—*Upper Byoritz Beds:* Tenshi, Shiko Shō, Shinchik (新竹州苗栗郡四湖庄店仔).

86. **Siliqua intoshiana**, n. sp.

Pl. VI. Fig. 8, 9, 10

Shell small, compressed, transversely elongato-elliptical, very inequilateral, posterior side more than twice as long as anterior. Surface smooth. A strong, straight, inner rib is present, running from the beak somewhat obliquely to the ventral margin. Length 15 millim. Height 6 millim.

The shell is much shorter than *Siliqua pulchella* Dkr. (Yokoyama, Foss. Up. Musash. Kaz. Shim., pl. IX, fig. 7) and longer than *Siliqua acutalis* Böttger (Tertiärform. u. ihre Thierreste, pl. III, fig. 10). Frequent, but all badly preserved.

Fossil occurrence.—*Lower Byoritz Beds:* Intōshi, Shinchik (新竹州竹東郡員埔子).

87. **Solecurtus** sp.

A compressed, transversely elliptical shell with engraved divaricating lines. It resembles *Solecurtus divaricatus* Lke. (Jap. Meeresconch., vol. I, pl. X, figs. 1, 2) living and also fossil in Japan. But as its preservation is extremely ill, it is not possible to determine it with any degree of accuracy.

Fossil occurrence.—*Upper Byoritz Beds:* Tanbunko, Shinchik (新竹州竹南郡淡文湖).

Family Tellinidae

88. **Tellina taiwanica,** n. sp.

Pl. VII. Figs. 1, 2

Shell small, thin, compressed, suboval in outline, inquivalve, very inequilateral, with anterior side longer than posterior, broadly rounded in front, subtruncate behind, arched at ventre, with antero- and postero-dorsal borders sloping and almost straight. Surface ornamented with elevated concentrical striae especially prominent on the posterior portion of the shell. A blunt edge is present near the postero-dorsal border. Beaks small.

A right and a left valve belonging to different individuals. The former is 15 millim. long, 12 millim. high and 3.2 millim. deep, while the latter is 11.5 millim. long, 9.8 millim. high and 2.5 millim. deep.

Closely related to *Tellina subtruncata* Hanl. (Reeve, Conch. Icon., sp. 41) of the Philippines. But judging from Reeve's figure, Hanley's species has the dorsal edge more distant from the posterior border, while the striae are described as serrate.

Fossil occurrence.—*Upper Byoritz Beds:* Tenshi, Shiko Shō, Shinchik (新竹州苗栗郡四湖庄店仔).

89. **Tellina** sp.

A shell more equilateral than the preceding. Only in fragments.

Fossil occurrence.—*Lower Byoritz Beds:* Shōmon, Shinchik (新竹州竹東郡照門).

Family Veneridae

90. **Dosinia gruneri,** PHILIPPI

Pl. VII. Fig. 3

Dosinia gruneri. Philippi, Abbild. III, p. 23, Cytherea, pl. VIII, fig. 2. Pilsbry, Cat. Mar. Moll. Japan, p. 126.

This species is related to *Dosinia troscheli* Lke., so frequent in the Tertiary layers of Japan, though distinguished by its dorsal border sloping more rapidly than in the latter. The surface is furnished with elevated concentric striae, and there is a deep lunula as well as a long narrow area.

Fossil occurrence.—*Upper Byoritz Beds:* (1) Shūtō, Sankyaksui, Enri Shō (苑裡庄山脚水圳頭) and (2) Jōnanseikō, Shiko Shō (四湖庄上南勢坑), both in Shinchik (新竹州苗栗郡).

Living.—Central and Western Japan.

91. **Dosinia angulosa,** PHILIPPI

Pl. VII. Fig. 4

Dosinia angulosa. Yokoyama, Moll. Rem. Mid. Part. Jōban Coalf., p. 17, pl. II, figs. 19, 20. Tert. Moll. Shinano Echigo, p. 12. Foss. Shells Atsumi Penin., p. 370.

A single individual with both valves intact.

Fossil occurrence.—*Lower Byoritz Beds:* Bansha, Tainan (臺南州新豐郡蕃社). Upper Musashino and Pliocene of Japan.

Living.—Central and Western Japan. Philippines.

92. **Dosinia troscheli,** LISCHKE

Dosinia troscheli. Yokoyama, Foss. Miura Penin., p. 119, pl. VIII, figs. 5, 6. Foss. Up. Musash. Kazusa, p. 144. Tert. Moll. So. Totomi, p. 349. Moll. Rem. Mid. Part Jōban Coalf., p. 17. Moll. Up. Musash. Tokyo, p. 400. Moll. Up. Musash. W. Shimosa a. So. Musashi, p. 444.

Only fragments of a left valve.

Fossil occurrence.—*Lower Byoritz Beds:* Sairyo, Tainan (臺南州新化郡菜寮). *Upper Arisan Beds:* A doubtful specimen was found at Shokōkō, Taichu (臺中州南投郡初口坑). Upper Musashino and Pliocene of Japan.

Living.—Central and Western Japan.

93. **Meretrix meretrix,** LINNÉ

Pl. VII. Fig. 9

Meretrix meretrix. Yokoyama, Foss. Miura Penin., p. 146, pl. XI, fig. 4. Neog. Shells Kozuke etc, p. 230. Foss. Shells Sado, p. 291.

The shell found in Formosa is markedly shorter than those already described by me from the Musashino Formation of Japan (Foss. Miura Penin, p. 146, Foss. Shells Sado, p. 291, etc). Such a form, however, we find occasionally also among the younger individuals of the recent seas, so that it must be considered merely as a variation.

Fossil occurrence.—*Upper Byoritz Beds:* (1) Hōtosak, Rinkō Shō, Taihok (臺北州新莊郡林口庄賓斗厝); (2) Kizan, Byoritz Gai, Shinchik (新竹州苗栗郡苗栗街蟠山); (3) Jōnanseikō, Shinchik (同州同郡上南勢坑). *Lower Byoritz Beds:* (1) Wankyo, Tainan (臺南州嘉義郡灣橋); (2) Rokjūkei, Tainan (同新營郡六重溪). *Upper Arisan Beds:* (1) South of Sekkasan, Taichu (臺中州東勢郡赤柯山); (2) between Shukkōkō (出磺坑) and Fukki (福基), Shinchik (新竹州苗栗郡).

Musashinos and Pliocene of Japan.

Living.—Northern, Central and Western Japan. Philippines. Indian Ocean.

94. **Meretrix indecoroides,** n. sp.

Pl. VII. Fig. 6

A left valve only.

Shell small, solid, inflated, roundly trigonal, somewhat longer than high, inquilateral, rounded in front and behind, though more broadly in the latter. Surface coarsely concentricably sublamellated. Lunula large, cordate, bounded by a deep groove on both sides, with length nearly equal to breadth. Main teeth three, strong, with the middle one thickest and the anterior shortest. Besides, there is a lunular tooth in front, process-like in shape. Pallial sinus large, deep, obliquely as-

cending, broad at mouth, gradually tapering toward its end which is bluntly pointed. The inner border of the shell is somewhat flattened, smooth and divided into two unequal parts by a groove running along its median line. Length 11.5 millim. Height 11 millim. Depth 4.2 millim.

This species shows a close relation to *Meretrix indecora* Phil. (Abbild. III, Cytherea, p. 42 pl. IX, fig. 7) living in Western Japan, Philippines, etc. Our fossil is perhaps more like the same species represented in fig. 70, pl. 136 of the second volume of Sowerby's Thesaurus Conchyliorum which is more rounded than that given by Philippi. But Philippi's species is described as „exquisite transversim sulcato-striata" which is not at all the case in ours.

Fossil occurrence.—*Lower Byoritz Beds:* Nankō, Kōzan Shō, Shinchik (新竹州竹南郡香山庄南港).

95. **Meretrix (Macrocallista) ezoensis,** (YOKOYAMA)

Pl. VIII. Fig. 1

Tapes ezoensis. Yokoyama, Verst. a. d. Japan. Kreide, p. 197, pl. XXV, fig. 6ab, 7, 8.

Callista chishimana. Iwakawa, Cat. Jap. Moll. Nat. Hist. Dep. Tokyo Imp. Mus., p. 294.

Meretrix (Callista) chinensis. Yokoyama, Foss. Miura Penin., p. 120, pl. VIII, figs. 9, 10. Foss. Up. Musash. Kaz. Shim., p. 146, pl. XI, fig. 5. Moll. Rem. Lowest Part Jōban Coalf., p. 14, pl. XIV, figs. 7, 8. Tert. Moll. Totomi, p. 350.

In my papers on the fossil Mollusca of Japan hitherto published, this species was erroneously treated as *Meretrix (Callista) chinensis* Chem. It is really *Macrocallista chishimana* Pilsbry as

pointed out by Mr. J. Makiyama of the Kyoto University. But before Pilsbry had given it a name, I described it in 1889 as *Tapes ezoensis* in a paper above cited relating to the fossils of the Hokkaido. Therefore I will henceforth call it by the name chosen by myself.

Frequent, though not all in a good preservation.

Fossil occurrence.—*Upper Byoritz Beds:* (1) Jōnanseikō (上南勢坑) and (2) Kōdenkō (鴨田坑) both in Shiko-Shō, Shinchik (新竹州苗栗郡四湖庄); (3) Enri (苑裡) and (4) Shūtō, Sankyaksui (山脚水圳頭), both in Byoritz Gun, Shinchik. *Lower Byoritz Beds:* Kwanshirei, Haksha Shō, Tainan (臺南州新營郡白沙庄關子嶺); (2) Meitō Shō, Tainan (臺南州新化郡鳴頭庄); (3) east of Shōshikyak, Takao (高雄州旗山郡松仔腳). Musashinos, Pliocene and Miocene of Japan.

Living.—Northern Japan.

96. **Sunetta excavata,** (Hanley)

Sunetta excavata. Yokoyama, Foss. Up. Musash. Kaz. Shim., p. 147, pl. XI, figs. 6-7.

Very rare. We possess only two left valves of young individuals.

Fossil occurrence.—*Upper Byoritz Beds:* Chōhōtō, Shinchik Gai, Shinchik (新竹州苗栗郡新竹街鳥崩頭). *Lower Byoritz Beds:* Nijūkei, Tainan (臺南州曾文郡二重溪). Upper Musashino of Japan.

Living.—Northern, Central and Western Japan.

97. **Clementia** sp.

A fragment of a thin shell concentrically furrowed. It

closely resembles that of *Clementia papyracea* Gray (Sowerby, Thes. Conch., vol. II, p. 700, pl. 160, fig. 155).

Fossil occurrence.—*Upper Byoritz Beds:* Shikō Kōshun, Takao (高雄州恒春四溝).

98. **Clementia** (?) sp.

Pl. VII. Figs. 5, 5a

A beak-portion of a small inflated, very inequilateral shell with the surface coarsely concentrically grooved and the beak prominent, pointed and incurved.

Fossil occurrence.—*Upper Arisan Beds:* Tairōkei, Arisan, Mingets, Tainan (臺南州嘉義郡眠月阿里山大濫溪).

99. **Venus** (?) **arisanensis**, n. sp.

Pl. VIII. Fig. 6

Shell moderate in size, flatly convex, trigonal in outline, rounded in front, bluntly pointed behind. Surface concentrically striated. Beaks approaching. Lunula cordate, somewhat longer than broad, bounded on both sides by a sharp edge. Pallial sinus short-triangular, somewhat ascending, with end bluntly pointed. Several specimens, but all ill preserved. The best preserved measures about 52 millim. in length, about 40 millim. in height and about 25 millim. in thickness.

Fossil occurrence—*Lower Arisan Beds:* (1) East of Sachihara (幸原), (2) Hagioka and (3), Hinata (日向), all in Shinchik (新竹州大湖郡).

100. **Chione casinaeformis**, Yokoyama

Pl. VIII. Fig. 4

Chione casinaeformis. Yokoyama, Tert. Moll. South. Totomi, p. 352, pl. XXXIX, figs. 7-9. Tert. Shells Tosa, p. 308, pl. XLII, fig. 3. Tert. Foss. West. Hizen, p. 186, Pl. I, fig. 5.

Several isolated valves comparatively well preserved.

Fossil occurrence.—*Upper Byoritz Beds:* Shikō, Kōshun, Takao (高雄州恒春四溝). Pliocene and Miocene of Japan.

Living.—Central Japan.

101. Chione foliacea, (Philippi)

Pl. VII. Fig. 7

Chione foliacea. Philippi, Abbild., vol. II, p. 107, pl. V, fig. 1.
Chione isabellina. Yokoyama, Foss. Miura Penin., p. 121, pl. VIII, fig. 13.

Quite frequent. The shell which I called *Chione isabellina* Phil. in my previons papers is, as I am now convinced, *Chione foliacea* of the same author.

Fossil occurrence.—*Lower Byoritz Beds:* (1) Nankō Kōzan Shō, Shinchik (新竹州竹南郡香山庄南坑); (2) Rokjūkei, Haksha Shō, Tainan (臺南新營郡白沙庄六重溪); (3) Sekibyō, Tainan (同州同郡石廟) (4) Nijūkei, Tainan (同州曾文郡二重溪).

Living.—Central and Western Japan. Philippines.

102. Cryptogramma kaneharai, n. sp.

Pl. VIII. Fig. 5

Shell small, thick, convex, subtrigonal, longer than high, rounded in front, beaked and bluntly pointed behind; antero-dorsal border slightly concave, postero-dorsal straight in the upper half, somewhat convex in the lower, ventral border arched in the an-

terior half, slightly excavated in the posterior. Surface coarsely concentrically corrugate, with a blunt, though distinct, posterior dorsal edge, in front of which there is a somewhat concave surface. Teeth three, with the middle one thinnest and the posterior thickest. Beak small, pointed. Lunula well marked, short-lanceolate, smooth. Area lanceolate, somewhat longer than lunula. Inner border of the shell crenulate. Pallial sinus obsolete.

A single left valve measuring 19 millim. in length, 12.5 millim. in height and 5 millim. in depth.

This species resembles *Venus cypria* Sow. (Syst. Conch. Cab., Mart. Chem., pl. 33, figs. 7–9) of Western Columbia, although differing from it in several respects such as the shorter shell, the more blunt posterior edge, and the smooth inner border.

Fossil occurrence.—*Upper Byoritz Beds:* Sankō, Injurin, Shinchik (新竹州大溪郡員樹林三抗).

103. **Circe scripta,** (LINNÉ)

Pl. VIII. Figs. 7, 8

Circe scripta. Yokoyama, Foss. Miura Penin., p. 123, pl. VIII, Figs. 15, 16.

A few examples which are shorter in form than those still living in our seas. However, this character I consider to be no more than a varietal one.

Fossil occurrence.—*Upper Byoritz Beds:* Shikō, Kōshun, Takao (高雄恒春郡恒春四溝). *Lower Byoritz Beds:* (1) Injurin, Shinchik (新竹州大溪郡員樹林); (2) Intōshi, Shinchik (同州竹東郡員埤子). *Upper Arisan Beds:* (1) Kōtei, Sansō Shō, Shinchik (新竹州大溪郡

三層庄坑底); (2) a doubtful specimen at Shokōkō, Taichu (臺中州南投郡初口坑). Upper Musashino of Japan.

Living.—Central and Western Japan. Australia. Red Sea.

104. **Tapes undulatus,** Born

Pl. VIII. Fig. 2

Tapes undulatus. Yokoyama, Moll. Rem. Upperm. Part Jōban Coalf., p. 22, pl. V, fig. 1. Moll. Up. Musash. W. Shimosa a. So. Musashi, p. 445.

A perfect shell with both valves intact. Somewhat longer than the living.

Fossil occurrence.—*Upper Byoritz Beds:* Shikō, Kōshun, Takao (高雄州恒春四溝). Upper Musashino and Pliocene of Japan.

Living.—Central and Western Japan.

105. **Tapes** sp.

Pl. VIII. Fig. 3

Imperfect specimens of a transversely elliptical shell whose surface is concentrically grooved, and resembling *Tapes amabilis* Phil., *Tapes euglyptus* Phil., etc. of our seas.

Fossil occurrence.—*Upper Byoritz Beds:* Kyushōkō, Enri Shō, Shinchik (新竹州苗栗郡苑裡庄芎蕉坑). *Lower Byoritz Beds:* (1) Katōkō, Rōdenryō Shō, Shinchik (新竹州苗栗郡老田寮庄茄苳坑); (2) Nijūkei, Tainan (臺南州曾文郡二重溪); (3) Wankyō, Tainan (同州嘉義郡灣橋).

106. **Tapes (?) taiwanensis,** n. sp.

Pl. IX. Figs. 1, 2

Shell transversely elongated, rather compressed, very inequilateral, rounded in front and behind, somewhat more broadly

in the latter, broadly arched at ventre, with antero- and postero-dorsal borders slightly arched and gently sloping, the latter more gently than the former. Surface finely concentrically striated.

Several examples, though all are in a bad state of preservation. The one shown in fig. 1 has both valves intact. It is about 48 millim. long, 28 millim. high and 18 millim. thick.

Fossil occurrence.—*Lower Arisan Beds:* (1) Kizan, Taihok (臺北州文山郡龜山); (2) Usekikōkei, Taichū (臺中州東勢郡烏石坑溪).

107. Gomphina sp.

Pl. XIII. Fig. 6

A right valve, compressed and triangular in outline, rounded in front and bluntly pointed behind, seems to belong to *Gomphina melanaegis* (Röm.) (Lischke, Jap. Meeresconchyl., III, pl. VII, figs. 10, 11) living in our seas. But the specimen is too imperfect for exact determination.

Fossil occurrence.—*Lower Byoritz Beds:* At the mouth of the Banbakōkei, Shinchik (新竹州竹東郡蕃婆坑溪).

Family Cardiidae

108. Cardium muticum, Reeve

Cardium muticum. Yokoyama, Foss. Miura Penin., p. 128, pl. IX, fig. 11. Foss. Up. Musash. Kaz. Shim., p. 154, pl. XII, fig. 7. Tert. Moll. So. Totomi, p. 353.

A small mutilated right valve only.

Fossil occurrence.—*Lower Byoritz Beds:* Katōkō, Rōdenryō Shō, Shinchik (新竹州苗栗郡老田寮庄茄苳坑). Musashino and Pliocene of Japan.

Living.—Northern, Central and Western Japan. Philippines.

109. Cardium burchardi, DUNKER

Pl. IX. Fig. 7

Cardium burchardi. Yokoyama, Foss. Up. Mus. Kazusa a. Shimosa, p. 153. pl. XII, fig. 3. Moll. Tert. Basin Chichibu, p. 130. Tert. Moll. Shiobara, p. 134, pl. XIX, figs. 3, 4. Moll. Up. Mus. W. Shimosa a. So. Musashi, p. 445.

Mostly in broken specimens.

Fossil occurrence.—*Upper Byoritz Beds:* (1) Tenshi (店仔), (2) Kōdenkō (鴨田坑), (3) Jōnanseikō (上南勢坑) and (4) Denshinshi (田心仔), all in Shiko Shō, Shinchik (新竹州苗栗郡四湖庄). Musashino and Pliocene of Japan.

Living.—Central and Western Japan.

110. Hemicardium hemicardium, (LINNÉ)

Pl. IX. Fig. 10

Cardium hemicardium. Römer in Syst. Conch. Cab. Mart. Chem., Cardiaceae, p. 107, pl. IV, figs. 1–4. Reeve, Conch. Icon., Cardium, pl. VII, fig. 38.

A small left valve much worn and broken. It has a triangular outline, with a high edge on the surface dividing it into two halves, the anterior having eight flat ribs and the posterior twelve. The grooves lying between the ribs are narrower than the latter and punctured.

Fossil occurrence.—*Lower Byoritz Beds:* Rokjūkei, Haksha Shō, Tainan (臺南州新營郡白沙庄六重溪).

Living.—Philippines.

Family Diplodontidae

111. Diplodonta japonica, Pilsbry

Diplodonta japonica. Yokoyama, Foss. Miura Penin., p. 131, pl. X, fig. 4. Foss. Up. Musash. Kazusa a. Shimosa, p. 159. Moll. Up. Musash. W. Shim. a. So. Musashi, p. 445.

One decorticated specimen only.

Fossil occurrence.—*Lower Byoritz Beds:* At the foot of Kwan-in San, Taikei Gai, Shinchik (新竹州大溪郡大溪街觀音山). Musashinos of Japan.

Living.—Central Japan.

112. Diplodonta murayamai, n. sp.

Pl. IX. Fig. 9 Pl. X. Fig. 2

A broken left and right valve.

Shell small, thin, convex, circular in outline, as long as high, somewhat equilateral. The surface is apparently smooth, yet it is possible that it was originally concentrically striate, the smoothness being due to friction. Teeth comparatively strong, two, diverging. Anterior muscular impression, somewhat elongated, bean-shaped, posterior oval. Lunula elongately heart-shaped, bounded by engraved lines. The dimensions of the right valve which is more perfect than the left are as follows: Height 8.7 millim. Length 9 millim. Depth 3.2 millim.

Fossil occurrence.—*Upper Byoritz Beds:* Denshinshikō, Shiko Shō, Shinchik (新竹州苗栗郡四湖庄田心仔坑). A shell resembling this species also occurs in the *Lower Byoritz Beds* at Intōshi, Shinchik (新竹州竹東郡員崠子).

113. **Loripes goliath**, n. sp.

Pl. IX. Fig. 8. Pl. X. Fig. 1

Shell very large, inflated, orbicular, slightly longer than high, somewhat inequilateral, antero- and postero-dorsal borders slightly sloping. Surface concentrically rugose. Beaks small.

One adult and many young individuals. It is much to be regretted that we can not examine the interior of the shell, the whole being quite petrified. The adult measures 150 millim. in length, 143 millim. in height and 118 millim. in thickness. One of the young individuals measures 50.5 millim. in length, 48 millim. in height and 40 millim. in thicknees.

The species closely resembles *Loripes philippiana* (Reeve) (Conch. Icon., pl. V, fig. 23). But the dorsal borders are more inclined in ours.

Fossil occurrence.—*Upper Arisan Beds:* (1) Kōsen, Takao (高雄州旗山郡甲仙); (2) a branch of the river Fūkō, Takao (同州恒春郡楓港溪). The adult specimen was obtained at Kōsen, and the younger ones all in the Fūkō).

Family Carditidae

114. **Venericardia cipangoana**, Yokoyama

Pl. IX. Figs. 3-5

Venericardia cipangoana. Yokoyama, Foss. Miura Penin., p. 137, pl X, fig. 2. Foss. Up. Musash. Kaz. Shim., p. 162, pl. XIII, fig. 4. Foss Shells Sado, p. 297. Tert. Shells Coalf. Haboro, p. 202. Foss. Moll. Oilf. Akita, p. 379. Moll. Up. Mus. W. Shim. a. So. Musashi, p. 446.

This shell which is frequent in the Japanese Neogene is also very common in Formosa. Most of the specimens have the ribs narrower, more elevated and more granose than those of the recent seas. But there are also those in which they are flatter and broader. The variation in this respect seems to be tolerably great

What Dickerson figures as *Cardita antiquata* L. in his "Review of Philippine Palaeontology," pl. VI, fig. 10 from the Vigo Group resembles some of the specimens of *Venericardia cipangoana*, though the former has the shell higher in form and the ribs less in number.

Fossil occurrence.—*Upper Byoritz Beds:* (1) Hōtosak, Rinkō Shō, Taihok (臺北州新莊郡林口庄賓斗厝); (2) Tenshi (店仔), (3) Jōnan-seikō (上南勢坑), (4) Jōwan (上灣) and (5) Goko (五湖) in Shiko Shō, Shinchik (新竹州苗栗郡四湖庄), (6) Kyushōkō and (7) Shūtō, Sankyaksui (山脚水圳頭) in Enri Shō, Shinchik (新竹州苗栗郡苑裡庄), (8) Kwanshinrin, Tsūshō Shō, Shinchik (同州同郡通宵庄菅眞林); (9) Kizan, Byoritz Gai, Shinchik (同州同郡苗栗街龜山). *Lower Byoritz Beds:* (1) Katōkō, Rōdenryō Shō, Shinchik (新竹州苗栗郡老田寮庄茄苳坑); (2) Shōmon, Shinchik (同州竹東郡照門); (3) Intōshi, Shinchik (同州同郡員崠子); (4) Nankō, Kōzan Shō, Shinchik (同州竹南郡香山庄南港); (5) foot of Kwan-in San, Shinchik (同州大溪郡觀音山); (6) Sekibyo, Tainan (臺南州新營郡石廟). *Upper Arisan Beds:* (1) Kōtei, Sansō Shō, Shinchik (新竹州大溪郡三層庄坑底); (2) a doubtful specimen at a place west of Koksei, Taichu (臺中州能高郡國姓). Musashino, Pliocene and Miocene of Japan.

Living.—Central and Western Japan.

115. **Venericardia** sp.

A small oblique form somewhat resembling the preceding, but with the radiating ribs finer. Preservation imperfect.

Fossil occurrence.—*Lower Arisan Beds:* Rahau, Shinchik (新竹州大溪郡大角山の向側ラハウ).

Family Astartidae

116. **Astarte sulcata,** DACOSTA

Pl. IX. Fig. 6

Astarte sulcata. Yokoyama, Foss. Shells Sado, p. 208, pl. XXXVII, figs. 9, 10.

A single left valve with the surface sulcate and the inner border crenulate. It is somewhat higher than most of the specimens hitherto found, though occasionally such a form was also found among the latter.

Fossil occurrence.—*Upper Byoritz Beds:* Jōwan, Shiko Shō, Shinchik (新竹州苗栗郡四湖庄上灣). English Crag. Upper Musashino of Japan.

Living.—Britain. Northern Seas.

Family Crassatellitidae

117. **Crassatellites heteroglyptus,** PILSBRY

Pl. XVI. Fig. 3

Crassatella heteroglypta. Yokoyama, Foss. Miura Penin., p. 141, pl. XI, figs. 10, 11. Foss. Up. Musash. Kaz. Shimosa, p. 165. Tert. Moll. So. Tōtōmi, p. 356.

A few isolated valves.

Fossil occurrence.—*Upper Byoritz Beds:* Shikō, Kōshun, Takao (高雄州恒春郡恒春四溝). Musashinos and Pliocene of Japan.

Living.—Northern, Central and Western Japan.

118. **Crassatellites nipponensis,** Yokoyama

Crassatella fusca. Yokoyama, Tert. Foss. Miike Coalf., p. 8, pl. II, figs. 1-3, 5, 6, p. 15, pl. II, fig. 4.

An internal cast which, however, undoubtedly belongs to what I called *Crassatella fusca* in my paper above cited. But as the name *fusca* is preoccupied by Kobelt for a living species, I seize this opportunity of changing it into *nipponensis.*

Fossil occurrence.—*Lower Arisan Beds:* Hagioka, Shinchik (新竹州大湖郡萩岡).

119. **Crassatellites oinouyei,** n. sp.

Pl. XIII. Fig. 1-3.

Shell comparatively thin, convex, subtrigonal, very inequilateral, posterior side almost twice as long as anterior, rounded in front, attenuated, beaked and bluntly pointed behind, antero-dorsal border straight, postero-dorsal slightly excavated, both sloping, ventral border arched in the anterior half, straight in the posterior. Surface concentrically grooved, with interspaces between grooves resembling ribs. A strong posterior edge is present, the grooves ending at this edge and the surface beyond being rather smooth. Inner border crenate. Dentition unknown.

Several examples. A perfect right valve found at Intōshi is 34 millim. long, 23 millim. high and about 6 millim. deep.

This species is not unlike *Crassatellites sulcatus* (Lam.) (Reeve, Conch. Icon., sp. 6) of Australia, though our shell is thinner, with the beak not so swollen,

Fossil occurrence.—*Lower Byoritz Beds*: (1) Intōshi, Shinchik (新竹州竹東郡員崠子); (2) Injurin, Shinchik (同州大溪郡員樹林); (3) Kyukyurin, Sanwan Shō, Shinchik (同州竹南郡三灣庄九芎林).

120. Crassatellites sp.

A single right valve. It is small, compressed, subpentagonal, and concentrically grooved on the surface, so that it resembles *Crassatellites oblongatus* Yok. (Foss. Miura Penin., pl. XI, figs. 8, 9). However, the preservation being imperfect, the accurate determination is at present not possible.

Fossil occurrence.—*Lower Byoritz Beds:* Kōkwan Shō on the lower course of the Senzankei, Shinchik (新竹州苗栗尖山溪下流公館庄).

Family Cyrenidae

121. Corbicula sandaiformis, Yokoyama

Corbicula sandaiformis. Yokoyama, Foss. Up. Mus. Kaz. Shim., p. 165, pl. XIII, figs. 14,15.

A left valve of a young individual.

Fossil occurrence.—*Lower Byoritz Beds:* South of Kwan-in San, Shinchik (新竹州大溪郡觀音山). Upper Musashino of Japan.

Living.—Central Japan.

Family Unionidae

122. Unio nipponensis, von Martens

Pl. XIII. Fig. 9

Unio nipponensis. Kobelt, Fauna Molluscorum Extramarinorum Japoniae, p. 138, pl. XII, fig. 3.

A young right valve quite like that of the species above cited in form, though somewhat coarser in sculpture. This sculpture consists of irregular semiconcentric corrugations around the beak and several radiating ridges oblique to the dorsal edge lying mostly behind it, those in front being less in number. Anterior tooth strong, with a deep pit above it; posterior elongated. The inner surface of the shell still shows some pearly lustre. Length 22 millim. Height 11 millim. Depth 3.7 millim.

Fossil occurrence.—*Lower Byoritz Beds:* Between Rokjukei (六重溪) and Sekibyō (石崩), Tainan (臺南州新營郡).

Living.—Northern, Central and Western Japan.

Family Anomiidae

123. Anomia lischkei, Dautzenberg et Fischer

Pl. XIV. Figs. 4, 5

Anomia lischkei. Tert. Moll. Shinano a. Echigo, p. 15. Foss. Shells Atsumi Penin., p. 371. Moll. Up. Mus. Tokyo, p. 402. Foss. Moll. Kaga, p. 169.

Anomia nipponensis. Foss. Miura Penin., p. 146, pl. XI, figs. 18, 19. Foss. Up. Mus. Kaz. Shim., p. 176.

Quite common.

Fossil occurrence.—*Upper Byoritz Beds:* (1) Hotosak, Rinko Shō, Taihok (臺北州新莊郡林口庄竇斗厝); (2) Tenshi (店仔) and (3) Denshinshi (田心仔) in Shiko Shō, Shinchik (新竹州苗栗郡四湖庄); (4) Enri, Shinchik (同州同郡苑裡). *Lower Byoritz Beds:* (1) Hok'ho, Sanwan Shō, Shinchik (新竹州竹南郡三灣庄北埔); (2) Wankyō, Tainan

(臺南州嘉義郡灣橋); (3) Bansha, Tainan (同州新豐郡番社). Musashinos of Japan.

Living.—Northern, Central and Western Japan.

124. **Placenta placenta,** (LINNÉ)

Pl. XI. Pl. XII

Placenta placenta. Pilsbry, Cat. Mar. Moll. Jap., p. 142.
Placenta orbicularis. Dunker, Ind. Moll., p. 248.
Anomia placenta. Linné, Syst. Nat., Ed. 10, p. 103. Ed. 12, p. 1154.
Placuna placenta. Lamarck, Anim. sans Vert., vol. VII. p. 270. Martin, Tertiarschichten v. java, p. 126, pl. XX, figs. 13, 14. Tiefbohr. in Java, p. 272. Jungtertiär v. Sumatra, p. 93. Dickerson, Rev. Philip. Palaeont., p. 203, pl. VII, figs. 2a, 2b.

This splendid shell orbicular in outline and quite flat is present in many specimens, though more or less broken on account of its thin state.

Fossil occurrence.—*Lower Byoritz Beds:* (1) Usantō, Tainan (臺南州曾文郡烏山頭); (2) Bansha, Tainan (同州新豐郡番社). Pliocene and Miocene of the Philippines, Java and Sumatra.

Living.—Central Japan. China. Singapore.

Family Spondylidae

125. **Plicatula cuneata,** DKR.

Pl. XIII. Figs. 4, 5

Plicatula cuneata. Yokoyama, Foss. Up. Mus. Kaz. Shim., p. 180, pl. XIV, fig. 25.

Several isolated valves.

Fossil occurrence.—*Upper Byoritz Beds:* (1) Enri (苑裡)

and (2) Kizan, Byoritz Gai (苗栗街龜山) in Shinchik (新竹州苗栗郡). Upper Musashino of Japan.

Living.—Central and Western Japan.

Family Pectinidae

126. Pecten (Chlamys) laetus, Gould

Pecten laetus. Yokoyama, Foss. Miura Penin., p. 152, pl. XIV, figs. 1, 2. Foss. Up. Mus. Kaz. Shim., p. 180, pl. XIV, fig. 20. Tert. Moll. Shinano a. Echigo, p. 16.

An isolated valve and a fragment.

Fossil occurrence.—*Upper Byoritz Beds:* Enri, Shinchik (新竹州苗栗郡苑裡). *Lower Byoritz Beds:* Nankō, Kōzan Shō, Shinchik (新竹州竹南郡香山庄南港); a doubtful specimen at Bansha, Tainan (臺南州新豐郡蕃社). Musashinos and Pliocene of Japan.

Living.—Northern, Central and Western Japan.

127. Pecten (Chlamys) aurantiacus, Adams et Reeve

Pl. XIII. Figs. 7, 8

Pecten aurantiacus. A. Adams and Reeve, Voyage Samarang, p. 74, pl. 21, figs. 1, 2. Syst. Conch. Cab. Mart. Chem., vol. III, part 2, p. 171, pl. 47, fig. 7.

A few, ill preserved, isolated, right valves. They are flatly convex, radiately ribbed, with ribs about fifteen in number, rounded, minutely scaly, separated by narrower interspaces and each divided into five parts by four narrow longitudinal grooves. Ears somewhat unequal.

Fossil occurrence.—*Shokkōsan Beds:* Hanpeisan, Takao (高雄州岡山郡半屏山).

Living.—Chinese seas.

128. **Pecten (Chlamys) satoi,** n. sp.

Pl. XIII. Figs. 13, 14 Pl. XIV. Fig. 2

Shell moderate in size, thin, orbicular, slightly higher than long, somewhat inequivalve. Left valve flatly convex, ornamented with about thirty radiating ribs, each accompanied by a minor one on both sides and close to it; interspaces between ribs somewhat narrower than the ribs themselves, and both covered with fine scales. Ears unequal; posterior much larger than anterior. Right valve flatter than left and almost flat with sculpture similar to the latter; ears less unequal with posterior triangular in shape. Proportions of height to length and depth are on an average as follows: In the left valve 10 : 9 : 2; in the right valve 10 : 9 : 1.1.

The largest example we have is a left valve measuring 52 millim in height.

In sculpture, this species resembles *Pecten australis* Sow. (Reeve, Conch. Icon., pl. 25, fig. 103) living in Australia. But the ribs are less, and the valves more equal in the latter.

Fossil occurrence.—*Upper Byoritz Beds:* (1) Hōtosak, Rinkō Shō Taihok (臺北州新莊郡林口庄賓斗厝); (2) Ubikō, Tsūshō Shō (通宵庄烏眉坑) and (3) Tanbunko (淡文湖) in Shinchik (新竹州苗栗郡). *Lower Byoritz Beds:* West of Bitō, Zuihō Shō, Taihok (臺北州基隆郡瑞芳庄鼻頭). *Upper Byoritz Beds:* Banahō, Shinchik (新竹州大湖郡馬那邦),

129. **Pecten (Chlamys)** sp.

Pl. XIV. Fig. 3

Several casts of a *Pecten*, some tolerably large and showing a striking resemblance to those of *Pecten kaneharai* Yok. (Tert.

Moll. Shiobara, pl. VIII, fig. 1, pl. XIX, figs. 1, 2, 5–7) of the Shiobara Tertiary of Japan. So far as the casts are concerned, there is not a slightest difference between the two.

Fossil occurrence.—*Upper Arisan Beds:* (1) Sanshikyakkei, Taihok (臺北州海山郡山子脚溪); (2) Shiigao, Shinchik (新竹州竹東郡シイガオ); (3) Mingets, Arisan, Tainan (臺南州嘉義郡阿里山眠月集材所).

130. Pecten (Chlamys?) sp.

Pl. XIV. Fig. 7

Several small flat valves with about ten radiating ribs which are roof-like in section. They resemble the flat (left) valves of young individuals of *Pecten tokyoensis* Tok. (= *P. murayamai*) having more prominent ribs than usual like those of Akita (Yokoyama, Foss. Moll. Oilf. Akita, pl. XLIV, figs. 18, 19).

Fossil occurrence.—*Upper Arisan Beds:* Bōryō, Takao (高雄州旗山郡枋寮).

131. Pecten (Amusium) japonicus, (Gmelin)

Pl. XIII. Fig. 12

Pecten japonicus. Sowerby, Thes. Conch., vol. I, p. 55, pl. XV, figs. 109, 110. Reeve, Conch. Icon., Pecten no. 47, pl. XII, fig. 47. Pilsbry, Catalogue, p. 145.

Ostrea japonica, Gmelin, Syst. Nat., p. 3317.

A broken left valve and several fragments of young individuals. The surface is smooth with radiating ribs inside arranged two and two.

Fossil occurrence.—*Upper Byoritz Beds:* (1) Tenshi, Shiko Shō (四湖庄店仔) and (2) Enri (苑裡) Shinchik (新竹州苗栗郡); (3) Tanbunko, Shinchik (同州竹南郡淡文湖).

Living.—Central and Western Japan. China.

132. Pecten (Amusium) praesignis, Yokoyama

Pl. XV. Fig. 1

Pecten praesignis. Yokoyama, Tert. Moll. So. Tōtōmi, p. 357, pl. XL, figs. 1, 2.

The examples of this species are frequent in Formosa. They are from the Upper Arisan Beds as well as from the Lower Byoritz. They are mostly in casts, but their internal characters impressed on these casts leave no doubt of their belonging to the above named Japanese fossil.

Fossil occurrence.—*Lower Byoritz Beds:* (1) Shōsokō, Shinten Shō, Taihok (臺北州文山郡新店庄小粗坑); (2) Kikō, Taichū (臺中州能高郡龜坑); (3) Chūryō, Taichu (同州南投郡中寮). *Upper Arisan Beds:* (1) Southeast of Sekitei, Taihok (臺北州文山郡石碇); (2) North of Baryōkō, Shichito Shō, Taihok (同州基隆郡七堵庄瑪陵坑); (3) Satō, Shinchik (新竹州竹東郡佐藤); (4) Shirei, Shinchik (同州大湖郡司令); (5) Kwanshirei, Haksha Shō, Tainan (臺南新營郡白沙庄關子嶺); (6) Taihei, Bōshiho, Tainan (同州嘉義郡茅子埔大坪); (7) between Gwaiko and Shōko, Tainan (同州同郡外湖樟湖間); (8) the lower course of the Anwana, Takao (高雄州旗山郡アンワナ); (9) Arikwan, Takao (同州同郡阿里關); (10) the lower course of the Tōzen, Takao (同州屏東郡桃剪). Pliocene of Japan.

133. Pecten (Vola) laqueatus, Sowerby

Pecten laqueatus. Yokoyama, Foss. Miura Penin., p. 160, pl. XIV, figs. 9, 10. Foss. Up. Mus. Kaz. Shim., p. 183.

Rare.

Fossil occurrence.—*Upper Byoritz Beds:* Shikō, Kōshun, Takao (高雄州恒春郡恒春四溝). Upper Musashino of Japan.

Living.—Northern, Central and Western Japan.

134. Pecten (Vola) sinensis, Sowerby

Pl. XIV. Fig. 1

Pecten sinensis. Sowerby, Thes. Conch., vol. I, p. 48, pl. XVI, figs. 120, 121, 134. Reeve, Conch. Icon., Pecten no. 33, pl. VIII, fig. 33.

Pecten excavatus. Anton, Verzeichn., p. 19, no. 710.

Pecten naganumanus. Yokoyama, Foss. Miura Penin., p. 160, pl. XIII, figs. 4-6. Dickerson, Rev. Phil. Palaeont., p. 203, pl. XII, fig. 1.

What I formerly described as a new species under the name of *Pecten naganumanus* from the Upper Musashino of Naganuma is, as I am now convinced, identical with Sowerby's *Pecten sinensis*, while *Pecten excavatus* Anton (Pecten sinensis Sow.) described and figured in my paper "Fossils from the Upper Musashino of Kazusa and Shimosa" (p. 183, pl. XV, figs. 6, 7) is probably an immature individual of *Pecten laqueatus* Sow.

Frequent.

Fossil occurrence.—*Upper Byoritz Beds:* (1) Tenshi (店仔), (2) Jōnanseikō (上南勢坑), (3) Jōwan (上灣), (4) Kōdenkō (鴨田坑), (5) Goko (五湖), and (6) Kwashōhei (火燒坪), all in Shiko Shō, Shinchik (新竹州苗栗郡四湖庄). *Lower Byoritz Beds:* (1) Kikō, Taichū (臺中州能高郡龜溝); (2) Suiryutō, Tainan (臺南州曾文郡水流東); (3) Tōshikō, Sachin Shō, Tainan (同州新化郡左鎮庄棟死狹); (4) Kwanshirei, Haksha Shō, Tainan (同州新營郡白沙庄關子嶺); (5) east of Shōshikyak, Takao (高雄州旗山郡松仔脚). Upper Musashino of Japan.

Living.—Northern and Central Japan. China.

135. Pecten (Vola) javanus, Martin

Pl. XIII. Figs. 10, 11

Pecten (Vola) javanus. Martin, Foss. v. Java, p. 355, pl. L, figs. 59-62.

This Javan fossil is represented by four isolated valves, three right and one left belonging to different individuals. The right valve is flatly convex, while the left is perfectly flat, both with nineteen, elevated, rounded, radiating ribs separated by intervals of about equal breadth. Ribs as well as intervals finely concentrically striated. Ears unequal.

One of the right valves is 22 millim. high, 25 millim. long and 4.3 millim. deep, while the left is 18.5 millim. high and 20 millim. long.

Fossil occurrence.—*Upper Byoritz Beds:* (1) Tenshi (店仔) and (2) Jōwan (上灣), both in Shiko Shō, Shinchik (新竹州苗栗郡四湖庄). *Lower Byoritz Beds:* Rokjūkei, Haksha Shō, Tainan (臺南州新營郡白沙庄六重溪). Pliocene of Java.

136. Pecten sp.

Pl. XIV. Fig. 6

A small flat valve with twenty-two elevated, rounded, radiating ribs separated by broader interspaces whose surface shows five growth-lines. Imperfect and indeterminable.

Fossil occurrence.—*Upper Arisan Beds:* Satō, Shinchik (新竹州竹東郡佐藤).

137. **Pecten** sp.

A convex valve about 47 millim. high, with numerous close-set radiating ribs about forty in number and with an intercalary between. Extremely worn and indeterminable.

Fossil occurrence.—*Lower Byoritz Beds:* Jūbunryō, Heikei Shō, Taihok (臺北州七里郡平溪庄十分寮).

Family Ostreidae

138. **Ostrea gigas,** THUNBERG

Pl. XV. Figs. 2, 3

Ostrea gigas. Yokoyama, Foss. Miura Penin., p. 162, pl. XV, figs. 1, 2. Foss. Up. Musash. Kaz. Shimosa, p. 184. Tert. Moll. Shinano a. Echigo, p. 19. Tert. Moll. So. Totomi, p. 358.

Frequent, but mostly imperfect.

Fossil occurrence.—*Shokkōsan Beds:* Zenpōbi, Takao (高雄州岡山郡前峰尾). *Upper Byoritz Beds:* (1) Hotosak, Rinkō Shō, Taihok (臺北州新莊郡林口庄竇斗厝); (2) Enri, Shinchik (新竹州苗栗郡苑裡); (3) Jōnanseikō (上南勢坑); (4) Tenshi (店仔) and (5) Jōwan (上灣) in Shiko Shō, Shinchik (新竹州苗栗郡四湖庄). A doubtful specimen was found at Taihanrok, Takao (高雄恒春郡大板麓). *Lower Byoritz Beds:* (1) Shinkeiryu, Shinchik (新竹州苗栗郡新鶯隆); (2) Kyūkyū-rin, Sanwan Shō, Shinchik (同州竹東郡三灣庄九芎林); (3) east of Hitō-san, Taichū (臺中州大屯郡坪頭山); (4) east of Tekisuishi, Tainan (臺南州新營郡滴水仔); (5) Wankyo, Tainan (同州同郡灣橋); (6) Senshūryō, Takao (高雄州岡山郡千秋寮). Musashinos and Pliocene of Japan.

Living.—Northern, Central, Western and Southern Japan. **China.**

139. Ostrea denselamellosa, Lischke

Pl. XVI. Fig. 1

Ostrea denselamellosa. Yokoyama, Foss. Miura Penin., p. 162, pl. XVI, fig. 6. Foss. Up. Mus. Kaz. Shim., p. 185. Foss. Up. Mus. Tokyo a. its Sub., p. 402.

Rather rare and mostly ill preserved.

Fossil occurrence.—*Lower Byoritz Beds:* (1) Wankyō (灣橋), and (2) Unsui (沄水) in Tainan (臺南州嘉義郡). Doubtful specimens at Taikeikan, Taihok (臺北州文山郡大溪墘) and Roksō, Tainan (臺南善化郡六双). Upper Musashino of Japan.

Living.—Central, Western and Southern Japan.

140. Ostrea sp.

Many fragments of a large *Ostrea* resembling *Ostrea gigas* Th. Some show crenulations at the ventral border. Not certain whether they all belong to the same species.

Fossil occurrence.—*Upper Arisan Beds:* (1) Sanshikyakkei (山子脚溪) and (2) Seifuk (成福) in Taihok (臺北州海山郡); (3) between Babutok (馬武督) and Nanko (南湖), Shinchik (新竹州竹東郡); (4) Rinbi, Taichū (臺中州新高郡林尾); (5) Shamaiki (砂米崎) and (6) Mingets, Arisan (阿里山眠月) in Tainan (臺南州嘉義郡); (7) Fūko, Takao (高雄州恒春郡楓港).

Family Arcidae

141. Arca (Barbatia) symmetrica, Reeve

Arca symmetrica. Yokoyama, Foss. Miura Penin., p. 106, pl. XVII, figs. 7, 8. Foss. Up. Mus. Kaz. Shim., p. 186. Foss. Shells Atsumi; p. 371.

A few isolated valves.

Fossil occurrence.—*Lower Byoritz Beds:* (1) Nankō, Kozan Shō, Shinchik (新竹州竹南郡香山庄南港); (2) Naikwakkō, Tainan (臺南州曾文郡內廓坑). Musashinos of Japan.

Living.—Central and Western Japan. Philippines. Indian Ocean.

142. Arca (Anomalocardia) granosa, Linné

Pl. XVII. Fig. 1

Arca granosa. Yokoyama, Foss. Up. Mus. Kaz. Shim., p. 186, pl. XV fig. 4.

Rather frequent.

The specimens of this shell found in the lower horizons (Lower Byoritz) are shorter in form than those of the recent seas. Moreover, the ribs are less in number, being between sixten and nineteen. Edward Morse in describing the shells found in the Neolithic shell mounds of Ōmori near Tokyo (Shell Mounds of Ōmori, Mem. Sci. Depart., Imp., Univ. Tokio, vol. I, no. 1, 1879) says that *Arca granosa* which has since retreated to the south is very frequent in the shell-mounds and that the ribs in the specimens of the mounds are only eighteen to twenty, while in the recent they are between twenty three and twenty-six. In the fossils of the Musashino Formation of Japan, they are also less, being about equal to those of Formosa, that is to say, they are between sixteen and eighteen. Thus we see that the ribs in *Arca granosa* have decidedly increased since the Tertiary time.

As to the habitat, Morse states that the species is not found north of Nagasaki (Western Japan), but since then it has also

been discovered in Isé Bay. And as I have a specimen of the same shell obtained somewhere in Sagami Bay, so it is quite certain that it still lingers near Tokyo. But that it is now very rare in the neighbourhood of our capital is beyond doubt.

Fossil occurrence.—*Upper Byoritz Beds:* (1) Jonanseikō (上南勢坑) and (2) Jōwan (上灣) in Shiko Shō, Shinchik (新竹州苗栗郡四湖庄). *Lower Byoritz Beds:* (1) Wankyo, Tainan (臺南州嘉義郡灣橋); (2) Roksō (六双) and (6) Usantō (烏山頭) in Tainan (同州善化郡); (4) between Sekibyo (石廟) and Rokjyūkei (六重溪), and (5) Kwan-shirei, Haksha Shō (白沙庄關子嶺) in Tainan (同州新營郡). A doubtful specimen at Yaryukō, Banri Shō, Taihok (臺北州基隆郡萬里庄野柳岬). *Lower Arisan Beds:* An ill preserved example which resembles this species was obtained at Shokōkō, Taichu (臺中州南投郡初口坑). Upper Musashino of Japan. Pliocene of Java. Miocene of the Philippines.

Living.—Central and Western Japan. China. Philippines. Indian Ocean.

143. Arca (Scapharca) inflata, Reeve

Pl. XVII. Fig. 3

Arca (Anomalocardia) inflata. Yokoyama, Foss. Miura Penin., p. 167, pl. XVIII, fig. 9. Foss. Up. Mus. Kaz. Shim., p. 187, pl. XV, fig. 9. Tert. Moll. South. Totomi, p. 359.

A few specimens.

Fossil occurrence.—*Upper Byoritz Beds:* (1) Kwashōhei (火燒坪) and (2) Tenshi (店仔) in Shiko Shō, Shinchik (新竹州苗栗郡四湖庄). *Lower Byoritz Beds:* South of Kwan-in San, Shinchik (新竹州大溪郡大溪街觀音山). Musashinos and Pliocene of Japan.

Living.—Central and Western Japan. Philippines.

144. Arca (Scapharca) subcrenata, Lischke

Pl. XVII. Fig. 6

Arca (Scapharca) subcrenata. Yokoyoma, Foss. Miura Penin., 146, pl. X, figs. 1-3. Foss. Up. Mus. Kaz. Shim., p. 187, XV, fig. 12. Moll. Rem. Upperm. Part Joban Coalf., p. 28.

Frequent at some places.

Fossil occurrence.—*Shokkōsan Beds:* Zenpōbi, Takao (高雄州岡山郡前峰尾). *Upper Byoritz Beds:* (1) Hōtosak, Rinkō Shō, Taihok (臺北州新莊郡林口庄賓斗厝); (2) Tenshi, Shiko Shō, Shinchik (新竹州苗栗郡四湖庄店仔); (3) Sankō, Injūrin, Shinchik (同州大溪郡員樹林三坑). *Lower Byoritz Beds:* (1) At the foot of Kwan-in San, Shinchik (新竹州大溪郡大溪街觀音山); (2) doubtful specimens at Gyunikki, Tainan (臺南州斗六郡牛肉崎). *Upper Arisan Beds:* Fragments apparently belonging to the same species at Kōtei, Sansō Shō, Shinchik (新竹州大溪郡三層庄坑底). Musashinos and Pliocene of Japan.

Living.—Central, Western and Southern Japan.

145. Arca (Scapharca) philippiana, Dunker

Pl. XVII. Figs. 4, 5

Arca (Scapharca) philippiana. Dunker, Ind. Moll. Mar. Jap., p. 235. Syst. Conch. Cab. Mart. Chem., p. 90, pl. XXV, figs. 1, 2.

Arca radiata. Reeve, Conch. Icon., Arca, pl. VI, fig. 40.

The shell is quadrato-oval in outline, convex, and provided with about thirty radiating ribs which in the left valve are about as broad as the interspaces, but in the right narrower. The concentric striae are conspicuous, and on crossing the ribs make them often granular, while in the interspaces they are in the form of erect lamellae.

Frequent. The largest example we possess is 65 millim. long, 42.5 millim. high and 19.5 millim. deep.

Fossil occurrence.—*Upper Byoritz Beds:* (1) Jōwan, Shiko Shō (四湖庄上灣), (2) Kyushōkō, Enri (苑裡芎蕉坑) and (3) Kwanshinrin, Tsūshō Shō (通宵庄菅眞林) in Shinchik (新竹州苗栗郡); (4) Shikō, Kōshun, Takao (高雄州恒春四溝). *Lower Byoritz Beds:* (1) The lower course of the Senzankei, Hakkwan Shō, Shinchik (新竹州苗栗郡八館庄尖山溪); (2) Wankyo, Tainan (臺南州嘉義郡灣橋).

Living.—Central Japan. China.

146. **Arca (Argina) auriculata,** LAMARCK

Pl. XVI. Fig. 4

Arca auriculata. Lamarck, Anim. sans Vert., ed. II, vol. VI, p. 472. Reeve, Conch. Icon., Arca, sp. 35. Syst. Conch. Cab. Mart. Chem., vol. VIII, p. 28, pl. VIII, figs. 5, 6.

This species is characterized by its posteriorly auriculate form. It is roundly quadrate and convex, with twenty-seven to thirty granose radiating ribs separated by equal or broader intervals. Area long and narrow.

We have only two right valves, one of which is broken. The perfect one measures 8 millim. in length, 6.5 millim. in height and 2.7 millim. in depth, and is somewhat shorter in form than that figured in the above cited works.

Fossil occurrence.—*Upper Byoritz Beds:* Hōtosak, Rinkō Shō, Taihok (臺北州新莊郡林口庄賽斗厝).

Living.—Indian Ocean. West Indies.

147. Arca (Parallelopipedum) tortuosa, Linné

Pl. XVI. Fig. 2

Arca tortuosa. Linné, Syst. Nat., ed. 12, p. 1140. Syst. Conch. Cab. Mart. Chem., vol. VIII, Arcidae, p. 7, pl. I, figs. 1, 2. Reeve, Conch. Icon., sp. 86.

This is a remarkable shell readily recognized by its transversely elongated twisted form. It is thin, very inequilateral, hardly convex and sculptured with fine radiating striae made scabrous by growth-lines. Rather frequent. The largest specimen measures 70 millim. in length.

Fossil occurrence.—*Upper Byoritz Beds:* (1) Kwashōhei, Shiko Shō (四湖庄火燒坪), (2) Kwanshinrin, Tsūshō Shō (通宵庄菅眞林) and (3) Kizan, Byoritz Gai (苗栗街龜山) in Shinchik (新竹州苗栗郡); (4) the lower course of the Chūkōkei, Tanbunko, Shinchik (新竹州竹南郡淡文湖中港溪). *Lower Byoritz Beds:* Nijūkei, Tonbokōkei, Tainan (臺南州新營郡豚母坑溪二重溪).

Living.—Indian Ocean.

148. **Arca** sp.

A cast of an oblique species quite convex and with radiating ribs over thirty in number. Indeterminable.

Fossil occurrence.—*Upper Arisan Beds:* Kikō, Taichū (臺中州能高郡龜溝).

149. **Arca** sp.

A few fragments with numerous radiating ribs. Somewhat resembling *Arca inflata* Rve. already mentioned.

Fossil occurrence.—*Upper Arisan Beds:* Shokōkō, Taichū (臺中州南投郡初口坑).

150. **Pectunculus formosanus**, n. sp.

Pl. XVIII. Figs. 1-3

Shell moderate in size, thick, flatly convex, ovato-orbicular, somewhat longer than high, broadest slightly below the middle, subequilateral, anterior border usually more broadly rounded than posterior. Surface with distant, incised, radiating lines. Area narrow, transversely elongato-triangular. Teeth more than ten on each side, right and left rows almost continuous, the vacant space between being very narrow.

If we take the length as 10, the height and depth are on an average 9 and 2.4. The largest example obtained is a left valve measuring 49 millim. in length. Rather common.

Fossil occurrence.—*Shokkōsan Beds:* Zenpōbi, Takao (高雄州岡山郡前峰尾). *Upper Byoritz Beds* (the localities are all in Shinchik): (1) Tenshi, Shiko Shō (苗栗郡四湖庄店仔); (2) Kodenkō, Shiko Shō (同郡同庄鴨母坑); (3) Shūtō Sankyaksui (同郡山腳水圳頭); (4) Sankō, Injurin (大溪郡員樹林三坑); (5) Chōhōkan (同郡烏崩嶽). *Lower Byoritz Beds* (specimens somewhat doubtful): (1) Injurin, Shinchik (新竹州苗栗郡員樹林); (2) Kwanshirei, Haksha Shō (臺南州新營郡白沙庄關子嶺).

151. **Pectunculus** sp.

Several isolated valves, small and more roundish than the preceding.

Fossil occurrence.—*Lower Byoritz Beds:* (1) Intōshi, Shinchik (新竹州竹東郡員崠子); (2) Nijūkei, Tainan (臺南州曾文郡二重溪); (3) Gyunikki Tainan (同州斗六郡牛肉崎).

Family Macrodontidae

152. Cucullaea pamotanensis, MARTIN

Pl. XVIII. Figs. 4, 5

Cucullaea pamotanensis. Martin, Foss. v. Java, p. 385, pl. LIV, figs. 132, 133.

A high-convex shell with an ovato-triangular outline, and a sharp dorsal edge behind which the surface is somewhat concave. The sculpture consists of numerous fine radiating striae. A few specimens present are all more or less deformed.

Fossil occurrence.—*Lower Byoritz Beds:* (1) West of Bitō, Zuihō Shō, Taihok (臺北州基隆郡瑞芳庄鼻頭); (2) the lower course of the Senzankei, Kōkwan Shō, Shinchik (新竹苗栗郡公館庄尖山溪); (3) Naikwakkō, Tainan (臺南州曾文郡內廓坑). Miocene of Java.

Family Limopsidae

153. Limopsis woodwardi, A. ADAMS

Pl. XVII. Fig. 2

Limopsis woodwardi. Yokoyama, Foss. Up. Musash. Kaz. Shim., p. 192, pl. XVII, fig. 5. Foss. Moll. Akita Oilf., p. 381.

Rare.

This is a species frequently found in the Musashino Formation of Japan. Its recent habitat is also Central Japan, but if it is really identical with *Limopsis cancellata* Rve. as asserted by some, its distribution extends to the Indian Ocean.

Fossil occurrence.—*Upper Byoritz Beds:* Shikō, Kōshun, Takao (高雄州恒春郡恒春四溝). Musashinos of Japan.

Living.—Central Japan.

INDEX

PLATE I.

Plate I

Fig. 1. Ringicula foveolata n. sp. Enlarged. Upper Byoritz: Shikō, Kōshun, Takao. P. 23

Fig. 2. Ringicula globulifera n. sp. Enlarged. Upper Byoritz: Wankyō, Tainan. 24

Fig. 3. Terebra naumanni Yok. Enlarged. Upper Byoritz: Shikō, Kōshun, Takao. P. 25

Fig. 4. Terebra subvariegata n. sp. Enlarged. Upper Byoritz: Hōtosak, Rinkō Shō, Taihok. P. 25

Fig. 5. Terebra sp. Enlarged. Upper Byoritz: Taihanrok, Takao. p. 27

Fig. 6. Terebra formosana n. sp. Upper Byoritz: Shikō, Kōshun, Takao. P. 26

Fig. 7. Conus kikaiensis Pils. Enlarged. Lower Byoritz: West end of Fukki, Shinchik. P. 29

Fig. 8. Conus sinensis Sow. Upper Byoritz: Enri, Shinchik. P. 28

Fig. 9. Terebra lischkeana Dkr. Enlarged. Lower Byoritz: Injurin, Shinchik. P. 24

Fig. 10. Conus comatosaeformis n. sp. Enlarged. Lower Byoritz: South of Kwan-in San, Taikei Gai, Shinchik. P. 29

Fig. 11. Pleurotoma oxytropis Sow. Upper Byoritz: Jōnanseikō, Shiko Shō, Shinchik. P. 31

Fig. 12. Surcula javana (L.) Enlarged: Upper Byoritz: Shikō, Kōshun, Takao, P. 33

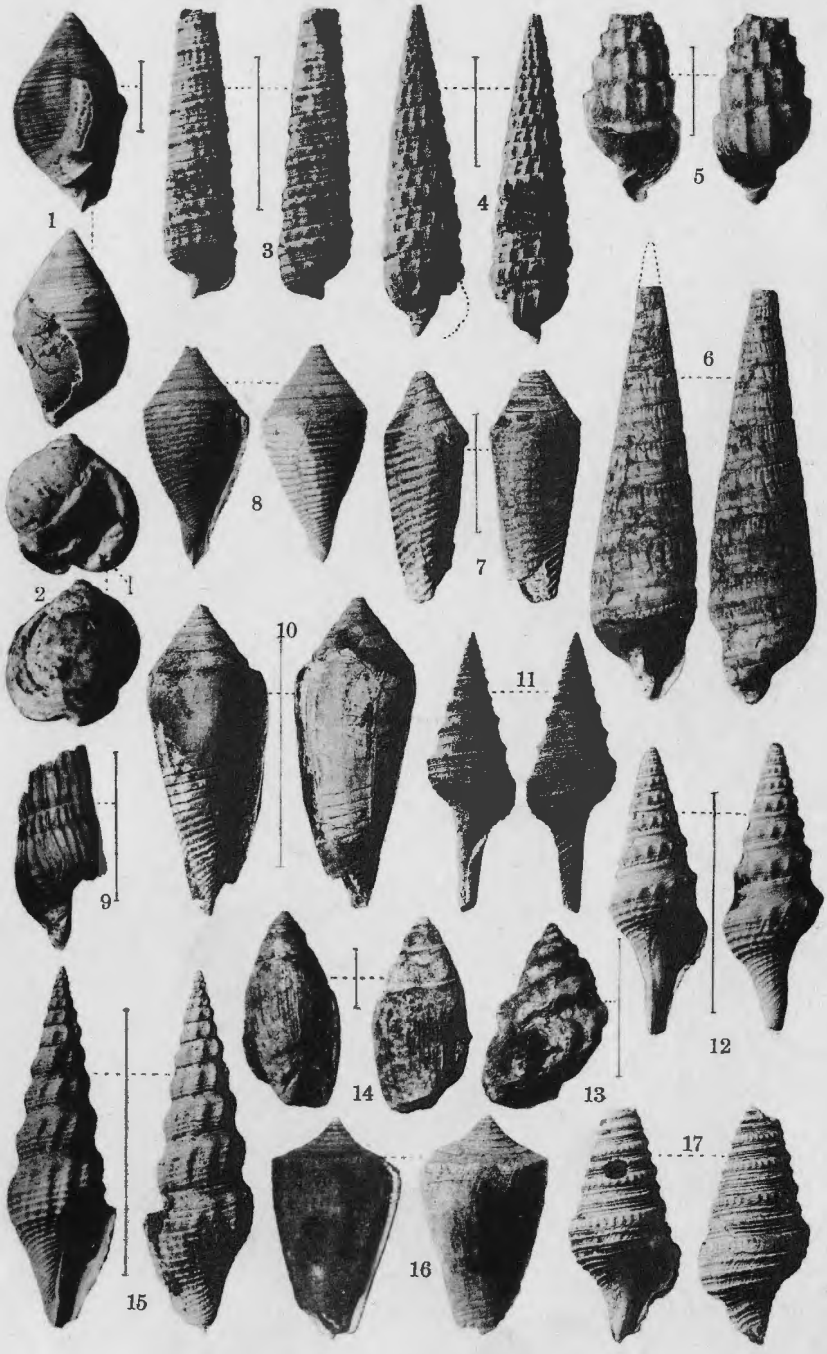
Fig. 13. Ocinebra sp. Upper Arisan: Shokōkō, Tainan. P. 42

Fig. 14. Olivella spretoides Yok. Enlarged. Upper Byoritz: Hōtosak, Rinkō Shō, Taihok. P. 35

Fig. 15. Drillia pseudoprincipalis Yok. Enlarged. Upper Byoritz: Kizan, Byoritz Gai, Shinchik. P. 32

Fig. 16. Conus ōinouyei n. sp. Lower Byoritz: South of Kwan-in San, Taikei Gai, Shinchik. P. 30

Fig. 17. Pleurotoma carinata Gray, var. woodwardi Mart. Upper Byoritz: Shikō, Kōshun, Takao. P. 32



Mollusca from the Oil-Field of Taiwan

PLATE II.

Plate II

Fig. 1. Mitra isabella Swain. Upper Byoritz: Shikō, Kōshun, Takao. P. 35

Fig. 2. Mangilia perparva n. sp. Enlarged. Upper Byoritz: Shikō, Kōshun, Takao. P. 33

Fig. 3. Fasciolaria iizukai n. sp. Upper Byoritz: Shikō, Kōshun, Takao. P. 37

Fig. 4. Mitra sphaerulata Martyn. Enlarged. Upper Byoritz: Kyūshōkō, Shiko Shō, Shinchik. P. 36

Fig. 5. Oliva mustellina Lam. Upper Byoritz: Kwashōhei, Shiko Shō, Shinchik. P. 34

Fig. 6. Mitra gembacana Mart. Enlarged. Lower Byoritz: Nijukei, Tondenkōkei, Tainan. P. 37

Fig. 7. Nassa (Niotha) gemmulata (Lam,). Upper Byoritz: Goko, Shikō Shō, Shinchik. P. 40

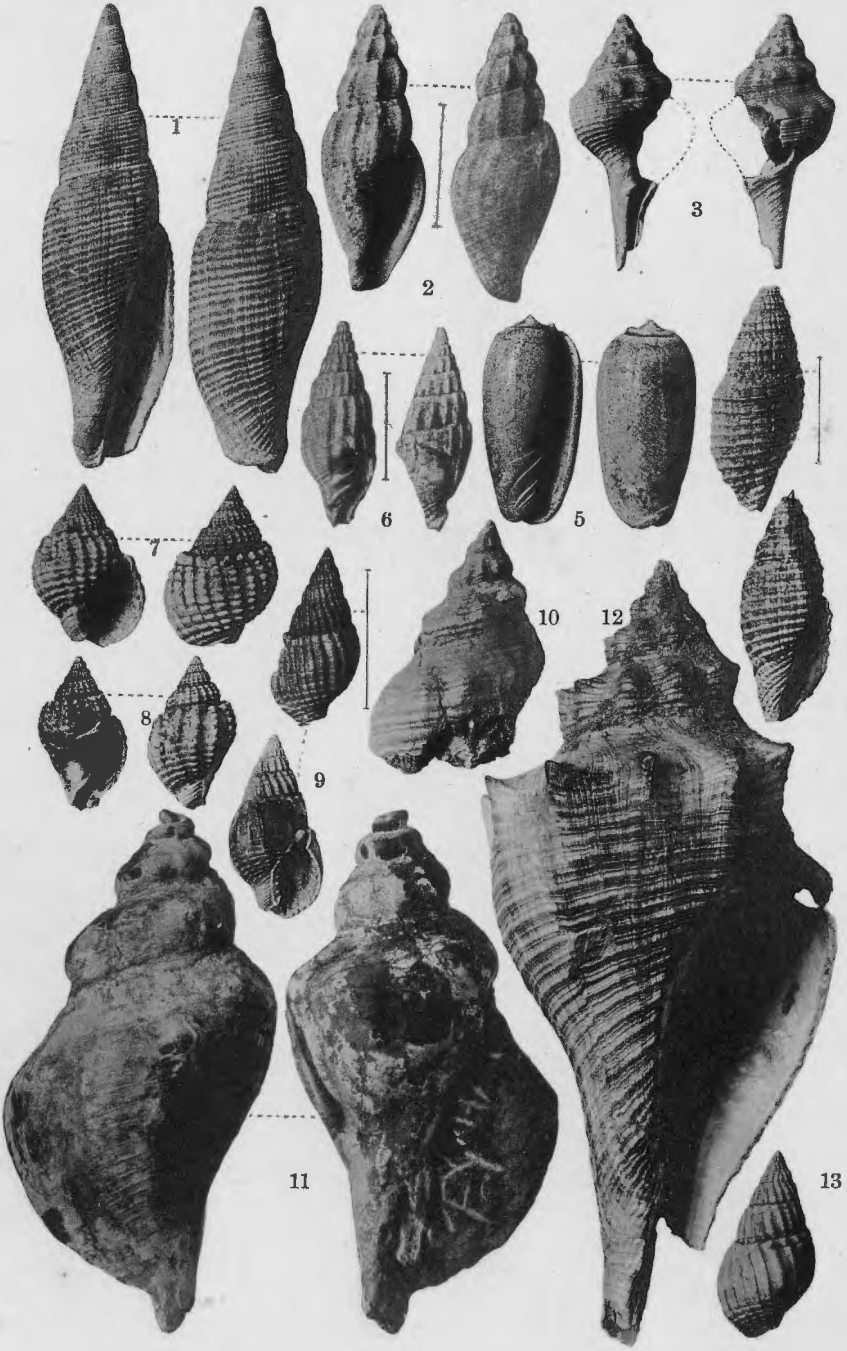
Fig. 8. Nassa gemmulata (Lam.) var. (last part broken and with a less number of ribs and slender). Upper Byoritz: Shikō, Kōshun, Takao. P. 40

Figs. 9, 13. Nassa (Hima) verbeeki Mart. 13. With coarser plicae. Upper Byoritz: Jōnanseikō, Shinchik. P. 40

Fig. 10. Siphonalia kellettioides n. sp. Lower Byoritz: Banbakōkei. Shinchik. P. 39

Fig. 11. Siphonalia kellettioides n. sp. Lower Byoritz: Takao, Shinchik. P. 39

Fig. 12. Hemifusus ternatanus (Gm.). Upper Byoritz: Between Hakshaton and Futōkōbi, Shinchik. P. 38



Mollusca from the Oil-Field of Taiwan

PLATE III.

Plate III

Fig. 1. Nassa canaliculata Lam. Enlarged. Upper Byoritz: Shikō, Kōshun, Takao. P. 41

Fig. 2. Murex ternispina Lam. Upper Byoritz: Shikō, Kōshun, Takao. P. 42

Fig. 3. Cassis japonica Rve. Upper Byoritz: Shikō, Kōshun, Takao. P. 46

Fig. 4. Cassis gracilenta n. sp. Enlarged. Lower Byoritz: Intōshi, Shinchik. P. 46

Fig. 5. Gyrineum scelestum n. sp. With the lower part of the canal preserved. Upper Byoritz: Goko, Shiko Shō, Shinchik. P. 44

Fig. 6. Gyrineum scelestum n. sp. With the lower part of the canal broken. Upper Byoritz: Nankwa, Shinchik, P. 44

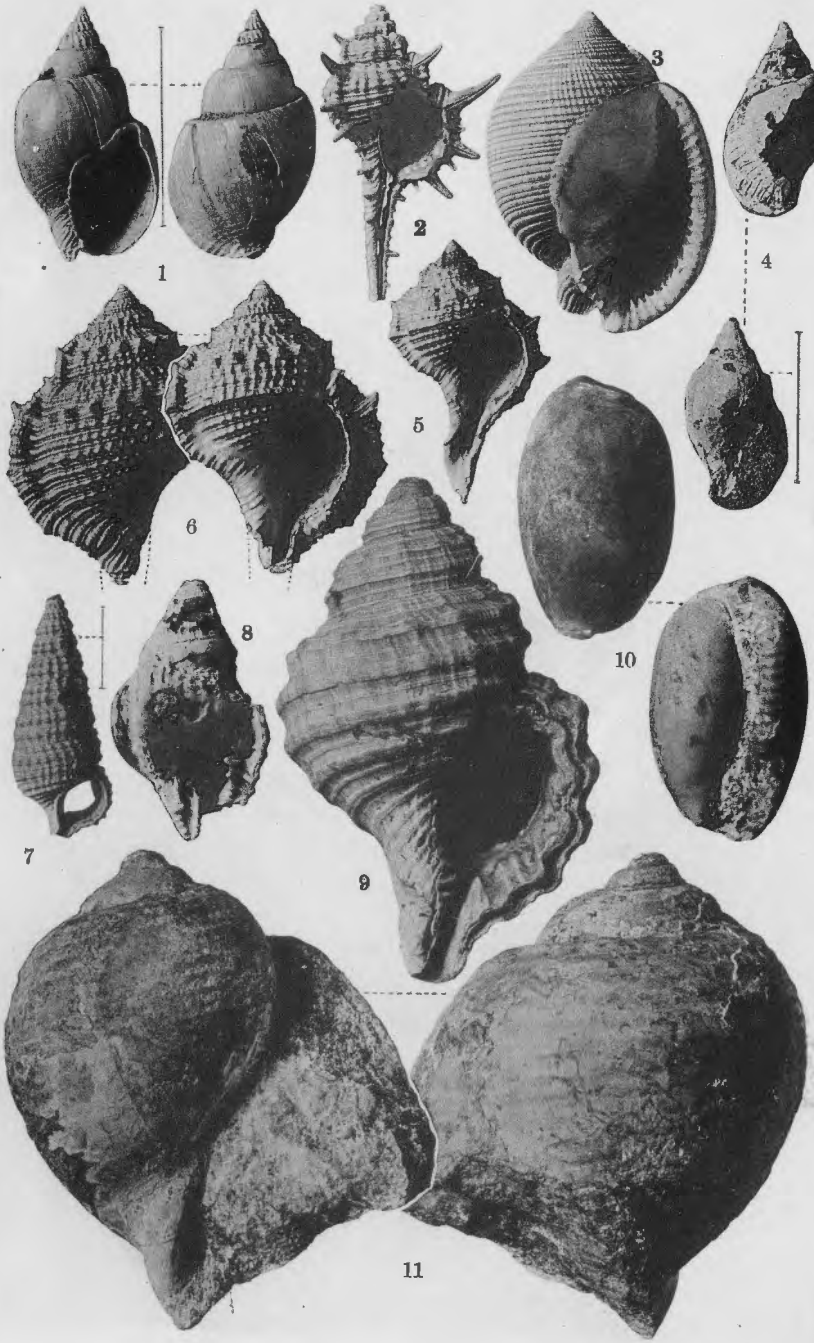
Fig. 7. Cerithium satoi n. sp. Enlarged. Upper Byoritz: Shikō, Kōshun, Takao. P. 51

Fig. 8. Distortio cancellinus (Rois.). Upper Byoritz: Shikō, Kōshun, Takao. P. 44

Fig. 9. Triton (Simpulum) costatus Born. Upper Byoritz: Shikō, Kōshun, Takao. P. 43

Fig. 10. Cypraea cinctoides n. sp. Lower Byoritz: Babukutz, Taitō. P. 48

Fig. 11. Dolium olearium Brug. Lower Byoritz: Babukutz, Taitō. P. 47



Mollusca from the Oil-Field of Taiwan

PLATE IV.

Plate IV

Fig. 1. Turritella bacillum Kien. Lower Byoritz: Roksō, Tainan. P. 56

Fig. 2. Rostellaria sp. Upper Byoritz: Jōwan, Shiko Shō, Shinchik. P. 51

Fig. 3. Turritella terebra L. Lower Byoritz: Rokjūkei, Haksha Shō, Tainan. P. 56

Fig. 4. Cypraea carneola L. Upper Byoritz: Kontei, Kōshun, Takao. P. 48

Fig. 5. Potamides murayamai n. sp. Lower Byoritz: Foot of Kwan-in San, Shinchik. P. 53

Fig. 6. Potamides murayamai n. sp. Upper Byoritz: Jōwan, Shiko Shō, Shinchik, P. 53

Fig. 7. Turritella filiola n. sp. Enlarged. Upper Byoritz: Kizan, Byoritz Gai, Shinchik. P. 57

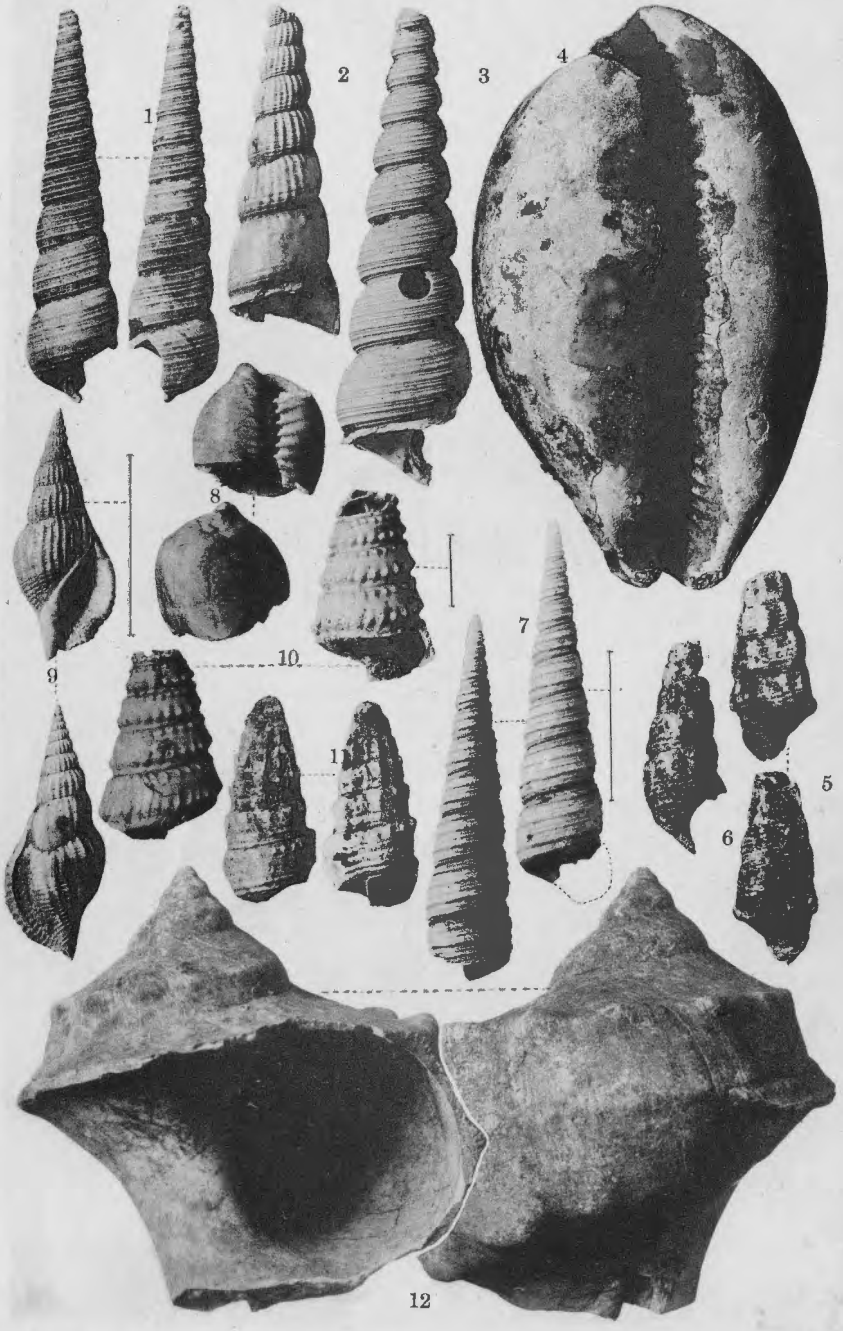
Fig. 8. Cypraea sp. Upper Byoritz: Hōtosak, Taihoku. P. 49

Fig. 9. Rostellaria spinifera Mart. var. formosana. Enlarged. Upper Byoritz: Jōwan, Shiko Shō, Shinchik, P. 50

Fig. 10. Cerithiopsis(?) shikoensis n. sp. Enlarged. Upper Byoritz: Shikō, Kōshun, Takao. P. 55

Fig. 11. Potamides muritus n. sp. Lower Byoritz: Between Sekibyō and Rokjūkei, Tainan. P. 54

Fig. 12. Turbo marmoratus L. var. laevis. 3/5 Nat. size. Upper Byoritz: Kontei, Takao. P. 65



Mollusca from the Oil-Field of Taiwan

PLATE V.

Plate V

Fig. 1. Melania scabroides n. sp. Enlarged. Upper Byoritz: Shikō, Kōshun, Takao. P. 58

Figs. 2–5. Melania submadiunensis n. sp. Enlarged. 2, 3. Lower Byoritz: Between Rokjūkei and Sekibyō, Tainan. 4, 5. Lower Byoritz: the upper course of the Nairin, Tainan. P. 59

Fig. 6. Scutus unguis L. Upper Byoritz: Kizan, Byoritz Gai, Shinchik P. 67

Fig. 7. Solarium perspectivum L. Upper Byoritz: Jōwanseikō, Shiko Shō, Shinchik. P. 62

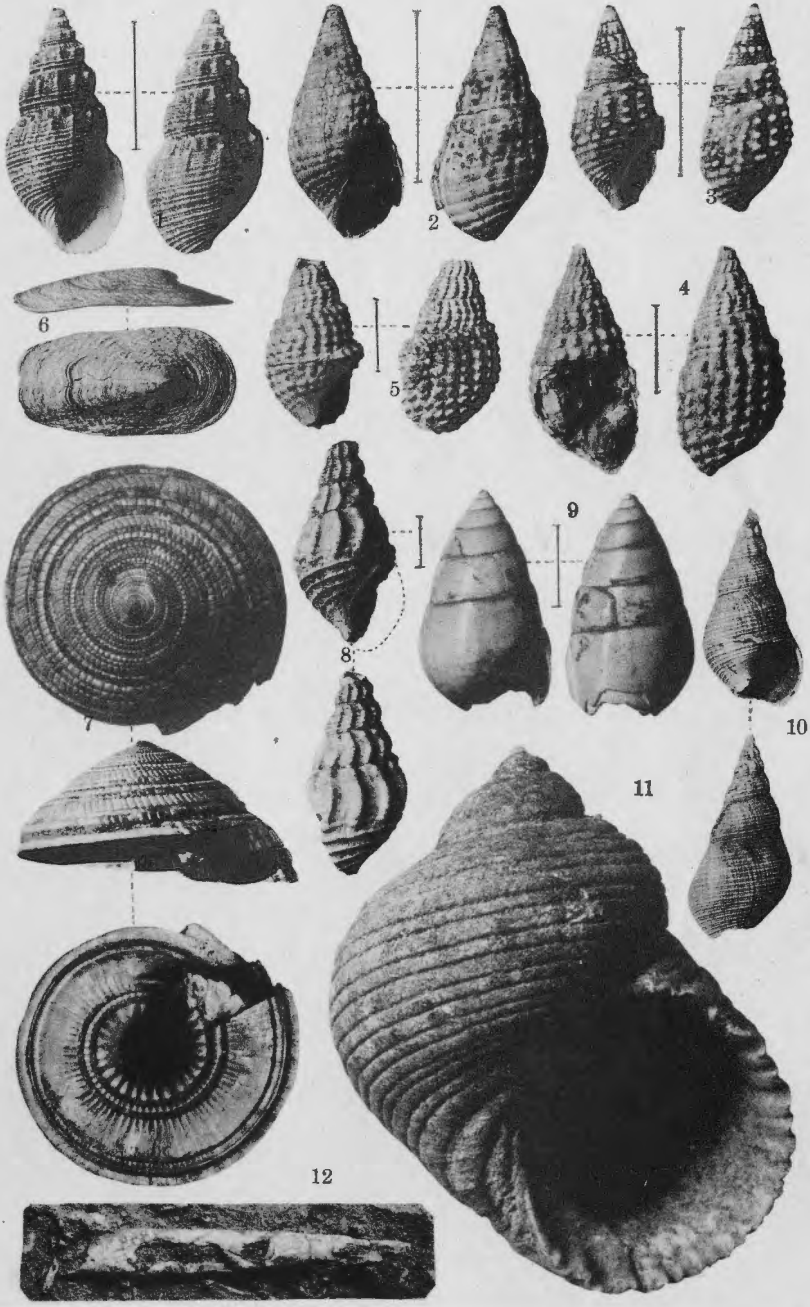
Fig. 8. Melania grossula n. sp. Enlarged. Lower Byoritz: The upper course of the Nairin, Tainan. P. 61

Fig. 9. Melania glabelliuscula n. sp. Enlarged. Upper Byoritz: Shikō, Kōshun, Takao. P. 61

Fig. 10. Melania saigoi n. sp. Upper Byoritz: Shikō, Kōshun, Takao. P. 60

Fig. 11. Turbo argyrostomus L. var. margaritacea L. Upper Byoritz: Kontei, Takao. P. 65

Fig. 12. Dentalium sp. (vernedei Hanl?). Lower Byoritz: Yaryukō, Banri Shō, Taihok. P. 68



Mollusca from the Oil-Field of Taiwan

PLATE V.

Plate V

Fig. 1. Melania scabroides n. sp. Enlarged. Upper Byoritz: Shikō, Kōshun, Takao. P. 58

Figs. 2-5. Melania submadiunensis n. sp. Enlarged. 2, 3. Lower Byoritz: Between Rokjūkei and Sekibyō, Tainan. 4, 5. Lower Byoritz: the upper course of the Nairin, Tainan. P. 59

Fig. 6. Scutus unguis L. Upper Byoritz: Kizan, Byoritz Gai, Shinchik P. 67

Fig. 7. Solarium perspectivum L. Upper Byoritz: Jōwanseikō, Shiko Shō, Shinchik. P. 62

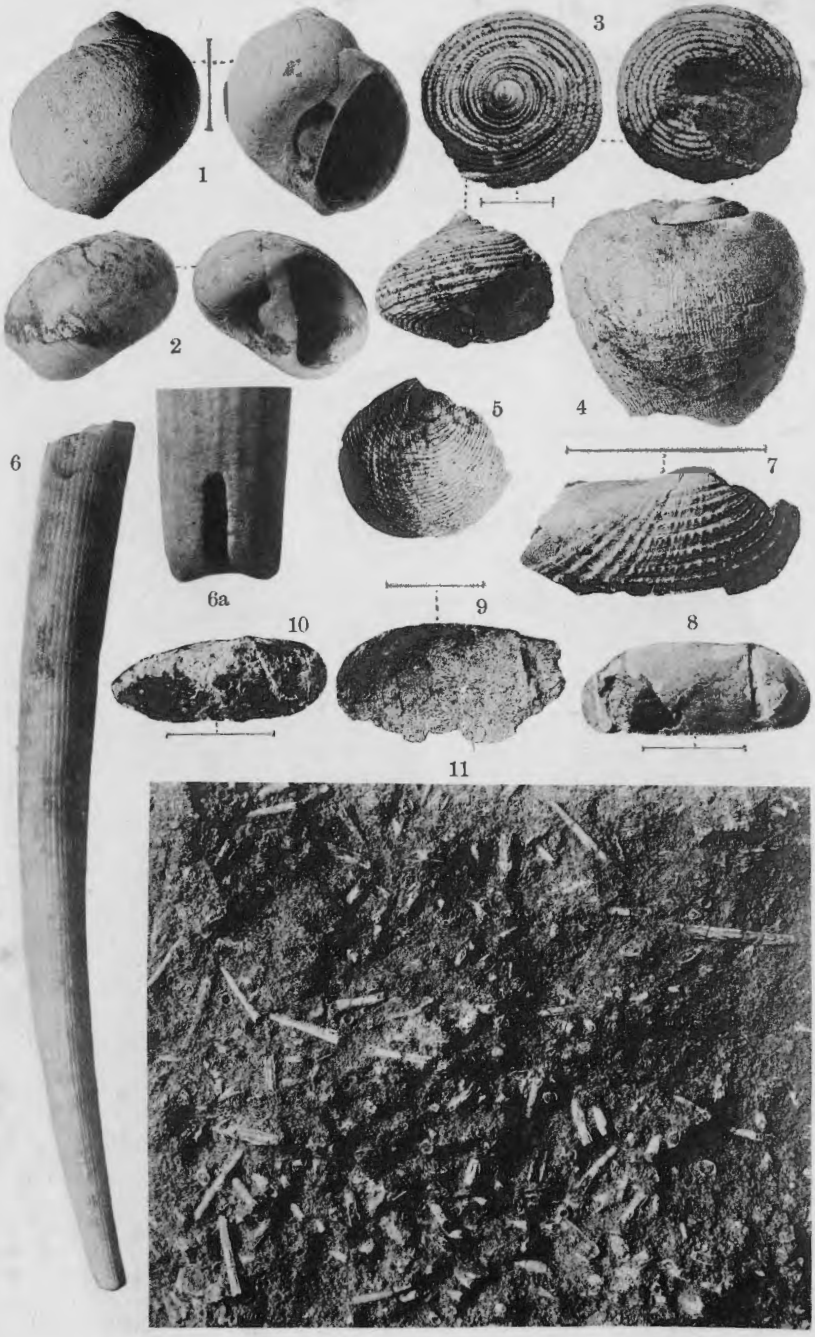
Fig. 8. Melania grossula n. sp. Enlarged. Lower Byoritz: The upper course of the Nairin, Tainan. P. 61

Fig. 9. Melania glabelliuscula n. sp. Enlarged. Upper Byoritz: Shikō, Kōshun, Takao. P. 61

Fig. 10. Melania saigoi n. sp. Upper Byoritz: Shikō, Kōshun, Takao. P. 60

Fig. 11. Turbo argyrostomus L. var. margaritacea L. Upper Byoritz: Kontei, Takao. P. 65

Fig. 12. Dentalium sp. (vernedei Hanl?). Lower Byoritz: Yaryukō, Banri Shō, Taihok. P. 68



Mollusca from the Oil-Field of Taiwan

PLATE VII.

Plate VII

Figs. 1, 2. Tellina taiwanica n. sp. Enlarged. Upper Byoritz: Tenshi, Shiko Shō, Shinchik. P. 73

Fig. 3. Dosinia gruneri Phil. Upper Byoritz: Shūtō, Sankyaksui, Enri, Shinchik. P. 74

Fig. 4. Dosinia angulosa Phil. Lower Byoritz: Bansha, Tainan. P. 75

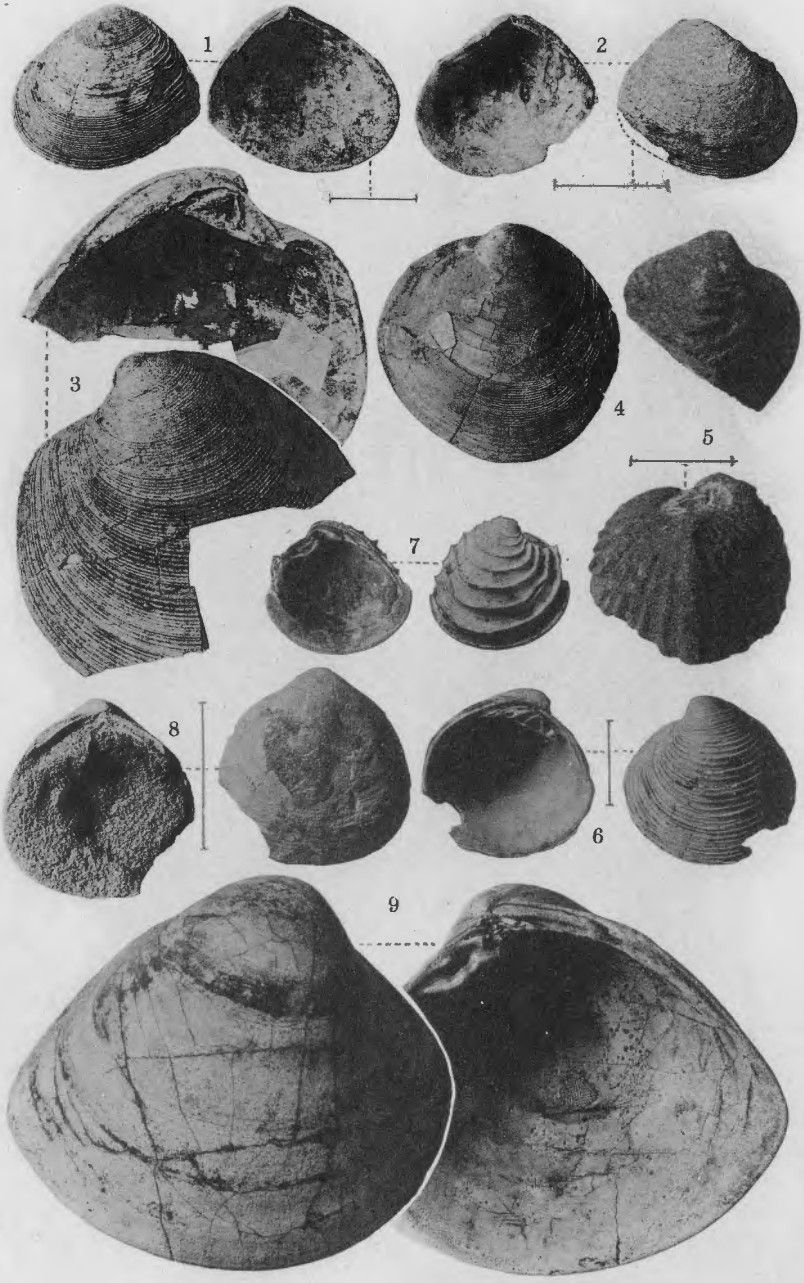
Figs. 5, 5a. Clementia sp. Enlarged. 5a. Front view. Upper Arisan: Tairō-kei, Arisan, Tainan. P. 79

Fig. 6. Meretrix indecoroides n. sp. Enlarged. Lower Byoritz: Nankō, Kōzan Shō, Shinchik. P. 76

Fig. 7. Chione foliacea (Phil.). Lower Byoritz: Nankō, Kōzan Shō, Shinchik. P. 80

Fig. 8. Mactra banbakoensis n. sp. Enlarged. Upper Byoritz: The mouth of the Banbakō, Shinchik. p. 71

Fig. 9. Meretrix meretrix L. Upper Byoritz: Jōnanseikō, Shiko Shō, Shinchik. P. 75



Mollusca from the Oil-Field of Taiwan

PLATE VIII.

Plate VIII

Fig. 1. Meritrix (Macrocallista) ezoensis Yok. Upper Byoritz: Enri, Shinchik. P. 77

Fig. 2. Tapes undulatus Born. Upper Byoritz: Shikō, Kōshun, Takao. P. 82

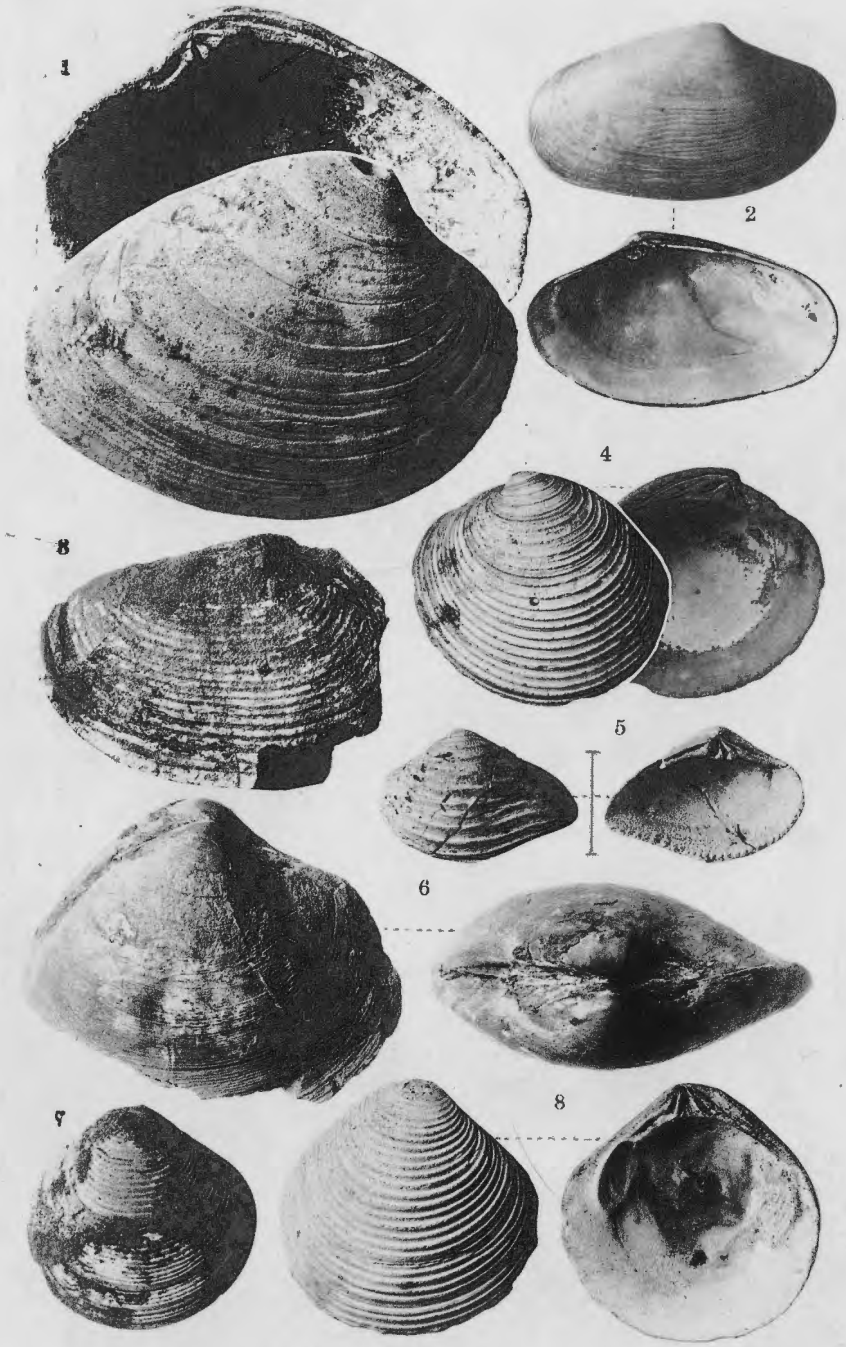
Fig. 3. Tapes sp. Lower Byoritz: Katōkō, Rōdenryō Shō, Shinchik. P. 82

Fig. 4. Chione casinaeformis Yok. Upper Byoritz: Shikō, Kōshun, Takao. P. 79

Fig. 5. Cryptogramma kaneharai n. sp. Enlarged. Upper Byoritz: Sankō, Injūrin, Shinchik. P. 80

Fig. 6. Venus(?) arisanensis n. sp. Lower Arisan: Sachihara, Shinchik. P. 79

Figs. 7, 8. Circe scripta L. 7. Lower Byoritz: Injūrin, Shinchik. 8. Upper Byoritz: Shikō, Kōshun, Takao. P. 81



Mollusca from the Oil-Field of Taiwan

PLATE IX.

Plate IX

Figs. 1, 2. Tapes(?) taiwanensis n. sp. Lower Arisan: Fig. 1. South of Kizan, Taihok. Fig. 2. Usekkōkei, Taichū. P. 82

Figs. 3, 4, 5. Venericardia cipangoana Yok. Upper Byoritz: Fig. 3. Broad-ribbed. Shūtō, Sankyaksui, Shinchik. Fig. 4. Narrow-ribbed. Tenshi. Shiko Shō, Shinchik. Lower Byoritz: Fig. 5. Medium-ribbed. Nankō, Kōzan Shō, Shinchik. P. 86

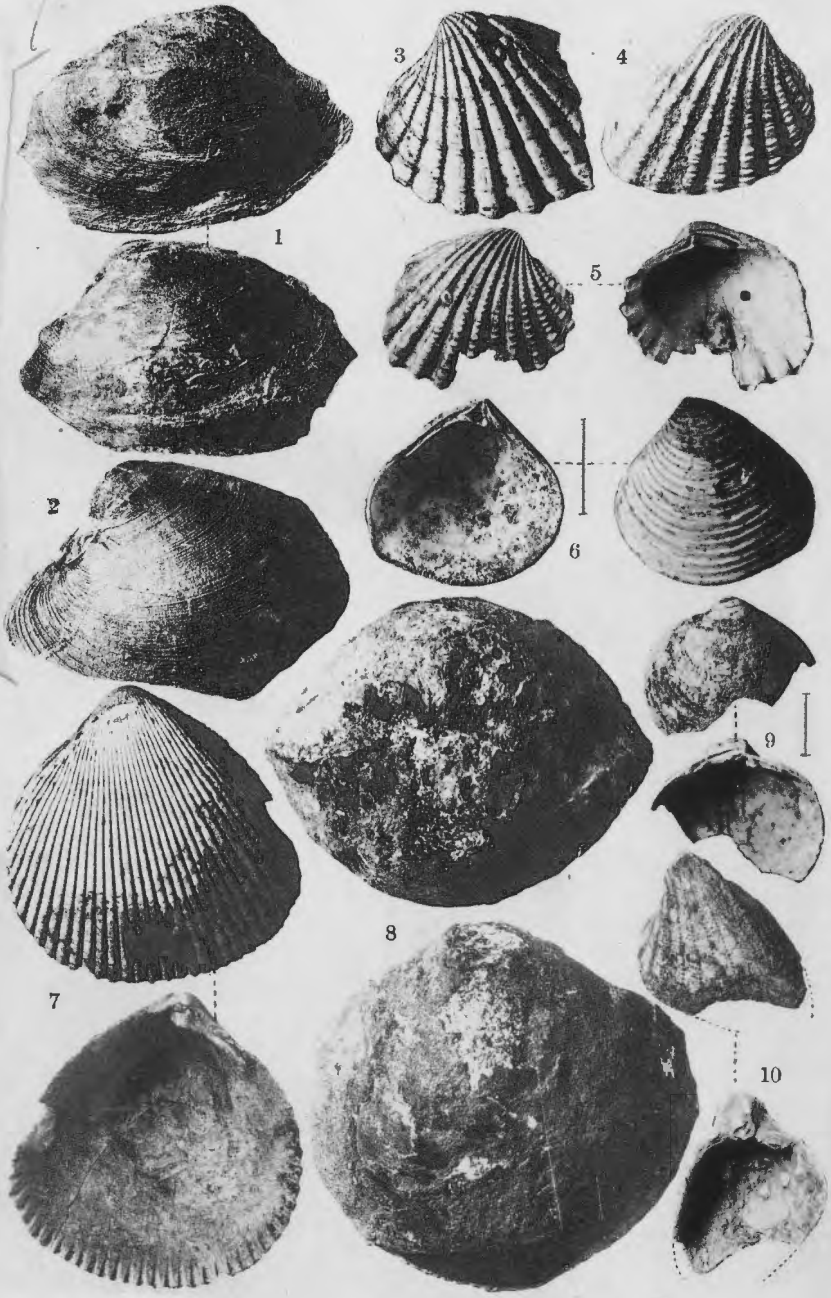
Fig. 6. Astarte sulcata Dac. Upper Byoritz: Jōwan, Shiko Shō, Shinchik. P. 88

Fig. 7. Cardium burchardi Dkr. Upper Byoritz: Tenshi, Shiko Shō, Shinchik. P. 84

Fig. 8. Loripes goliath n. sp. Upper Arisan: A branch stream of the Fūkō Takao. P. 86

Fig. 9. Diplodonta murayamai n. sp. Left valve. Upper Byoritz: Denshinshi, Shiko Shō, Shinchik. P. 85

Fig. 10. Hemicardium hemicardium(L.). Lower Byoritz: Rokjūkei, Haksha Shō, Tainan. P. 84



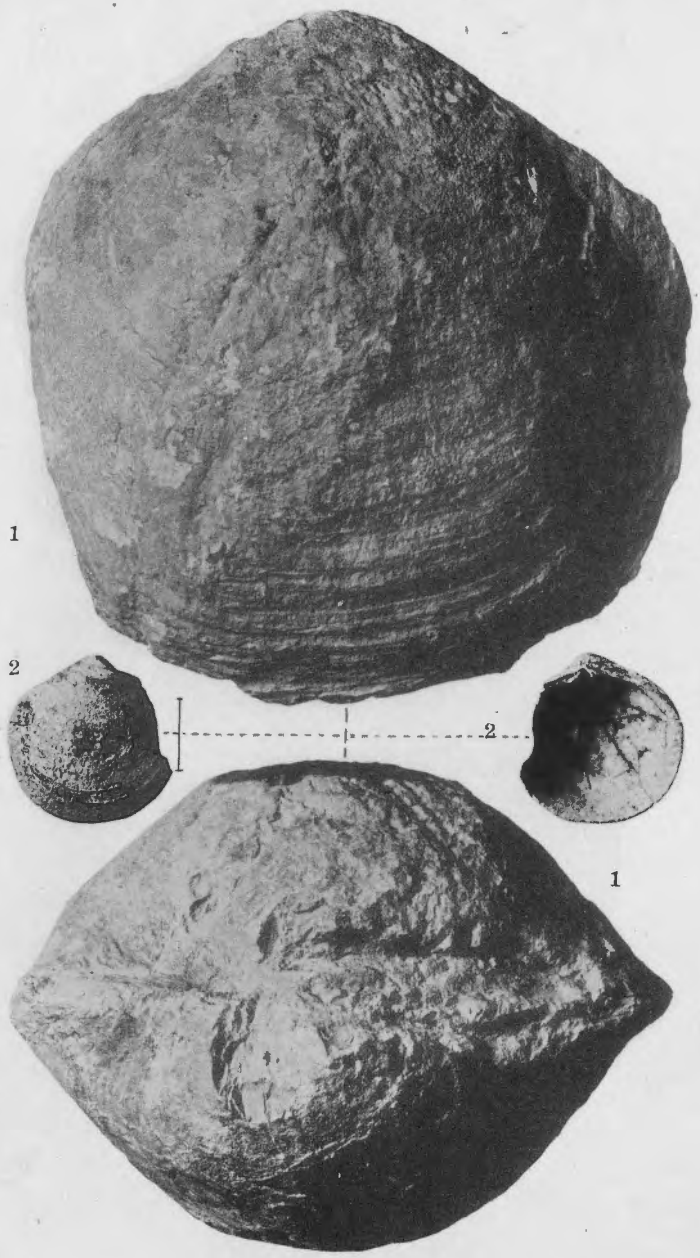
Mollusca from the Oil-Field of Taiwan

PLATE X.

Plate X

Fig. 1. Loripes goliath. n. sp. ⅔ Nat. Size. Upper Arisan: Kōsen, Takao. P. 86

Fig. 2. Diplodonta murayamai n. sp. Right valve. Upper Byoritz: Denshinshi, Shiko Shō, Shinchik. P. 85

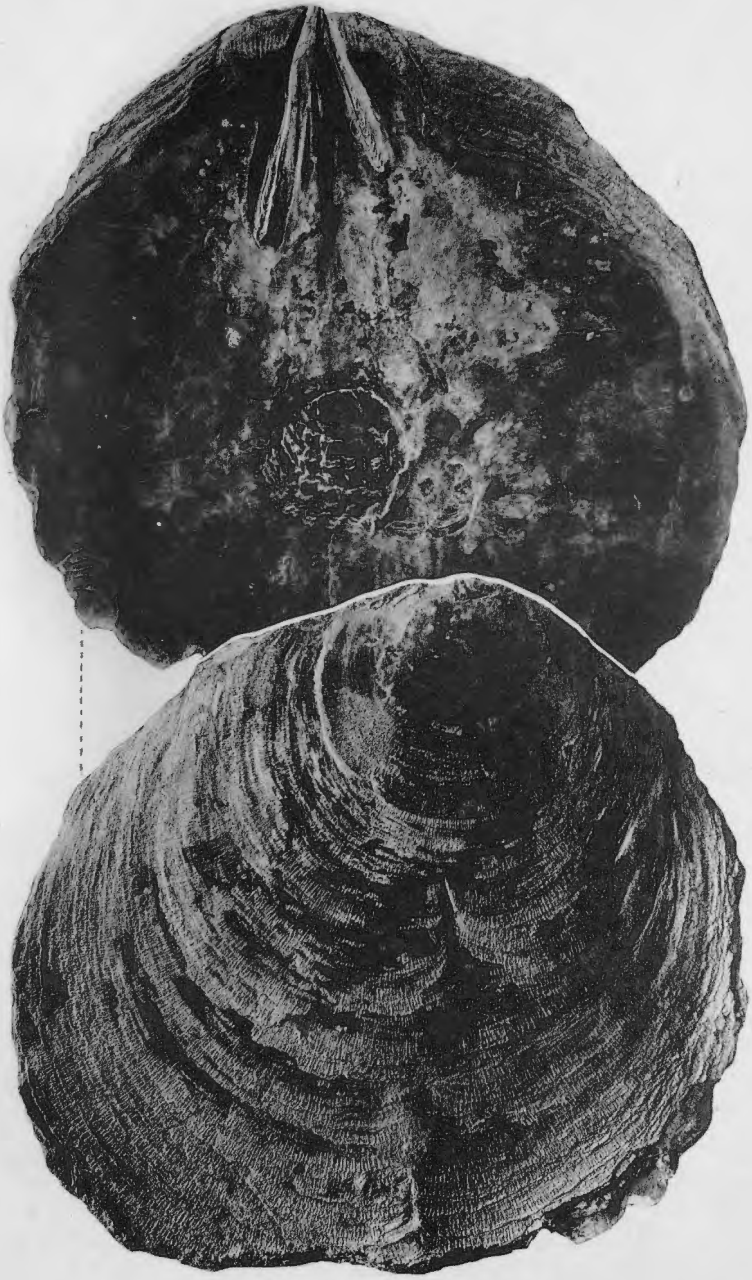


Mollusca from the Oil-Field of Taiwan

PLATE XI.

Plate XI

Placenta placenta (L.). Left valve. Lower Byoritz: Usantō, Tainan. P. 92

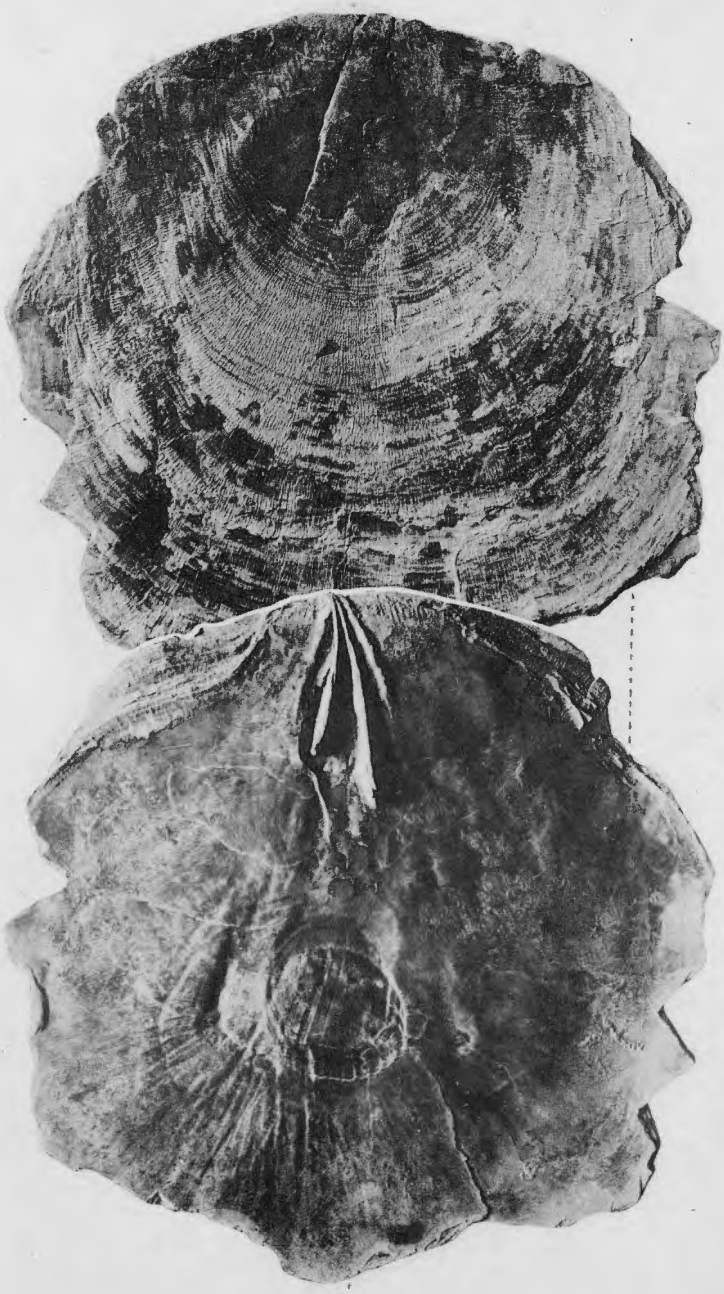


Mollusca from the Oil-Field of Taiwan

PLATE XII.

Plate XII

Placenta placenta (L.). Right valve. Lower Byoritz: Usantō, Tainan. P. 92



Mollusca from the Oil-Field of Taiwan

PLATE XIII.

Plate XIII

Figs. 1, 2, 3. Crassatellites oinouyei n. sp. Lower Byoritz. Figs. 1, 2. Injūrin, Shinchik. Fig. 3. Kyukyurin, Shinchik. P. 89

Figs. 4, 5. Plicatula cuneata Dkr. Enlarged. Upper Byoritz: Kizan. Byoritz Gai, Shinchik. P. 92

Fig. 6. Gomphina sp. Lower Byoritz: Banbakōkei, Shinchik. P. 83

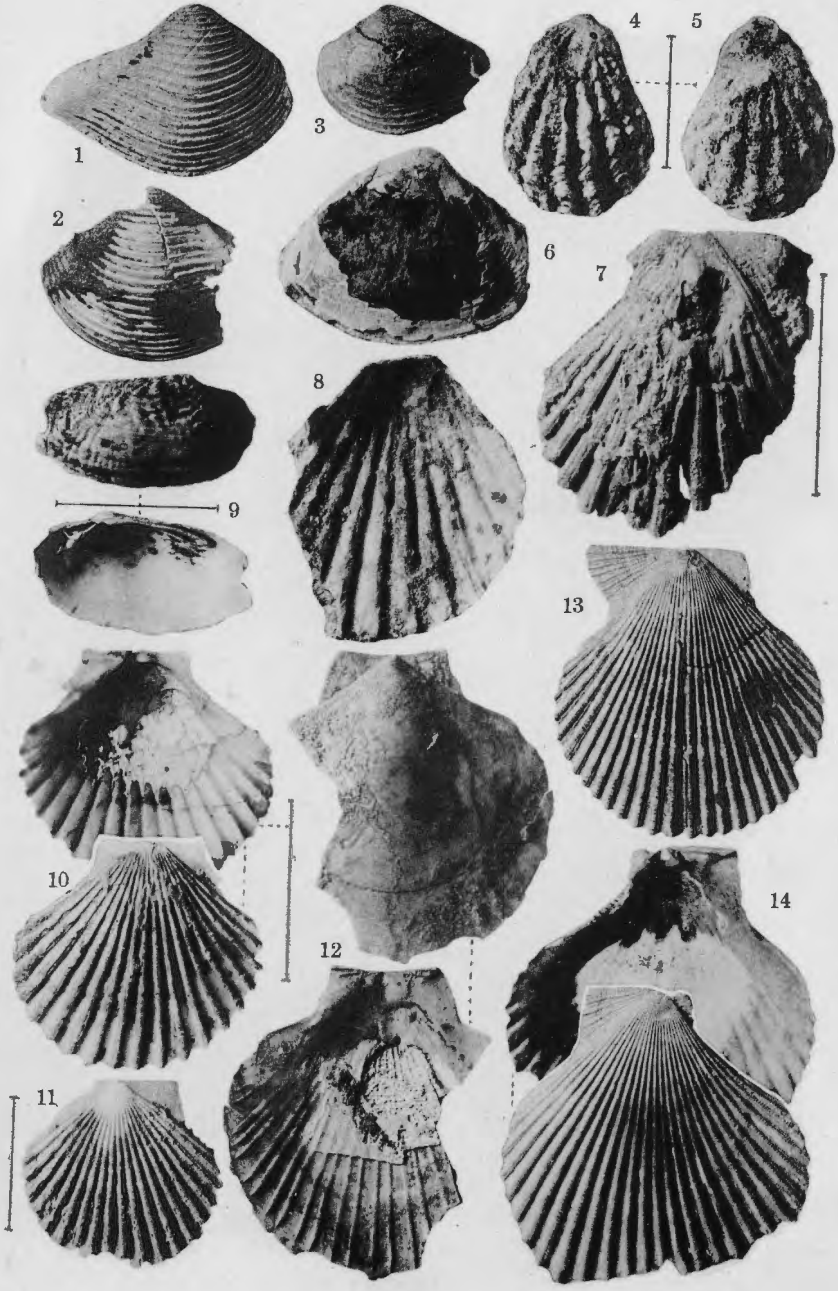
Figs. 7, 8. Pecten (chlamys) aurantiacus Ad. et Rve. Right valves. Fig. 7. Enlarged. Fig. 8. Inner side. Shokkōsan: Hanpeisan, Takao. P. 93

Fig. 9. Unio nipponensis v. Mart. Lower Byoritz: between Sekibyō and Rokjūkei, Tainan. P. 90

Figs. 10, 11. Pecten (Vola). javanus Mart. Enlarged. Upper Byoritz: Tenshi, Shiko Shō, Shinchik. P. 98

Fig. 12. Pecten (Amusium) japonicus (Gm.). Upper Byoritz: Tenshi, Shiko Shō, Shinchik. P. 95

Figs. 13, 14. Pecten (Chlamys) satoi n. sp. Upper Byoritz. Fig. 12. Left valve. Hōtosak. Rinkō Shō, Taihok. Fig. 13. Right valve. Ubikō, Tsūshō Shō, Shinchik. P. 94



Mollusca from the Oil-Field of Taiwan

PLATE XIV.

Plate XIV

Fig. 1. Pecten (Vola) sinensis Sow. Upper Byoritz: Jōnanseikō, Shiko Shō, Shinchik. P. 97

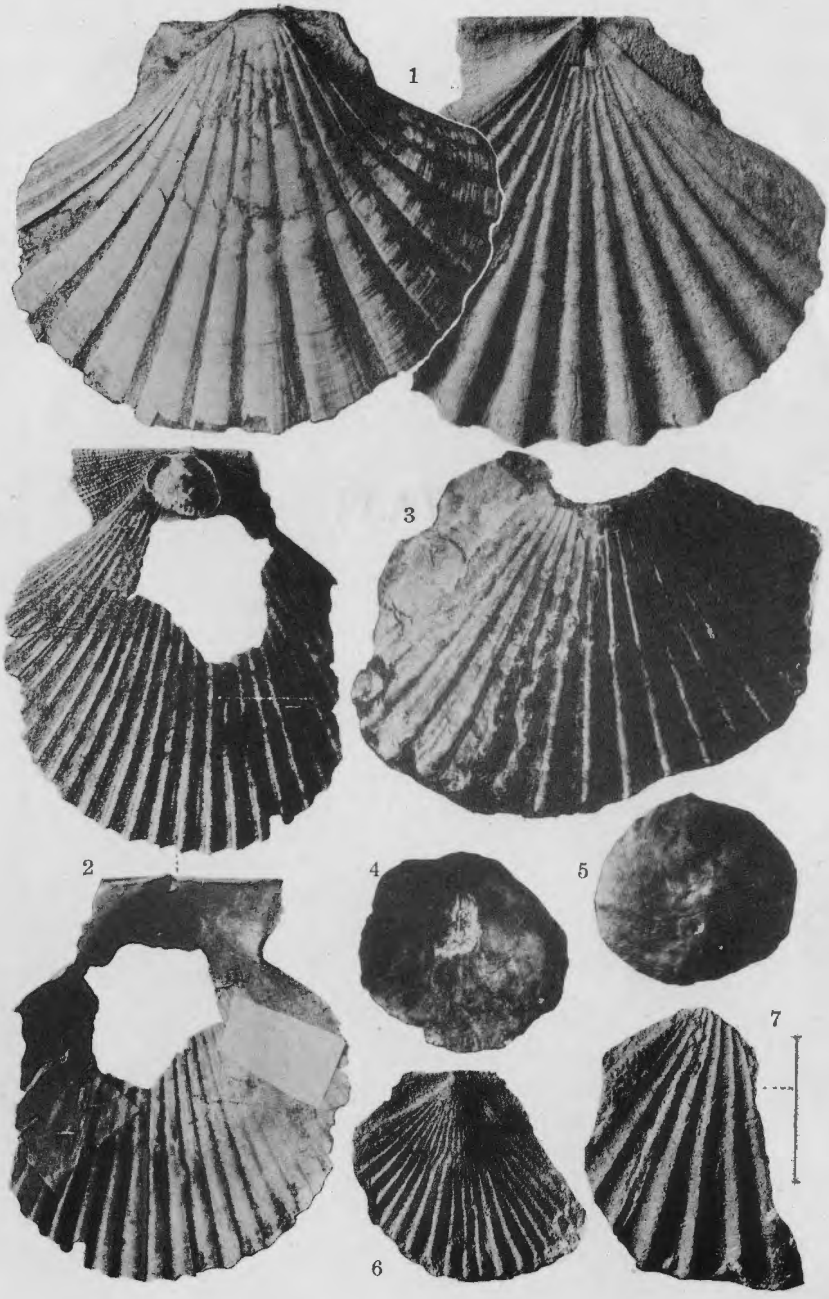
Fig. 2. Pecten (Chlamys) satoi n. sp. Left valve. Upper Byoritz: Ubikō, Tsūshō Shō, Shinchik. P. 94

Fig. 3. Pecten (Chlamys) sp. ⅔ Nat. Size. Upper Arisan: Sanshikyakkei, Taihok. P. 94

Figs. 4, 5. Anomia lischkei Dautz. et Fisch. Lower Byoritz: Hok'ho, Sanwan Shō, Shinchik. P. 91

Fig. 6. Pecten sp. Upper Arisan. Satō, Shinchik. P. 98

Fig. 7. Pecten (Chlamys?) sp. Enlarged. Upper Arisan: Bōryō, Takao. P. 95



Mollusca from the Oil-Field of Taiwan

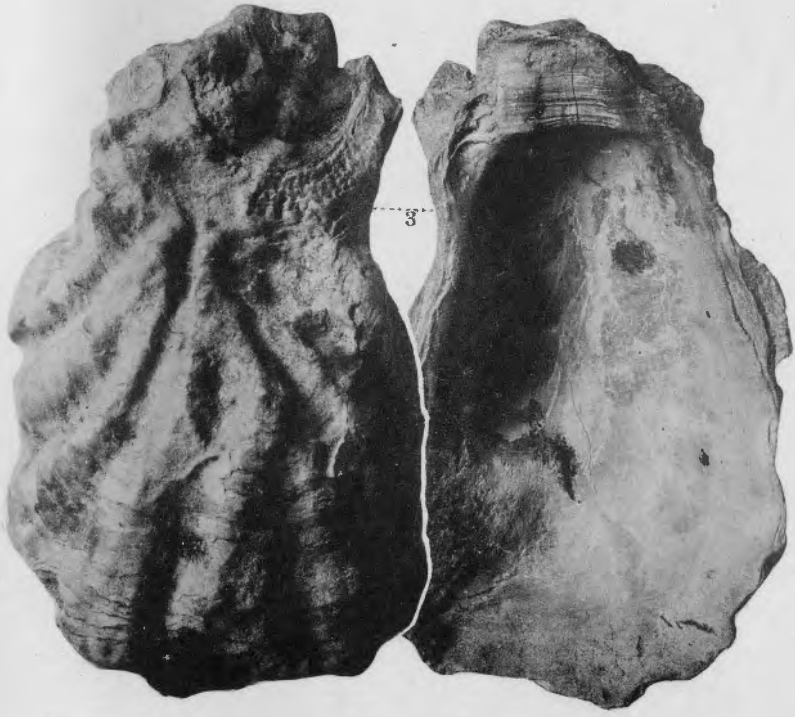
PLATE XV.

Plate XV

Fig. 1. Pecten (Amusium) praesignis Yok. Cast. ⅔ Nat. Size. Upper Arisan: Kwanshirei, Haksha Shō, Tainan. P. 96

Fig. 2. Ostrea gigas Thunb. Convex valve. Shokkōsan: Zenpōbi, Takao. P. 99

Fig. 3. Ostrea gigas Thunb. Convex valve. Upper Byoritz: Hōtosak, Rinkō Shō, Taihok. P. 99



Mollusca from the Oil-Field of Taiwan

PLATE XVI.

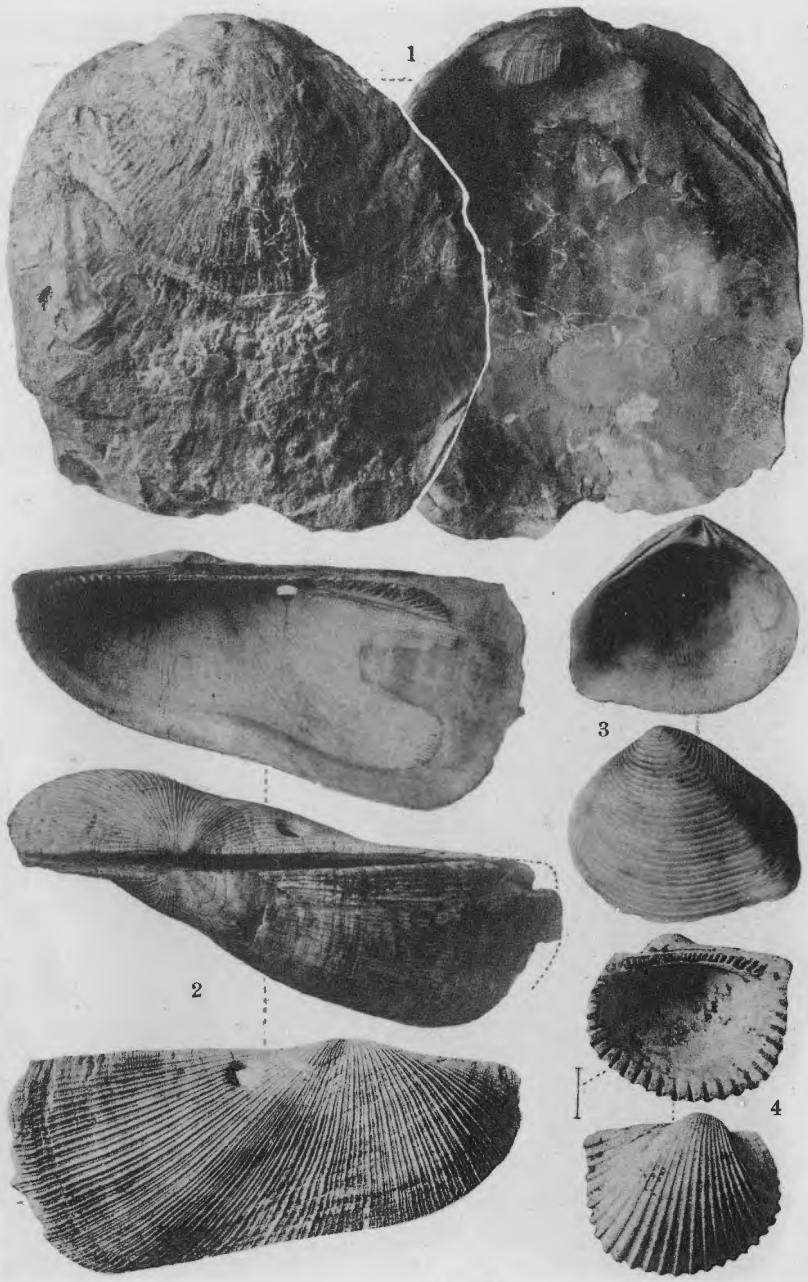
Plate XVI

Fig. 1. Ostrea denselamellosa Lke. Upper valve. ⅔ Nat. Size. Lower Byoritz: Wankyo, Tainan. P. 100

Fig. 2. Arca (Parallelopipedum) tortuosa L. Upper Byoritz: Kizan, Byoritz Gai, Shinchik. P. 105

Fig. 3. Crassatellites heteroglyptus Pils. Upper Byoritz: Shikō, Kōshun Takao. P. 88

Fig. 4. Arca (Argina) auriculata Lam. Enlarged. Upper Byoritz: Hōtosak, Rinkō Shō, Taihok. P. 104



Mollusca from the Oil-Field of Taiwan

PLATE XVII.

Plate XVII

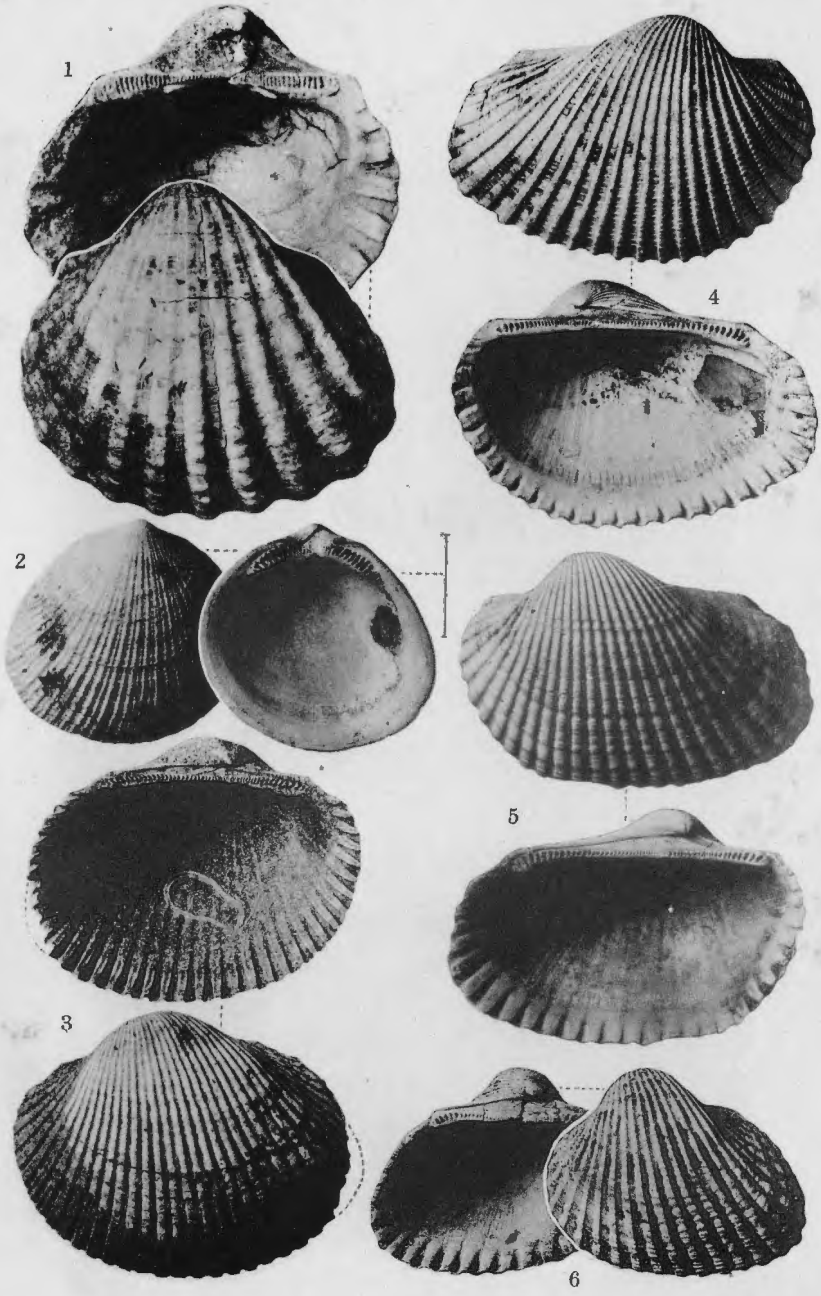
Fig. 1. Arca (Anomalocardia) granosa L. Upper Byoritz: Jōwan, Shiko Shō, Shinchik. P. 101

Fig. 2. Limopsis woodwardi Ad. Enlarged. Upper Byoritz: Shikō, Kōshun, Takao. P. 107

Fig. 3. Arca (Scapharca) inflata Rve. Upper Byoritz: Tenshi, Shiko Shō, Shinchik. P. 102

Figs. 4, 5. Arca (Scapharca) philippiana Dkr. Upper Byoritz: Shikō, Kōshun, Takao. P. 103

Fig. 6. Arca (Scapharca) subcrenata Lke. Upper Byoritz: Sankō, Injurin, Shinchik. P. 103



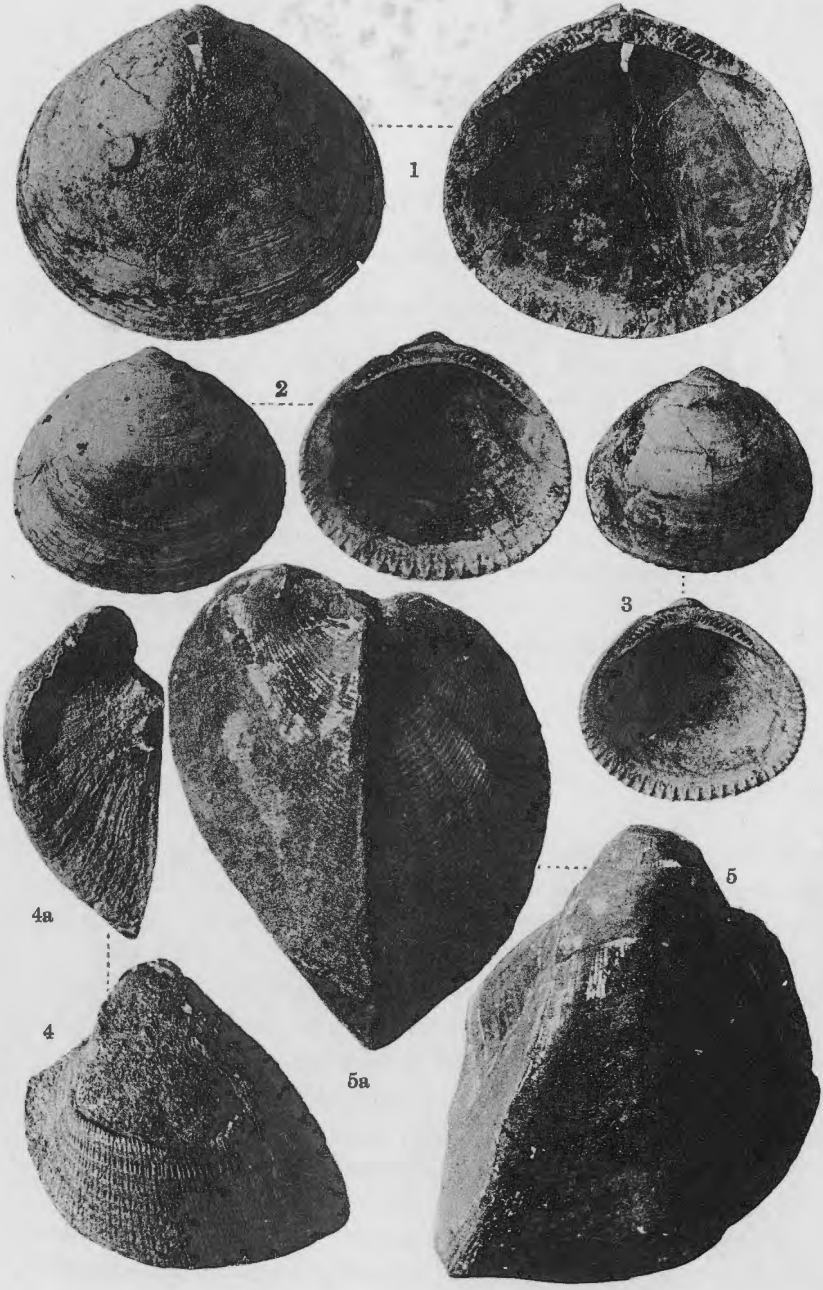
Mollusca from the Oil-Field of Taiwan

PLATE XVIII.

Plate XVIII

Figs. 1, 2, 3. Pectunculus formosanus n. sp. Upper Byoritz: Fig. 1. Left valve. Shūtō, Sankyaksui, Shinchik. Fig. 2. Right valve. Kōdenkō, Shiko Shō, Shinchik. 3. Right valve. Tenshi, Shiko Shō, Shinchik. P. 106

Figs. 4, 5. Cucullaea pamotanensis Mart. Lower Byoritz: Fig. 4. Left valve. 4a. View from behind. West of Bitō, Zuihō Shō, Taihok. Fig. 5. Right valve, 5a. View from front. The lower course of the Senzankei, Kōkwan Shō, Shinchik. P. 107



Mollusca from the Oil-Field of Taiwan

Semi-Fossil Shells from Noto

By

Matajiro YOKOYAMA, *Rigakuhakushi*

On the west shore of Port Nanao, Noto, a province of Central Japan facing Japan Sea and forming a peninsula, there is at several places a horizontal layer of sand covering the foot of the hills made up of inclined Tertiary strata containing fossils. These fossils which are probably Pliocene in age, though few in number, have already been mentioned by me in the April number of the Journal of the Geological Society of Tokyo, 1926. They are the following:

Terebratulina septentrionalis Couth.
Terebratulina japonica (Sow.)
Terebratella crossei Dav.
Laqueus rubellus Sow.
Magellania lenticularis Desh.
Pecten permirus Yok. n. sp.

The upper sand-layer is also fossiliferous and often rich in shells which are quite young-looking, retaining in many instances their original colour, though more or less faded. In the autumn of 1927 I had an opportunity of making a collection at a place where a hill-side was cut down to obtain a sufficient level ground for the compound of a newly established cement-making company. The layer was several feet thick covered above with that of a soil. Soon after my return to Tokyo, Mr. Katsumi Mochizuki, then a student of geology in the Imperial University of Tokyo, visited Nanao, kindly seizing the occasion for making a further collection for me at the same place, which added not a little to the number of the species already collected. The names of all the species found are given in the following table:

Gastropoda	Geological Occurrence
1. Solidula strigosa Gld.	Rec. (C. W. S. Japan). Up. Musashino
2. Cylichna andenica Yok.	Up. Musashino
3. Cylichna incisula n. sp.	
4. Pleurotoma vertebrata Sm.	Rec. (C. W. Japan). Up. Musashino
5. Clathurella centrosa Pils.	Rec. (S. Japan). Coral Bed (Pleistocene?)
6. Cancellaria spengleriana Desh.	Rec. (C. Japan, Philippines). Up. Musashino-Pliocene
7. Fusus perplexus Ad.	Rec. (N. C. W. Japan). Up. Musashino-Pliocene
8. Nassa (Hima) japonica Ad.	Rec. (C. W. Japan). Up. Musashino-Pliocene.
9. Nassa (Hima) festiva Pow.	Rec. (N. C. W. Japan). Up. a. Low. Musashino
10. Nassa (Niotha) livescens Phil.	Rec. (C. Japan, Philippines). Coral Bed-Low. Musashino
11. Ocinebra contracta Rve.	Rec. (N.-S. Japan). Coral Bed. Up. Musashino
12. Cuma pseudodiadema n. sp.	
13. Columbella (Mitrella) dunkeri Try.	Rec. (N. C. W. Japan). Coral Bed-Pliocene
14. Rapana bezoar L. v. thomasiana Cr.	Rec. (N. C. W. Japan). Up. Musashino-Pliocene
15. Purpura alveolata Rve.	Rec. (C. W. Japan, Panama). Up. Musashino-Pliocene
16. Strombus japonicus Rve.	Rec. (C. W. S. Japan). Up. Musashino
17. Cerithium (Clava) kochi Phil.	Rec. (C. W. Japan). Coral Bed. Up. Musashino
18. Cerithium kobelti Dkr.	Rec. (C. Japan). Up. Musashino
19. Potamides (Tympanotomus) fluviatilis (P. et M.)	Rec. (C. W. Japan). Up. Musashino-Pliocene
20. Triforis otsuensis Yok.	Rec. (C. Japan). Up. Musashino.
21. Thylacodes medusae Pils.	Rec. (C. W. S. Japan). Coral Bed. Up. Musashino
22. Vermetus ebaranus Yok.	Up. Musashino
23. Litiopa simplex Yok.	Up. Musashino
24. Rissoa (Cingula) subdharma n. sp.	
25. Rissoina submercurialis Yok.	Rec. (C. Japan). Coral Bed. Up. Musashino

26.	Rissoina cancellata Phil.	Rec. (Japan, W. Indies). Coral Bed.
27.	Fenella septentrionals Tok.	Rec. (C. Japan). Up. Musashino.
28.	Natica colliei Recl.	Rec. (W. Japan). Pliocene
29.	Polinices pallidus Br. et Sow.	Rec. (N. Japan). Up. a. Low. Musashino
30.	Polinices ampla (Phil.)	Rec. (N.-S. Japan). Up. Musashino-Pliocene
31.	Sigaretus (Eunaticina) papilla Gm.	Rec. (C. W. Japan, Philippines). Up. Musashino-Pliocene
32.	Pyramidella (Syrnola) toshimana Yok.	Upper Musashino
33.	Turbo (Marmorostoma) coreensis Recl.	Rec. (C. W. Japan). Up. Musashino
34.	Turbo (Marmorostoma) granulatus Gm.	Rec. (C. W. Japan, Indian O.). Coral Bed. Up. Musashino.
35.	Chlorostoma umbilicatum (Lke.)	Rec. (C. W. Japan). Up. Musashino
36.	Chlorostoma argyrostomum Gm.	Rec. (C. W. Japan). Up. Musashino
37.	Monodonta labio L.	Rec. (N.-S. Japan, Moluccas). Coral Bed.
38.	Cantharidus japonicus (Ad.)	Rec. (C. W. Japan). Coral Bed
39.	Cyclostrema duplicatum Lke.	Rec. (C. Japan). Up. Musashino
40.	Fissuridea sieboldi Rve.	Rec. (C. W. Japan).
41.	Acmaea schrencki Lke.	Rec. (N. C. W. Japan). Up. Musashino
	Scaphopoda	
42.	Dentalium octagonum Lam.	Rec. (N.-S. Japan, Ceylon). Coral Bed-Pliocene
	Lamellibranchiata	
43.	Pholas fragilis Sow.	Rec. (W. Japan, Philippines). Up. Musashino
44.	Martesia striata L. var. tokyoensis Yok.	Up. Musashino
45.	Panope generosa (Gld.)	Rec. (N. Japan). Up. Musashino-Pliocene
46.	Mya arenaria L.	Rec. (N. C. W). Up. Musashino-Pliocene
47.	Mactra ovalina Lam.	Rec. (C. Japan). Up. Musashino
48.	Raeta yokohamensis Pils.	Rec. (C. Japan). Up. Musashino-Pliocene

	Geological Occurrence
49. Solen krusensternii Schr.	Rec. (N. Japan). Up. Musashino-Pliocene
50. Solecurtus abbreviatus Gld.	Rec. (W. Japan)
51. Semele sinensis Ad.	Rec. (C. Japan)
52. Tellina iridella Mart.	Rec. (C. W. Japan). Coral Bed. Up. Musashino
53. Tellina gargadia L.	Rec. (C. Japan, Philippines)
54. Macoma inquinata (Desh.)	Rec. (N. C. W. Japan). Coral Bed-Miocene
55. Macoma praetexta v. Mart.	Rec. (C. W. Japan). Up. Musashino-Miocene
56. Loripes philippiana (Rve.)	Rec. (C. W. Japan). Up. Musashino
57. Petricola japonica Dkr.	Rec. (N. Japan)
58. Dosinia trosheli Lke.	Rec. (C. W. Japan). Up. Musashino-Pliocene
59. Meretrix tigrina (Lam.)	Rec. (W. Japan (Osumi), Moluccas). Coral Bed.
60. Venus jedoensis Lke.	Rec. (N. C. W. Japan). Coral Bed. Up. Musashino
61. Chione crenifera (Sow.)	Rec. (W. Japan, Peru). Up. Musashino
62. Circe scripta L.	Rec. (C. W. Japan, Red Sea). Up. Musashino-Miocene.
63. Circe divaricata Chem.	Rec. (C. W. Japan)
64. Venerupis insignis (Desh).	Rec. (C. Japan). Coral Bed. Up. Musashino
65. Tapes variegatus Harl.	Rec. (C. W. Japan, Philippines). Up. Musashino-Pliocene
66. Cardium muticum Rve.	Rec. (N. C. W. Japan, Philippines). Up. Musashino-Pliocene.
67. Kellia notoensis n. sp.	
68. Diplodonta japonica Pils.	Rec. (C. Japan), Up. Musashino-Pliocene
69. Diplodonta semiaspera Phil.	Rec. (C. W. Japan, W. Indies). Coral Bed-Low. Musashino
70. Codakia bella Conr. var. delicatula Pils.	Rec. (S. Japan). Coral Bed.

71.	Lucina contraria Dkr.	Rec. (C. Japan). Coral Bed-Low. Musashino
72.	Lucina pisidium Dkr.	Rec. (N.-S. Japan). Coral Bed. Up. Musashino
73.	Chama semipurpurata Lke.	Rec. (C.-S. Japan). Coral Bed. Up. Musashino
74.	Cardita crassicosta Lam.	Rec. (Philippines). Coral Bed
75.	Trapezium nipponicum Yok.	Rec. (C. W. Japan). Up. Musashino
76.	Coralliophaga coralliophaga Gm.	Rec. (C. W. Japan, South Sea). Coral Bed. Up. Musashino
77.	Anomia lischkei F. et D.	Rec. (N. C. W. Japan). Up. a. Low. Musashino
78.	Lima angulata Sow.	Rec. (N. C. Japan, Philippines). Up. Musashino-Pliocene
79.	Spondylus cruentus Lke.	Rec. (C. W. Japan). Coral Bed. Up. Musashino
80.	Pecten (Chlamys) laetus Ged.	Rec. (N. C. W. Japan). Coral Bed-Pliocene
81.	Pecten (Vola) laqueatus Sow.	Rec. (N. C. W. Japan) Up. Musashino-Pliocene
82.	Pecten (Vola) sinensis Sow.	Rec. (N. C. Japan, China). Up. Musashino
83.	Ostrea gigas Thumb.	Rec. (N. C. W. Japan, N. China). Up. Musashino-Pliocene
84.	Ostrea denselamellosa Lke.	Rec. (N.-S. Japan). Up. Musashino-Pliocene
85.	Arca kobeltiana Pils.	Rec. (N. C. Japan). Coral Bed-Pliocene
86.	Arca (Barbatia) stearnsii Pils.	Rec. (C. W. Japan). Coral Bed. Up. a. Low. Musashino
87.	Arca (Barbatia) symmetrica Rve.	Rec. (C. W. Japan, Philippines). Coral Bed-Pliocene
88.	Arca (Barbatia) decurvata Lke.	Rec. (W. Japan, Philippines)

Brachiopoda

89.	Terebratulina caputserpentis L.	Rec. (C. Japan, N. Pacific). Up. Musashino-Miocene

The eighty-nine species above enumerated consist of the following elements :

	Number
Species hitherto found only Recent.	7
Species hitherto found Recent as well as in Coral Bed.	7
Species hitherto ranging between Recent and Upper Musashino.	29
Species hitherto ranging between Recent and Pliocene.	33
Species hitherto ranging between Recent and Miocene.	4
Species hitherto found only fossil (in Upper Musashino).	5
Species entirely new.	4
	89.

From this we see that the living species occupy at least 90% of the whole which, however, is liable to be increased, as there is a possibility of what are here treated as extinct (only fossil or new) turning out to be living by future discoveries.

A fauna containing more than 90% of the living species, geologically considered, must be called very young, belonging either to the *Pleistocene* or to the earlier part of the *Holocene* or *Modern*. To whichever age it may belong, it is very likely that the deposit containing the shells in question approximately corresponds in horizon to the so-called Coral Bed of Awa found on the Pacific side of Central Japan and not far from Tokyo. That this bed entombs among others several forms now living only further south had already been pointed out in my paper

relating to it. Accordingly, it is essential to examine whether the Nanao bed too contains such forms. For this purpose I divide the living species which amount to eighty into the following groups according to their present habitat:

Species now known to be living only in Central Japan or in about the same latitudes (Western Japan).	32
Species now known to be living in Central (or Western Japan) as well as south of it.	17
Species now known to be living in Central (or Western Japan) as well as north of it.	16
Species now known to be living north as well as south of Central (or Western) Japan.	7
Species now known to be living only south of Central (or Western) Japan.	4
Species now known to be living only north of Central (or Western Japan).	4
	80

The greatest number is taken by those species which are now living in Central Japan or in about the same latitudes (Western Japan), as might naturally be expected, the fossil locality itself lying in the same portion of Japan. They amount to 32 or about 40% of the whole. Next come those which live in Central or Western Japan as well as south of it, amounting to 17 or about 21%; then those which live as well north of it, amounting to 16 or about 20%. The 7 species living north as well as south may be called indifferent forms. The further two groups, the exclusively southern and exclusively northern, are each represented by four species.

The fauna according to the above distribution seems to show no peculiarity, for the last two groups which decide the character of the whole are equal in number, apparently cancelling each other. However, we must bear in mind that the position of Nanao, though geographically lying *within* Central Japan, is only one degree south of the 38th parallel, north latitude, which I usually take as a boundary between Northern and Central Japan, besides being situated *not* on the Pacific side of the latter, but on Japan Sea side where the water is always somewhat cooler. Consequently the value of the four northern forms is much diminished, while that of the four southern is in a corresponding degree increased. What I take for the latter are *Clathurella centrosa Pils.*, *Meretrix tigrina* (*Lam.*), *Lucina bella Conr. var. dedicatula Pils.* and *Cardita crassicosta Lam.*, all of which occur in the Coral Bed, though in the recent seas, as far as our present knowledges goes, are not living north of the southern end of the island of Kyushu which counted by latitudes is six degrees south of Nanao. The species which is found near this island is *Meretrix tigrina*, while *Clathurella centrosa* is hitherto known only from the Bonin Islands, and *Lucina bella delicatula* only from the Ryukyus. As to *Cardita crassicosta*, its present home is said to be the Philippines.

Incidentally I may mention that the shells like those of the Coral Bed of Awa have also been discovered north of Numa, the site of the Bed. On the sea-shore of Tomiura, a place many kilometres from Numa, a sand-bed was found containing shells among which there is *Arca fusca Brug.* This shell is frequent in the Coral Bed, but at present is not known to be living north

of Tosa (Southern Shikoku). Also at Saginuma, a place near the town of Funabashi, situated at the head of Tokyo Bay, many shells were obtained from a sand-layer three feet below the surface of the ground, containing *Soletellina adamsii Desh.* (pl. XXI), a bivalve now known only from the Philippines.

That some of the Japanese shells had receded to the south since the Neolithic Period was first pointed out by the late Edward S. Morse who, nearly fifty years ago, in his "Shell Mounds of Omori" (Memoirs of the Science Department, Imperial University of Tokio, vol. I, part 1, 1879) states that *Arca granosa L.* so frequent in the shell mounds of Omori, a place between Tokyo and Yokohama, had entirely disappeared from the outlying coasts and that it is not known living north of Nagasaki, a port 900 kilometres from Tokyo in a straight line and about three degrees south counted by latitudes. Since then the species was found living also near the coast of Awa, but not *within* Tokyo Bay as rightly pointed out by Morse. Now I recall to mind the statement made by Professor K. Kishinouyé in one of his scientific papers of a find in the shell-mounds of the eastern portion of Northern Honshū of bones of a species of tunny which nowadays does not go up so far north.

From what has been said above, it is quite certain that some species of shells began their *retreat to the south* since the time of the Coral Bed and continued it through the Neolithic Period down to a comparatively recent epoch, and are perhaps still continuing it at the present time.

Description of New or Important Species

1. **Cylichna incisula,** nov. spec.

Pl. XIX. Fig. 1

Shell minute, ovato-cylindrical, with apex concealed. Height equal to about twice the diameter. Surface ornamented with fine, transverse, rather distant, incised lines. Aperture as long as shell, almost parallel-sided in the upper one-third, gradually widening below and quite dilated at the lower end which is truncate. Inner lip folded outward near the lower extremity. Outer lip thin.

A single example, measuring 7.2 millim. in height and 3.6 millim. in diameter.

This species closely resembles a living one found in Sagami, Central Japan, which seems to be still unnamed, though less slender in form.

12. **Cuma pseudodiadema,** nov. spec.

Pl. XIX. Fig. 5

Shell small, broad-fusiform. Whorls six, of which two and a half are nuclear, smooth and rounded. Postnuclear whorls angulate slightly below the middle, with the surface above the angle somewhat concave and sloping, below flat and vertical. Longitudinally plicate and spirally corded. Longitudinal plicae about fifteen, elevated but rounded, with interspaces broader and often differing in breadth. Spiral cords four on the sloping shelf, one on the angle and two below it, with interspaces usually somewhat broader. Intersection points of plicae and cords

tubercular. On the body-whorl there is a strong cord on the periphery making it angulate. On the base there are three strong spiral cords with one or two weaker ones between. Aperture ovate, angulate behind. Outer lip sinuous with transverse grooves within, corresponding in position to cords outside. Canal very short, straight.

Only one specimen, 6 4 millim. in height and 4.2 millim. in diameter. It seems to be a young individual.

The species is akin to *Cuma diadema* Rve. which according to Tryon is identical with *Cuma carinifera* (Lam.) (Man. Conch., II, p. 200, pl. LXII, figs. 319, 320, 324, 325, 327) which lives in Central Japan as well as in the Philippines. But the Japanese fossil has the sculpture finer, the plicae being about twice as many.

24. **Rissoa (Cingula) subdharma,** nov. spec.

Pl. XIX. Fig. 2

Shell minute, ovato-conical, pointed at apex. Whorls six, almost flat, the convexity being very slight, provided with a faint incised spiral line somewhat below the suture, otherwise smooth. Periphery rounded. Base convex. Aperture ovate, angular behind. Lower end of inner lip somewhat elevated.

A single example, 3 millim. in height and 1.6 millim. in diameter.

Resembling *Rissoa dharma* Yok. (Foss. Shells Sado, p. 275, pl. XXXIII, fig. 9) from the Upper Musashino of Sado in form, though differing by the presence of an incised spiral line.

29. **Polinices pallidus,** (Broderip et Sowerby)

Pl. XIX. Fig. 3

Polinices pallidus. Yokoyama, Foss. Miura Penin., p. 77, pl. IV, Fig. 1. Foss. Shells Sado, p. 278.

Many small immature individuals. The umbilicus is narrow in the adult specimen, but is wide open when very young. The shape, however, does not differ from that of the adult.

This species has already been described from the Upper and Lower Musashino. Its present habitat is Northern Japan and also circumpolar seas.

40. **Fissuridea sieboldii,** (Reeve)

Pl. XIX. Fig. 4

Fissuridea sieboldii. Pilsbry, Cat. Mar. Moll. Japan, p. 100. Man. Conch., XII, p. 204, pl. 38, figs. 58, 59.

Fissurella sieboldii. Reeve, Conch. Icon., spec. 102.

Lucapina sieboldii. Dunker, Ind. Moll. Mar. Jap., p. 149, pl. 6, figs. 14, 15.

Only one specimen, but excellently preserved. The concentric laminae are more elevated than in the figures of Dunker and Pilsbry.

This species has never been found fossil until now, though living in Central and Western Japan.

50. **Solecurtus abbreviatus,** Gould

Pl. XIX. Fig. 12

Solecurtus abbreviatus. Gould, Otia Conchologica, p. 164. Iwakawa, Catal. Jap. Moll., Nat. Hist. Dep., Tokyo Imp. Mus., p. 313. Reeve, Conch. Icon., Solecurtus spec. 6.

Reeve describes this species as follows: Shell compressed, truncated at each end, a little open; concentrically wrinkled; posterior side obliquely truncated, anterior side rather short; middle depressed with a broad groove, slightly ribbed at the middle within; ventral margin straight, sinuous at the medial groove; dorsal margin sloped at each side.

A few specimens were obtained perfectly agreeing with the above description.

The habitat is stated by Reeve as Malacca and by Gould as Hongkong. But it is also living in Awa (Central Japan) and Awaji (Western Japan).

51. **Semele sinensis**, A. ADAMS

Pl. XX. Fig. 3

Semele sinensis. A. Adams, Proc. Zool. Soc. London, 1853, p. 95. Dunker, Ind. Moll., p. 195.

Amphidesma sinensis. Reeve, Conch. Icon., Amphidesma spec. 28.

A fine compressed suborbicular shell with numerous radiating striae on the surface. Pallial sinus large, deep and ascending with the end rounded.

As a fossil this species was found for the first time. It is living in China as well as in Central Japan (Sagami).

53. **Tellina gargadia**, LINNÉ

Pl. XIX. Figs. 6, 7

Tellina gargadia. Linné, Syst. Nat., Ed. XII, p. 1116, no. 44. Reeve, Conch. Icon., Tellina, spec. 84. Römer in Mart. Chem. Syst. Conch., Cab., Tellinidae, p. 38, pl. II, figs. 2–4, pl. XI, figs. 8–10.

A young individual with both valves perfect. The shell is subcompressed, obliquely oval with the posterior side shorter than anterior, rounded in front and subtruncate behind. The antero-dorsal border is sloping and slightly excavated, the postero-dorsal also sloping, somewhat convex and spinous, behind which there is a second row of less sharp spines. The surface is provided with concentric furrows.

The species is found in the Philippines as well as in Central Japan (Sagami).

57. **Petricola japonica,** DUNKER

Pl. XIX. Figs. 14, 15

Petricola japonica. Dunker, Ind. Moll. Mar. Jap., p. 209, pl. IX, fig. 4–6.

Two isolated valves, both with a somewhat abnormally thickened hinge.

Living in Kesennuma (Northern Japan) according to Dunker.

59. **Meretrix tigrina,** (LAMARCK)

Pl. XIX. Figs. 10, 11

Meretrix tigrina. Yokoyama, Moll. Coral Bed Awa, p. 42, pl. II, fig. 16.

Several specimens of this neat shell were obtained. The species occurs in the Coral Bed of Awa, but is at present not known to be living north of Osumi, the southernmost province of the island of Kyushū.

62. Circe scripta, (Linné)

Pl. XX. Fig. 2

Circe scripta. Yokoyama, Foss. Miura Penin., p. 123, pl. VIII, figs. 15, 16. Moll. Up. Musash. Tokyo, p. 400.

The specimens hitherto obtained from the Upper Musashino Formation of the neighbourhood of Tokyo are not only very small, but also very rare. Those of Nanao are large and numerous, being one of the most frequently occurring shells.

The species lives in Central and Western Japan as well as further south.

63. Circe divaricata, Chemnitz

Pl. XX. Fig. 1

Circe divaricata. Pilsbry, Catal. p. Dunker, Index Moll., p. 202.
Venus divaricata. Chemnitz, Conch. Cab,, VI, p. 317, pl. 30, fig, 316. Pfeiffer in Syst. Conch. Cab. Mart. Chemn., p. 44, pl. 16, pl. 8.

Distinguished from the foregoing by the divaricating sculpture of the surface. Also very frequent. The species is living in the Indian Ocean as well as in Central and Western Japan.

67. Kellia notoensis, nov. spec.

Pl. XIX. Fig. 13

A single left valve. Shell subcompressed, transversely oval, rounded both in front and behind, though somewhat more broadly in the former than in the latter. The anterior side is shorter than the posterior, with the beak very small and pointed. The surface is smooth save for lines of growth. Height 5 millim. Length 5.7 millim. Depth 1.6 millim.

Extremely like *Kellia pumila* Wood (Yokoyama Moll. Up. Musash. Tokyo, p. 431, pl. XL, IX, figs. 1, 2), but with the main tooth much nearer the beak.

74. **Cardita crassicosta,** Lamarck

Pl. XIX. Figs. 8, 9

Cardita crassicosta. Yokoyama, Moll. Coral Bed Awa, p. 51, pl. III, fig. 12.

This shell already described from the Coral Bed is not rare at Nanao. At present it is not known to be living north of the Philippines.

88. **Arca decurvata,** Lischke

Pl. XX. Fig. 4

Arca decurvata. Lischke, Malakoz. Blätter, vol. 16, p, 108. Jap. Meeresconch., I, p. 148.

Arca obliquata. Reeve, Conch. Icon., Arca, spec. 80.

This shell found fossil for the first time is readily recognized from the other species living in Japan by its extremely inequilateral form. It is quite narrow near the anterior end and much dilated behind, with numerous radiating striae on the surface.

Living in Western Japan as well as in the Philippine Islands.

PLATE XIX.

Plate XIX

Fig. 1. Cylichna incisula n. sp. Enlarged. P. 122

Fig. 2. Rissoa (Cingula) subdharma n. sp. Enlarged. P. 123

Fig. 3. Polinices pallidus (Br. et Sow.). Enlarged. P, 124

Fig. 4. Fissuridea sieboldii (Rve.) Enlarged. P. 124

Fig. 5. Cuma pseudodiadema n. sp. Enlarged. P. 122

Figs. 6, 7. Tellina gargadia L. Enlarged. P. 125

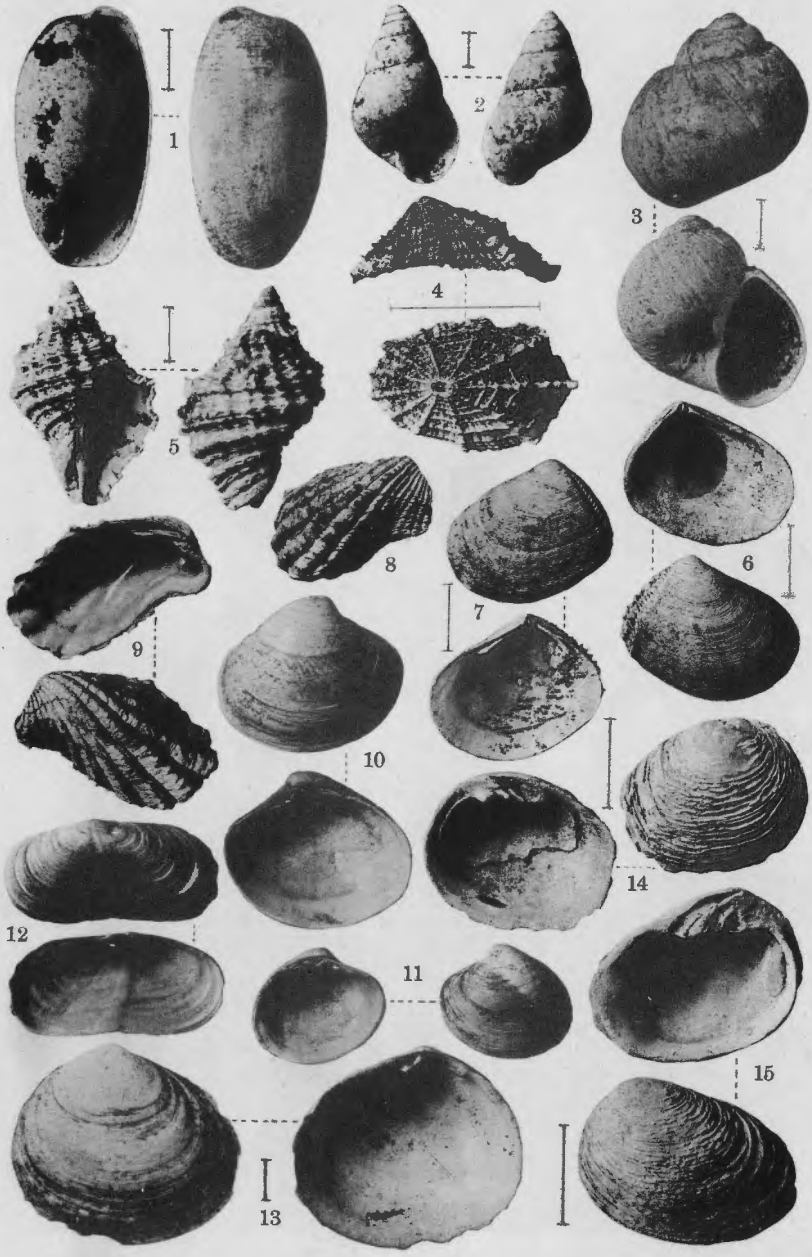
Figs. 8, 9. Cardita crassicosta Lam. P. 128

Figs. 10, 11. Meretrix tigrina (Lam.) P. 126

Fig. 12. Solecurtus abbreviatus Gld. P. 124

Fig. 13. Kellia notoensis n. sp. Enlarged. P. 127

Figs. 14, 15. Petricola japonica Dkr. Enlarged. P. 126



Semi-Fossil Shells from Noto

PLATE XX.

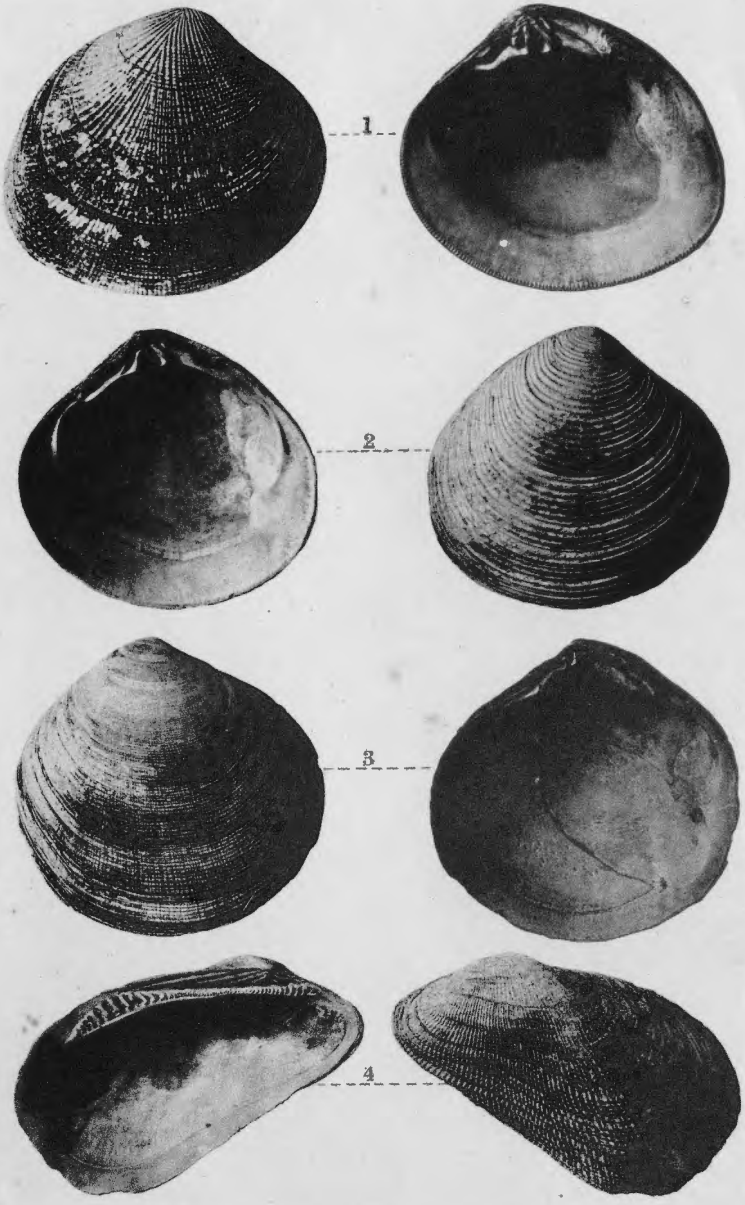
Plate XX

Fig. 1. Circe divaricata Chem. P. 127

Fig. 2. Circe scripta (L.) P. 127

Fig. 3. Semele sinensis A. Adams. P. 125

Fig. 4. Arca decurvata Lke. P. 128

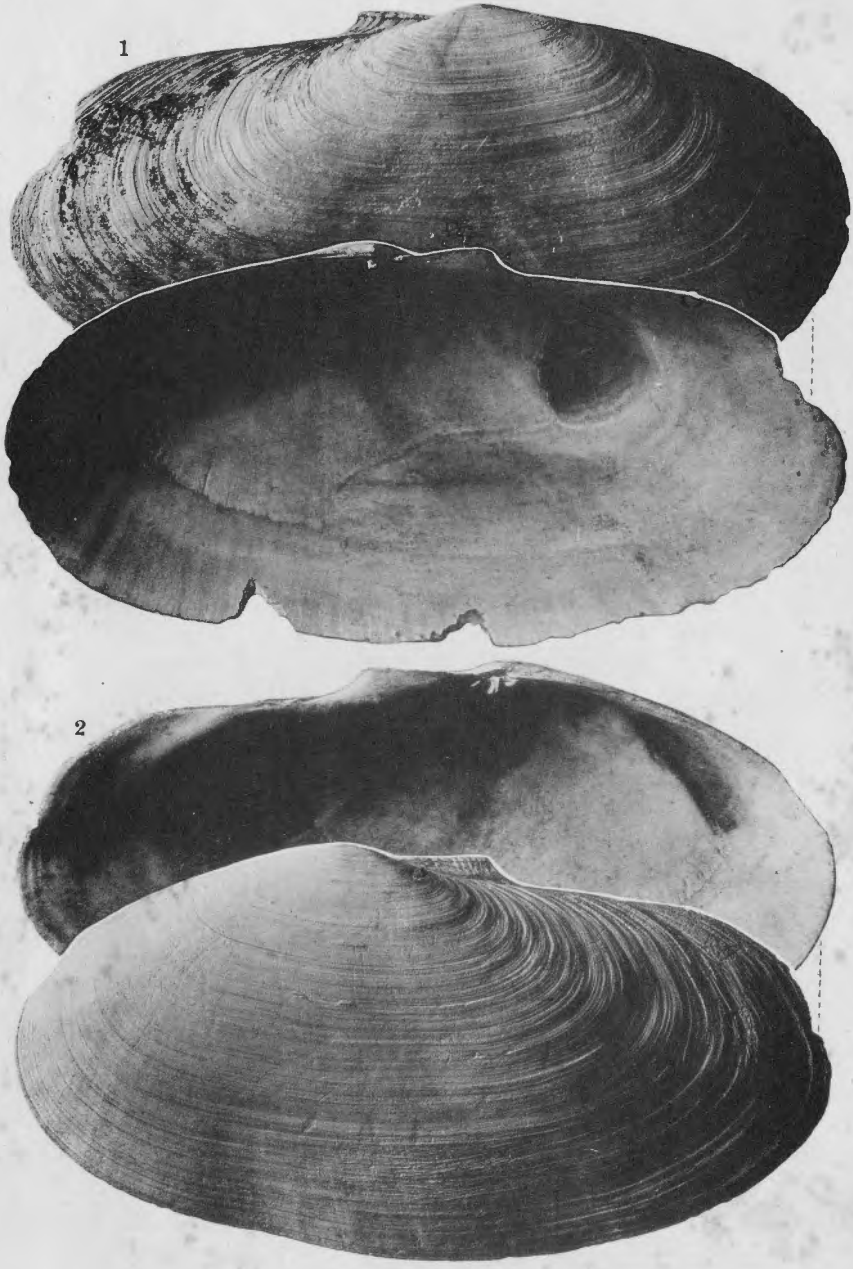


Semi-Fossil Shells from Noto

PLATE XXI.

Plate XXI

Soletellina adamsii Desh. found at Saginuma near the town of Funabashi, Shimōsa, about three feet below the surface of the ground in a bed of sand. P. 121



Semi-Fossil Shells from Noto

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