

*Nippon-no-Rômazi-Sya wa, Nippongo ni mottomo tekitoña
“Nipponsikino Kakikata” de kaita Rômazi wo Kononaka ni hiro-
meru koto wo Meate ni site iru.*

*Koremadewa omoni Rômazi ni narenai Hito ya Kodomo no
tameni karui Yomimono (kono Syomotu no Owari ni syôkaisite
aru) wo dasite ita ga, kondo motto gakuzyutuzyôno Mi no aru riga-
ku-kwankeino Syomotu wo, “Rigaku” to iu Namae no Series ni
site, dasu koto ni sita.*

*Rômazibun wa mada yoku hattatusite inai. Yomu Hito no hô
demo mada yomi-narete inai. Sitagatte, Rômazibun no zyûbunna
Neuti wa mada arawarete inai. Sikasi, Rômazibun to iu mono ga
mudukasi Giron ya, hukuzatuna Sisô wo arawasu ni sukosimo
Sasitukae no nai koto wa, kono Series “Rigaku” demo syômeisarete
iru to omou. Nominarazu, wareware wa, Muri no nai hontôno
Nippongo de yomikaki-suru to iu Ten de, Rômazibun no hô ga
Sinamozi wo tukatta mono yorimo Nippongo ni tekisite iru to kan-
gaete iru.*

*“Rigaku” wo yonde, wareware to onazi Kangae wo motareta
kata wa, Rômazibun no syôraino Nippongo-kakikata to site ôini
Nozomi aru koto wo mitomerare, susunde narubeku ôku Rômazibun
no Yomikaki wo kokoromite, Wagakuni no Bunmei no tameni Ti-
kara wo soeraretaï mono de aru.*

Nippon-no-Rômazi-Sya.

Sôdanyaku { *Rigakuhakusi Tanakadate-Aikitu.*
Bungakuhakusi Haga-Yaiti.

Zimu-sasidryaku, Rigakuhakusi Tamaru-Takurô.

“RIGAKU” 2 no Maki

UMI NO BUTURIGAKU



Rigakuhakushi Terada-Torahiko
noberu.

Aratame kakitasita Dainino Han

X

P125

22.5 cm

TÔKYÔ
NIPPON-NO-RÔMAZI-SYA

Taisyô 5 nen (1916)

HASIGAKI.

Kotosi no 4 gwatu kara 5 gwatu e kakete, Zenkoku no, Kisyô-kwansoku ni kwankeisite irareru Katagata ga, Tyûtô-Kisyôdai ni atumatte, Kyôgikwai wo hirakareta. Sonotoki, Okada Hakusi kara watasi ni, kono Kwai de, Kaiyôgaku ni kwansita Hanasi wo seyo to iu Otanomi ga atta. Watasi wa motoyori tokubetuni Kaiyôgaku wo kuwasiku sirabeta Wake dewa nai ga, heizei Umi ni kwankeisita buturigakutekino Kotogara ni Kyômi wo motte ori, mata Wagakuni de Umi no Kenkyû no amari susunde inai no wo zannenni omotte ita kara, mosi Umi no Kenkyû no omosiroi to iu Koto dake demo syôkaisuru koto ga dekireba yoi to omotta node, Ouke wo site, zengo 10 zikan bakari Hanasi wo sita. Sore wo Fujiwara Rigakusi ga kakitotte oite kudasatta no wo Moto ni site, kono Syomotu wo dasu yôni natta. Kôgi wo sita tokiniwa, kore wo ôyakenisuru to iu Kangae wa nakatta ga, sononoti susumeru Kata ga atte, Seken ni dasu koto ni natta. Sôiu Wake de aru kara, motoyori Kyôkwasyo no yôna Seisitu no Syomotu dewa nai; tada kore wo yonda Katagata no utide, Umi no Buturigaku ni Kyômi wo kanzuru Hito ga hitori demo areba, watasi no Nozomi wa todoku no de aru.

Atarimaeno Kaiyôgaku no Syomotu niwa, kono Syomotu ni aru yôna Kotogara no hokani, Umi no Soko ni aru Bussitu, iwayuru *Teisitu* no Koto ga dete iru ga, koko dewa subete ryakusite simatta. Mata, tirigaku-

tekino Kotogara mo ôkata habuite simatte, sonokawari, Umi no Undô ni kwansita Koto wo narubeku kuwasiku noseru yôni sita. Kore ga zibun ni tekitô demo ari, mata ôkuno Hito no Nozomi nimo kanau to omotta kara de aru.

Tamaru Hakusi, sonohokano Kata no Osusume mo atta node, zibun ga kanete yoi to sinzuru Nipponsiki-Rômazi de kaku koto ni sita. Gakuzyututekino Syomotu wo Rômazi de kaku no wa, zibun ni tottewa, hitotuno atarasii Kokoromi de atta. Kono Kokoromi no Kekkwa ni tuitewa, kore wo yomareta Katagata no Hihyô wo matu hokawa nai.

Kono Syomotu wo dasu ni tuitewa, Tamaru Hakusi ga iroiro hitotôri-narazu Tikara wo soete kudasatta node, koko de aratamete, atuku Orei wo nobete okitai.

Taisyô 1 nen 12 gwatu no Sue.

Terada-Torahiko.

Dainino Han no Hasigaki.

Dainino Han wo dasu ni tuite, tugino Pêzi ni sukosi bakarino Kakiaratame matawa Kakikuwae wo sita :

37-38, 41, 50-51, 71, 90, 102-103

Sonohoka Monku wo aratameta Tokoro mo tokoro-dokoro aru. Mata betuni "*Huroku*" tosite, Kwansoku wo suru Hito no Kokoroe to naru Kotogara wo tukekuwaete oita.

Taisyô 5 nen 6 gwatu.

Terada-Torahiko.

Kotowari :—(1) Gakuzyututekino tokubetuna Kotoba wa, naru-beku ari-hureta mono wo, mata sore ga iroiro aru Baai niwa, naru-beku yasasii mono wo eranda Tumori de aru. *Kantjô*, *Mantjô* nado mo, *Hisio*, *Mitisio* to sita hô ga yokatta ka to omou. Mata, mada kimatta Kotoba no nai Baai niwa, zibun no Kangae de tekito to omou mono wo dasite oita.

(2) Columbus, Aden, Wanryû no yôni, Zi no aida wo sukasite aru no wa, Hito, Toti sonohokano Koyûmeisi de aru.

(3) "Heikinno Kaimen (*E.*, mean sea-level)" no yôni, () no naka ni aru *E.* wa "Eigo de" no Ryakuzi.

(4) Sonohoka, hutû tukau Ryakuzi wa — C.=Sessi; m=mêtoru; cm = sentimêtoru; ccm = rippô-sentimêtoru; km = kiro-mêtoru; gr=guramu; kg=kiroguramu.

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UMI NO BUTURIGAKU



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§ 1. Kaiyôgaku.

Ippanni *Kaiyôgaku* to ieba, iroirono Hômen ni wata-tatte, nakanaka Kwankei no hiroi Gakumon de aru. Sikasi, ôkiku wakete miruto, *Umi no Buturigaku* to, *Umi no Seibutugaku* to, oyobi *Umi no Kisyôgaku* to mittuno Bubun ni naru. Koko dewa tada Umi no Buturigaku wo aramasi noberu no de aru.

Umi no Buturigaku wa mada kiwamete yôtina Gakumon de, korekara kenkyûseneba naranai Kotogara ga takusanni aru. Nakaniwa, totemo Ikkozin no Tikara dewa dekinai yôna Sigoto mo aru ga, mata wadukani issôno Kobune to goku kantanna Dôgu wo tukatte Kenkyû no dekiru yôna omosiroi Mondai mo takusanni aru. Umi ni tikai Tokoro ni iru Hito wa, kono Hômen ni tyûisite kenkyûsureba, taihenni omosiroku mata yûekina koto to omou.

§ 2. Kaiyôgaku no Rekisi.

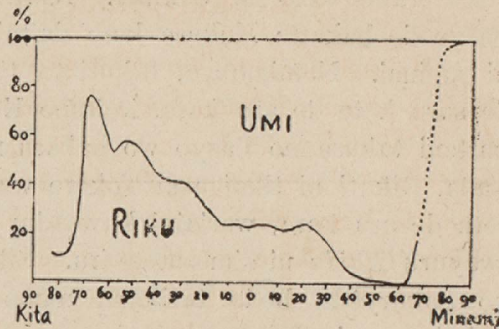
Mukasi no Hito wa, Umi to iu mono wa hirokute Kagiri no sirenai mono no yôni omotte ita ga, Columbus, Vasco da Gama nado no nadakai Kôkai kara sukosiwa Umi, Ooumi (Taiyô) to iu mono no Yôsu ga wakatte kita. Sikasi, mada Ooumi no Hukasa nado wo hakaru yôna koto wa hotondo nakatta no de aru.

Sikaruni, 18-Seiki no Sue ni, Kaitei-densinsen wo Taiseiyô ni sidumeru koto ni nari, sore ni tuitewa Umi no Hukasa ya Soko no Moyô wo kuwasiku siraberu Hituyô ga okori, mazimeni sorera no Sirabe wo sita. Sono Sirabe no Kekkwa tosite iroiro omosiroi Kotogara ga wakari, mata medurasii Dôbutu nado ga miidasareta node, kondowa Umi no Dôbutu wo siraberu tameni waza-waza tokubetuna Hune wo dasu yôna koto ni nari, dandan Umi ni kwansuru Koto ga wakatte kita. Mata, IPPÔ dewa, Hokkyoku ya Nankyoku no Tanken ga sakanni natta tameni, Kyokuti ni tikai Umi no Moyô mo wakaru yôni natta. Sorekara, Gyogyô wo suru tamenimo Umi no Kenkyû ga taisetuni nari, mata Kôkaisya mo Umi no Buturigaku wo siraberu Hituyô ga okotte kita tameni, sidaini Umi no Tisiki ga susunde kita. Yôroppa dewa Kokusai-Kaiyô-Kenkyûkwai to iu mono ga dekite Kuniguni de sakanni Kenkyû wo site iru.

§ 3. Umi no Hyômen no Katati to Ookisa.

Tikyû no Hyômen wo, Ido no Sen de Haba 5-do dutuno Obi ni wakati, sono hitotu-bitotuno Obi no naka ni aru Rikuti to Umi to ga Obi zentai ni taisuru Wariai

wo Hyakubunritu de arawasi, sore wo Du ni kaite miruto, Du 1 no yôni naru. Hukisokuna utini onodukara kisokudatta tokoro ga aru. Love to iu Hito wa, Umi to Rikuti no daitaino Katati wo kantanna Sûgakusiki de arawasu koto ga dekita.



Du 1.

Ima Umi no iroirono Bubun no Menseki wo sirusite miruto,

Taiseiyô	82 000 000	heihô-km
Indoyô	73 000 000	„
Taiheiyô	166 000 000	„
sonohokani daibubun		
Rikuti ni kakomareta		
Utiumi ya Wান		
nado	40 000 000	„
awasete	<u>361 000 000</u>	heihô-km

to naru. Taiseiyô to Indoyô wo awasete mono ga oyoso Taiheiyô no Ookisa de aru.

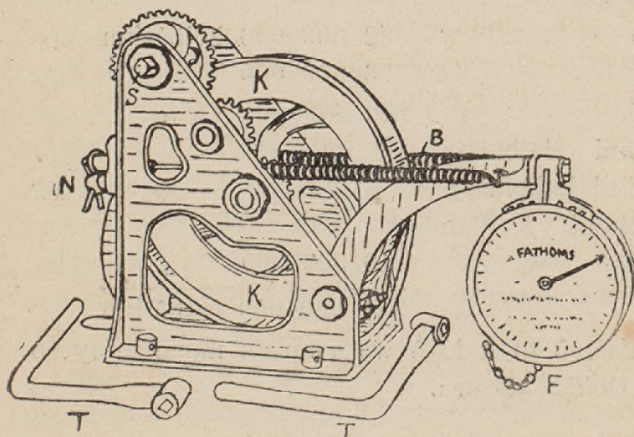
§ 4. Umi no Hukasa. Soko no Katati.

A. Hukasa no Sokuryô.

Umi no Soko wo sokuryôsuru no wa, Rikuti wo sokuryôsuru to kurabete yohodo mudukasii. Madu, dai-

taino Katati ga wakaranai kara, hakaru Basyo wo tugô-yoku eramu koto ga dekinai. Atira-kotira to, kattena Basyo de hakatta Hukasa kara daitaino Katati wo siru ni suginai. Nominarazu, Rikuti to tigatte, Hune no ue de suru koto de aru kara, iroirono Konnan ga aru node, katteni takusanno Basyo wo hakaru no wa tayasuku nai. Tada, Rikuti ni tikai asai Tokoro wa, Kôkaisya ni taisetu de aru kara, wariaini kuwasiku Sokuryô ga dekite, iwaiyuru *Kaidu* ni simesarete iru. Sikasi, kore mo Rikuti no Sokuryôdu hodo tasikana mono dewa nai. Masite hukai Ooumi (Taiyô) no Hukasa wo simesita Du nado wa yohodo aramasina mono to omowanakereba naranai.

Madu, Umi no *Hukasa no Hakarikata* wo noberu. 50 m kara 100 m gurai madewa asano Nawa ni namarino



Du 2.

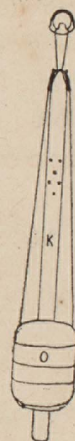
Lucas no Sokusinki.

K wa Harigane wo makitukete aru Kuruma; *S* wa *K* wo mawasu tame no Haguruma no Sinbô; *T* wa *S* ni hameru Totte; *N* wa Hadome wo simeru Nedi; *B* wa Bane; *F* wa Hukasa wo simesu Sikake de aru. *K* ni makitukete aru Harigane wa *K* no sita kara *F* no ue wo tôtte sono Migigawa kara sita e oriru.

Omori wo tukete nagekomi, Omori ga Soko ni tuita Tego-taeniyotte Hukasawo siru koto mo dekiru ga, Du 2 no yôna Kikai wo tukaeba nao Tugô gayoi. Sikasi, 1000 m yorimo

hukai Tokoro ni naruto, sô tayasukuwa hakarenai. Dai-iti Omori wo turusu Tuna no Mekata ga omoku natte hubenna nominarazu, Omori ga Soko ni tuita Tegotae ga hakkiri sinai yôni naru. Sorede, narubeku wariaini karokute tuyoi Mono wo tukawaneba naranai kara, tûrei haganeno Harigane no Tyokkei 0.6 kara 0.9 mm made no wo tukau; kono Harigane nareba 200 kg made no Mekata wo sasaeru. Kono Hasi ni 15 kg kara 30 kg made guraino Omori wo tuke, kore ga Soko ni tukuto Omor ga hadurete otiru yôni Sikake ga site aru (Du 3⁽¹⁾). Dôzini, Harigane no Tyôryoku ga kyûni heru node, Harigane wo maite aru Kuru-ma ni Hadome ga kakatte, hitoride tomaru yôni natte iru. Kono Sikake ga naito, Harigane zisin no Omosa de doko mademo orite yuku no de aru. Mata, Nami no tameni Hune ga yureru toki, mosi Harigane ga Hune ni koteisite iruto, Tyôryoku ga hukisokuni kawatte ikenai kara, Du 4 no yôni gomuno Bane de turusu yôni natte iru.

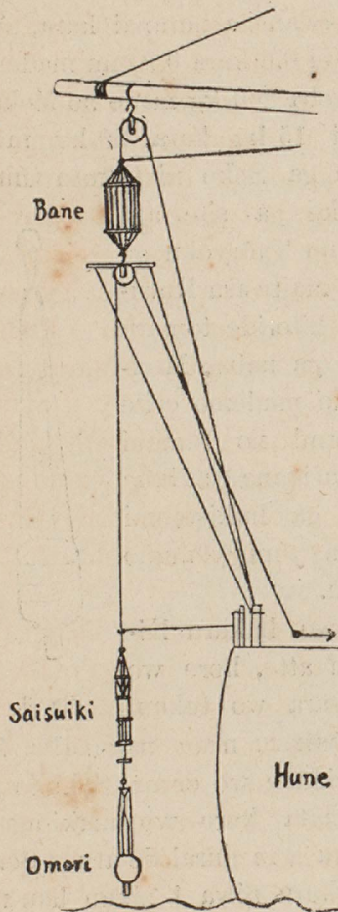
Konoyôni hukai Tokoro wo hakaru Kikai nimo iroirono Katati ga atte, kore wo ugokasu niwa Zyôki no Tikara wo tukau. Soredemo, hukai Tokoro wo hakaru niwa nakanaka Zikan ga kakaru. Madu, Harigane wo orosu Sokudo ga mai-byô 2 m kara 2.5 m, mata kore wo maki-ageru Sokudo ga mai-byô 1.5 m kara 2 m gurai de aru. Sorede, 5000 m no Hukasa wo hakaru niwa 1 zikan han mo kakaru no de aru.



Du 3.

(¹) O wa Omori; K wa Soko no Dorô ya Suna no Mihon wo totte kuru tame no Kuda. Kono Kikai wo Hydra- mata Baillie-Omori to nadukeru.

Maeni nobeta nō wa mina Hune wo tomete oite motiiru Kikai de aru ga, mata Hune ga susunde iru tokini Hukasa wo hakaru Kikai ga aru. Kore wa, asai



Du 4.

tokubetuna Monosasi ga dekite ite, kore wo atete mireba, suguni Hukasa ga yomeru yōni natte iru. Kono Kikai

Tokoro wo kōkaisuru tokini taihen Tugō no yoi mono de, Buturigakusya tosite yūmeina Lord Kelvin no hatumeisita mono de aru. Nagasa 50 cm guraino hosoi Garasukuda no ippō wo hūzita mono no Utigawa ni Kurōmusan-gin (CrO_4Ag_2) wo nuri, kore wo sintyūno Kuda ni irete Omori to tomoni nagekomu. Kuda no naka no Kūki wa Umi no Soko no Aturyoku ni ōzite Midu ni ositukerare, Siomidu ga Kuda no naka ni irikomū. Akai Iro wo sita Kurōmusan-gin wa, Siomidu no haitta Tokoro dake siroku natte simau kara, Kuda wo hikiagete doko made Iro ga kawatta ka wo mireba, Soko no Aturyoku ga wakari, sitagatte Hukasa ga wakaru. Kore niwa

dewa, Nawa ya Kuda ga suityokuni naru Hituyô wa nai.

Konohokani taihen takumina iroirono Hôhô wo kangaeta Hito mo aru ga, ippanni motiiraretewa inai.

Tugini, Umi no Hukasa wo hakaru tokini, *doredake seimituni* hakareru ka to iu koto, sunawati Sokuryô no Kekkwa no *Gosa* (Ayamari) no Teido wo noberu.

Daiitino Gosa wa, Omori wo turusu Harigane no Katamuki kara okoru. Mosi Harigane ga massuguni harikitte, Suityokusen kara Kakudo θ dake katamuite ita to sureba, Harigane no Nagasa l ni $\cos\theta$ wo kaketete Hukasa d wo siru koto ga dekiru ga, zissainiwa Harigane wa hukai Soko no Nagare no tameni massuguni naranai koto ga ôi kara, kantan de nai. Konotameni manugare-gatai *Gosa* ga zentaino Hukasa no madu 1000 gurai de aru.

Dainino Gosa wa Hune ga Nami ni yurareru tameni okoru, sunawati Omori ga Soko ni tuku koto ga hayasugi matawa ososugiru no de aru. Konohôno *Gosa* wa 5 m gurai; kore wa hukai Tokoro demo asai Tokoro demo amari kawaranai.

Daisanno Gosa wa, Hukasa wo hakatta Basyo no hutasikana koto kara okoru. Ooumi no naka de Hune no Iti wo kimeru niwa, Hosi ya Taiyô wo kwansokusuru no de aru ga, kono Kwansoku ni manugarenai *Gosa* no tameni, Hune no Iti wa Hankei 1-kairi guraino Enkei no naka de dokoka ni aru to iu koto wa wakaruga, sore izyô tasikaniwa kimaranai. Konotameni okoru Hukasa no *Gosa* wa, Umi no Soko no Keisya no ôkii Tokoro dewa nakanaka ôkii.

Sorede, Kaidu ni simesite aru Hukasa nado niwa mina korerano *Gosa* ga tuite iru koto wo wasuretewanaranai.

B. Soko no Katati.

Maeni nobeta yôna Hôhô de hakatta Keġkwa ni yoruto, ippanni *Ooumi no Soko wa hizyôni hirattai mono de aru.* Rikuti wa tuneni Midu no Sayô de kedurarete iru kara, iroiro hukuzatuna Katati wo site iru ga, kore to hantaini, Umi wa taezu umerareru bakari de aru kara, konoyôna Tigai ga dekiru no de aru. Arû Hito wa kô itte iru: "Mosi Umi no Soko ni tatte Sihô wo miwatasu koto ga dekitara, tada itimenni mattaku hirattai Ita no yôni mieru de arô."

Sikasi, tokoro-dokoro ni kono Tantyô wo yaburu yôna Takahiku ga aru.

Hukami. *Kaizan* mata *Kaigô* (Umi no Hori) to nadukeru mono ga aru. Kore wa, Umi no Soko ni taitei hosonagaku Mizo no yôni natta Hukami de aru. Mata maruku Nabe no yôni otikonda Tokoro mo aru. Ippanni itizirusii Hukami wo *Kaien* (Umi no Hûti) to iu.

Ima madeni sirete iru Kaigô ga 21 aru. Sonoutide 16 wa Taiheiyô ni ari, atono 5 ga Taiseiyô to Indoyô ni aru. Itiban hukai no wa Mariana-guntô no Higasi ni atte, kore wo mituketa Amerika no Hune no Na ni tinande *Nero no Hukami* to nadukeru. Ima omona Kaigô no Hukasa wo agete miruto, tugino yô de aru:

	Hukasa (mêtoru)
Mariana-kaigô	9636 ⁽¹⁾
Kermadec- „	9427
Tonga- „	9184
Tuscarora-(Nippon-) „	8513
Ryûkyû- „	7481

(1) Tui konogoro Mindanao no Tikaku de miidasareta Hukami wa kore yori 144 m mo hukai to iu koto de aru.

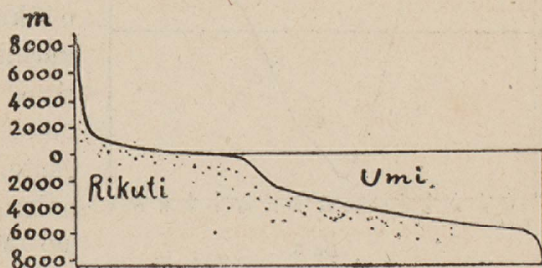
Konoyôna Hukami wa, taitei mina Umi kara takaku tukideta Sima ya Kaigan ni tikai Tokoro ni aru. Tabun, Kaigô wa, sore no Tikaku ni aru Sima ya Sanmyaku no dekita tokini dekita mono de arô to iu koto de aru.

Bank. Kaigô to hantaini, Umi no hirattai Soko kara tokoro-dokoro takaku tukideta, Eigo de *Bank* to nadukeru mono ga aru. Mottomo, Atama wa Kaimen niwa tassinai. Dote no yôni hosonagai no mo areba, Dai no yôni hiroi no mo ari, mata ensuikeini tukideta no mo aru. Bank niwa, sore no Mawari no Keisya no itizirusiku kyûna mono ga aru. Rikuti no Yama dewa, tatoeba Huzisan no Tyôzyô ni tikai Tokoro demo 35-do gurai ni suginai ga, Bank niwa 80-do hodono ôkina Keisya wo sita no ga aru.

Bank wa Usio no Nagare wo samatagete, Umi no Midu wo kakimazeru Sayô wo suru koto ga aru. Mata konoyôna Asase niwa Gyorui ga atumaruru node, Gyogyôsyâ ni tottewa kiwamete taisetuna mono de aru.

Kaigan no Kinzyo. Kaigan kara Umi no Hô e dôiu Guai ni Hukasa ga masite yuku ka to iuto, madu Hukasa 100 m kara 200 m gurai made wa ôyoso Rikuti to onaziguraino Keisya wo site iru ga, 200 m gurai kara Keisya ga ikuraka kyûni nari⁽¹⁾, sore kara hukaku naru ni turete, mata

dandanni Keisya ga sukunaku naru. Kono Moyô wo simesu tameni Du 5 wo kakeru. Kore wa. Rikuti to



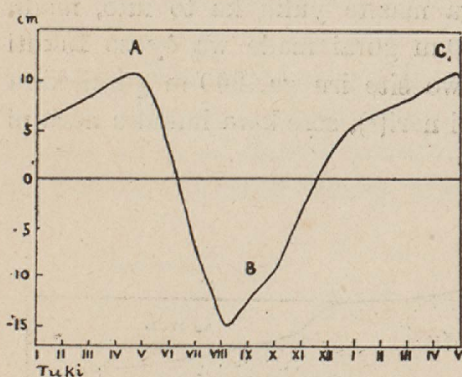
Du 5.

(1) Heikin 4-do gurai.

Umi to ni tuite, iroirono Takasa ya Hukasa no Tokoro no Menseki wo simesita mono de aru. Kono Du ni arawasita Rikuti no Katati wa, Sôkyokusen (hyperbola) no yôna Katati de aru ga, kore wa, Rikuti ga taezu Ame no Midu ni arawareru tameni konoyôna Katati ni naru no de aru. Maeni nobeta tôri, Umi no Hukasa 200 m made wa, Rikuti no Suso no yôni natte ite, iroirono Ten kara, Rikuti ni huzokusita mono to kangaeta hô ga yoi. Sakana no ôku iru no mo kono Bubun de ari, mata Rikuti kara nagare-komu mono no tamaru no mo oyosokore made de aru. Kono Bubun wo Eigo de *continental shelf* to iu.

§ 5. Heikinno Kaimen.

Umi no Midu no Hyômen wa Nami ya Usio no Mitihi nado no tameni taezu ugoite iru ga, kono Undô wo torinokereba, hitotuno namerakana Men to naru. Kore ga



Du 6.

heikinno Kaimen (E., mean sea-level) de aru.

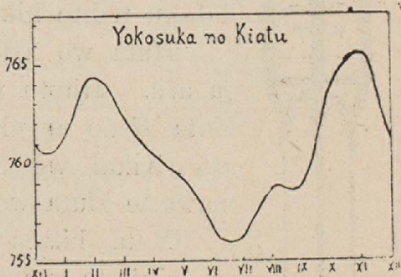
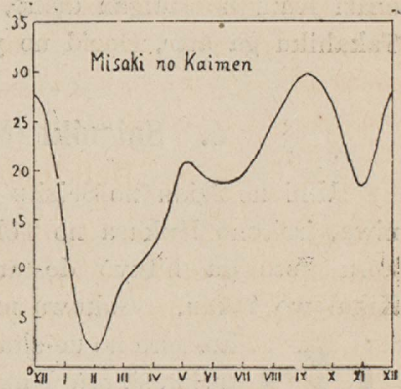
Ima Kaimen wo, Sôzô no uede, Rikuti no Hô e hikinobasu, sunawati karini Umi kara Rikuti e semai Mizo wo hotte yuku to kangaete, sono Mizo no nakani irikomu Umi no Midu no Hyômen wo, sono Basyo no

Kaimen to minasu. Kore wo Tikyû zentai ni hikiwatasita mono wo *Geoid* to nadukeru. Kono Hyômen

wa, doko demo sono Tokoro no Dyûryoku no Hôkô, sunawati Entyokusen ni sùityoku de aru. Geoid no Katati wa hobo Daentai de, sore ni goku wadukana Takahiku ga aru mono de aru.

Zissaino Kaimen wa itinen no uti demo, Kisetu ni yotte, kanarina Henkwa ga aru. Tatoeba, Arabia no A den no Kaimen wa, itinen no utini Du 6 no yôna Kawari ga aru. A kara B made wa minami-nisino Kikôhû (monsoon) ga huki, B kara C no aida wa kita-higasino

Kikôhû no huku Zikô de aru kara, kono Kaimen no Henkwa wa, omoni Kaze no tameni okoru koto ga wakaruru. Nippon no Rei wo agereba, Ômori Hakusi ga sirabeta tokoro ni yoruto, Misaki (Sagami) no Kaimen no nendyûno Henkwa wa Du 7 (ueno Du) no yô de aru. Daitai, konohen no Kiatu no Henkwa (sitano Du) to yoku nite iru ga, sikasi Kiatu no Kawari bakari dewa Setumei ga dekinai. Kore wa syôrai nao kenkyûsubeki Mondai de aru.



Du 7.

Maeni Kaidu no Koto wo nobeta ga, Kaidu no Omote ni sirusite aru Umi no Hukasa wa doko kara hakatta mono ka to iuto, taiteiwa mina Haru to Aki no Higan no Oosio (§ 24) no toki no heikinno Kantjômen wo Hyôzyun

to site, kore kara no Hukasa wo simesita mono de aru. Kôkaisya no tameniwa, kore ga itiban Tugô ga yoi kara de aru. Nippon, Igrisu, Doitu nado wa iduremo kono Siki de aru. Huransu dewa koremadeno aidani itiban hikukatta toki no Kaimen wo Moto to site aru. Amerika dewa subeteno Kantyô no toki no heikinno Kaimen wo Hyôzyuni to site aru. Mata Baltic-kai no yôna Usio no Mitih no sukunai Tokoro dewa, heikinno Kaimen wo Hyôzyun ni site aru. Sorede, ippanno Kaidu ga simesite oru Kaimen wa, onazi Kuni no Kaigan demo, Basyô ni yotte hukisokuna Takahiku ga atte, Geoid no yôna mono dewa nai.

§ 6. Saisuiki (Midukumikikai).

Umi no Midu no Seisitu wo kuwasiku siraberu tame-niwa, iroirono Hukasa no Tokoro no Midu wo kumiagete kuru koto ga hituyô de aru. Kore niwa tokubetuna Kikai wo tukau. Ookuwa marui Tutu no Katati wo site

ite, sore no ue-sitano Huta wo hiraita mama de turiorosi, aru Hukasa ni todoita toki, Huta wo kataku todite hikiageru Sikake ni natte iru.

Huta wo todiru niwa hutatôrino Sikake ga aru. Hitotu wa *Nedibane-siki* de (Du 8), Huta *H* no ue ni *Nedibane* (propeller) *N* ga atte, Kikai wo hikiage-hazimeruto, kore ga mawatte Huta wo osaetukeru yôni natte iru.

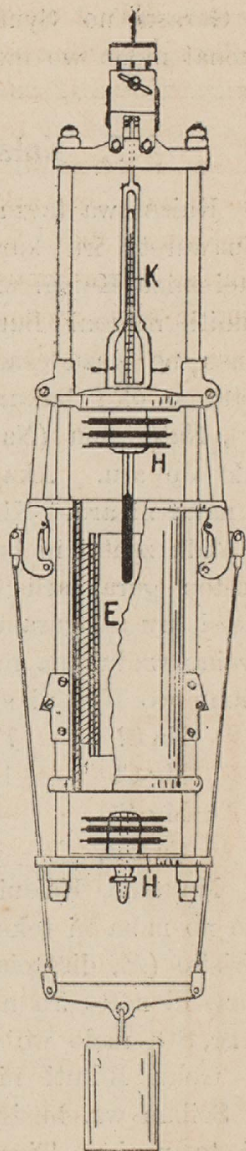
Mata hitotu wa *Messenger-siki* de, Huta wo siyô to omou tokini, ue kara Harigane wo tutatte Omori wo otosuto kore ga Kikai ni todoite Kakegane wo hadusi, Huta ga todiru yôni natte iru; *Messenger* to iu no wa kono otosite yaru Omori no koto de aru



Tikagoro wa taitai mina Messenger-siki wo tukau koto ni natte iru.

Sononakade, ima itiban yoi to natte iru Petterson no Saisuiki (Du 9) wa, tada Midu wo totte kuru bakari de naku, hukai Soko kara Kaimen made hikiagete kuru aida ni, Entô *E* no naka no Midu no Ondo ga kawaranai yôni, Netu wo tôsi-nikui Mono de nandyûnimo kakonde aru. Huta *H* mo 4-dyûni natte iru. Sosite, Huta ni sasikonde aru Kandankei *K* de, suguni Ondo wo yomu yôni site aru⁽¹⁾.

Saisuiki de kumiageta Midu wo, suguni sono Ba de siraberu koto mo aru ga, mata sono Midu wo Rikuti e motte kaette siraberu koto mo aru. Kono Baai niwa, Midu wo Bin ni tumete kuru no de aru ga, korukuno Sen nado wa ikenai; Midu ga dandan zyôhatusuru kara Hidyû ga kawatte kuru. Mata, Garasu wa taitai sukosi Midu ni tokeru kara, seimituna Bunseki nado wo suru Baai niwa, tokubetu-



Du 9.

(1) Hukai Tokoro kara hikiagete kuru to, Aturyoku ga heru tameni Midu ya Kikai no iroirono Bubun ga bôtyôsite, sonotameni sukosi Ondo ga kawaru kara, seimituna Kwansoku niwa, sore ni ôzite Hosei (correction) wo kuwaeneba naranai.

ni Garasu no Syurui wo erande, narubeku Midu ni tokenai mono wo motiineba naranai.

§ 7. Kaisui no Kwagaku-seibun.

Kaisui wa taezu Rikuti kara nagare-komu Midu de oginawarete iru kara, Rikuti ni aru yōna Bussitu wa taitei mina Kaisui ni hukumarete i-sōni omowareru ga, konniti madeni Bunseki no Kekkwa de miidasareta Genso no Kazu wa wadukani 32 de aru. Sononakade mottomo ōku hukumarete iru no wa Enso (Cl), Syūso (Br), Natoriumu (Na), Kariumu (K), Magunesiumu (Mg) nado de aru. Akagane ya Nikkeru nado mo Umikusa no naka ni aru. Kin, Gin nado mo sukosiwa aru; Umi no Midu zentai ni hukumarete iru Gin no Ryō wa 133-oku-ton gurai aru to iu koto de aru. Radiumu mo sukosi aru; 1 guramu no Kaisui ni tuki 0.25×10^{-12} gr guraino wadukana mono de aru. Ima Kaisui no omona Seibun wo Hyō ni site miruto,

Na Cl	77.8 %	K ₂ SO ₄	2.5 %
Mg Cl	10.9	Ca CO ₃	0.35
Mg ₂ SO ₄	4.7	Mg Br	0.22
Ca SO ₄	3.6		

Mottomo, Kaisui wa kihakuna Yōeki de aru kara, sore no naka ni tokete iru Enrui no Bunsu wa, iwayuru kairisite (*E.*, dissociate) ite, kono Hyō no yōna Musubiawase ni natte iru no dewa nai. Bunseki wo suru nimo Cl, Br, SO₃ nado wo sorezore teiryōsuru no de aru.

Goku Rikuti ni tikai Tokoro wo nozoitewa, Kaisui no Seibun wa, husigina hodo doko demo onazi de aru; koi to usui no Tigai wa aru ga, hukumarete iru Enrui no tagaino Wariai wa Sekaidyū itteisite iru to ittemo

yoi. Sorede, doredemo tada hitotuno Seibun, tatoeba Enso no Bunryô wo hakareba, sonohokano Seibun no Ryô mo wakari, sitagatte Enrui no sôtaino Bunryô ga wakari, mata Hidyû mo wakaru no de aru. Forchhammer to iu Hito no sadameta tokoro ni yoreba,

$$\frac{\text{Enrui zentai no Bunryô}}{\text{Enso no Bunryô}} = 1.818.$$

Kore wo Forchhammer no *Enso-Keisu* to nadukeru. Denmaruku no Knudsen wa, kore wo issô kuwasiku sirabeta Kekkwa, sukosi tigatta Siki wo ataete iru :

Enrui zentai no Ryô⁽¹⁾ = 0.030 + 1.805 × (Enso no Bunryô). Sunawati, kono Siki dewa, Kaisui no Seibun ga kanarazusimo itteisite inai koto ni naru; kore nareba Rikuti ni tikai Tokoro no Midu nimo hobo atehamaru to iu koto de aru. Mottomo, kono Siki no arawasu Bunryô wa, Kaisui no naka no Yûkibutu wo mina yaite simai, mata Syûso wo Enso de okikae, Tansan-kwagôbutu wo San-kwabutu ni kaeta ato no Bunryô de aru.

Kaisui wo Kawa no Midu to kurabete miruto,

	Tansan-enrui	Ryûsan-enrui	Enkwabutu
Kawa	80 %	13 %	7 %
Umi	0.2 „	10 „	89 „

Naze Umi no Midu ni Tansan-kwagôbutu ga wariaini sukunai ka to iuto, daiiti Tansan-enrui wa *Globigerina*, Sango, Kai nado no yôna Dôbutu no tameni syôhisare, mata, Kaisui no Tansan-enrui wo tokasu Wariai ga gwanrai sukunakute, sudeni Hôwa no Zyôtai ni natte iru ga, Enkwabutu sunawati Sio wa kore wo syôhisuru mono mo naku, mata Midu ni toke-uru Wariai ga ôi kara de aru.

(1) Kaisui 1 kg ni hukumareta guramu no Kazu.

Kaisui ni hukumarete iru Sio no Bunryô kara *Umi no Nenrei*, sunawati Umi ga hazimete dekita Toki kara konniti made doredakeno Nensû wo heta ka to iu koto wo keisansuru koto ga dekiru. Ima, itinen no aidani Umi ni sosogu Kawamidu no Ryô wa, Umi no zentaino Midu no $\frac{1}{45200}$ gurai de aru. Ima, 1 kg no Kaisui niwa 31.02 gr, mata 1 kg no Kawamidu niwa 0,0087 gr guraino Enrui wo hukunde iru to site kandyôsuruto, mainen Kawa kara Umi ni nagare-komu Enrui no Ryô wa, Umi no Enrui no Sôryô no $\frac{1}{161\,138\,000}$ to naru. Sorede, mosi, zutto mukasi kara ima made onazi Wariai de, Kawa kara Umi e, Sio wo nagasi-konda mono to sureba, Umi no Nenrei wa 161 138 000 nen to naru Wake de aru. Sikasi, kore wa tada, hitotuno omosiroi Keisan da to iu dake de, goku ôyosono Nensû wo ataeru ni suginai koto wa motiron de aru.

Kitai. Tugini, Kaisui ni hukumarete iru iroirona Kitai ni tuite noberu. Kaisui ni hukumarete iru Kitai no Seisitu ya, sore no Bunryô wa, Umi no Seibutu no Seikwatu ni kwankeisuru kara, Gyogyôsyô ni tottewa kore no Kenkyû ga nakanaka taisetu de aru. Mata, Kaisui no Kitai wo siraberuto, sono Midu ga doko kara nagarete kita ka to iu koto ga wakaru Baai mo sukunaku nai.

Umi no Hyômen wa itudemo Kûki ni hurete iru kara, Sanso to Tisso wa dokodemo hukumarete iru. Sikasi, kono hutatuno Kitai wa Midu ni tokeru Wariai ga tigau. Ima, Kûki ga, hutuno Baai no yôni, Sanso 21, Tisso 79 no Wariai de, 1-kiatu no Aturyoku de Midu no Hyômen ni hurete iru tokini, toke-uru dake tokete simatta notini, doredakeno Kitai ga 1 rittoru no Midu no naka ni hukumareru ka to iuto, sono toketa Kitai wo toridasite hutatabi Gasutai to site, Ondo 0°C., Kiatu

760 mm no Hyôzyun-zyôtai ni sureba, sore no Taiseiki (cem) wa tugino Hyô no tôri de aru :

		Sanso			Tisso		
$t \backslash s$		0 ‰	20 ‰	35 ‰	0 ‰	20 ‰	35 ‰
	0° C.	10.29	9.01	8.03	18.56	16.18	14.40
	10	8.02	7.10	6.40	14.97	13.27	12.00
	20	6.57	5.88	5.35	12.54	11.32	10.40

Tadasi, s wa Midu ni tokete iru Enrui no Wariai (Senbunritu), t wa Midu no Ondo de aru.

Kono Hyô de mireba, Midu ga awaku mata tumetai hodo, Tisso ni kurabete wariaini yokeini Sanso wo tokasu koto ga wakaru. Tumetai Kanryû ni Sakana ga takusanni iru no wa kore demo setumeisuru koto ga dekiru. Zissaino Kaisui niwa, Sanso mo Tisso mo ôyoso sorezoreno Ondo to Enbun ni sôtôsite hôwasite iru. Mototomo, Ondo no kawaru tameni sukosi dutuno Sa ga ari, mata Bakuteria no tameni Tisso ga yokeini aru koto nado mo aru.

Tugini *Tansan-gasu* bakari ga 1-kiatu no Aturyoku wo ukete Midu ni sessite iru tokini, 1 rittoru no Midu ni toke-uru Bunryô wo, mae to onaziku, Hyôzyun-ondo oyobi-kiatu ni okeru Taiseiki no rittoru de arawasuto, sitano Hyô no yôni naru. Kore wo maeno Sanso ya Tisso no

$t \backslash s$	0 ‰	35.19 ‰
0	1.71	1.41
10	1.19	0.99
20	0.88	0.73

Baai ni kurabete miru-to, it aini tokeru Wariai ga ôi koto ga wakaru. Sikasi, zissaino Kûki dewa, hukumarete iru

Tansan-gasu no Bunryô ga hizyôni sukunakute, sore no Aturyoku ga 0.0003-kiatu gurai de aru kara, tokeru

dake toketemo waduka de aru. Tatoeba, 3.8° C. no Kaisui de 0.366 cem, Mekata ni site 0.72 gr gurai de aru.

Umi ni sunde iru kenbikyôtekino Seibutu ni, Tansan-sekkai de dekita Kara wo motte iru no ga aru; kore ga sinde, sono Kara ga Umi no Soko ni sidunde Dorô no atui Sô wo tukutte iru no ga aru. Sikasi, goku hukai Tokoro niwa kore ga nai. Kore wa, kono Kara ga hukai Tokoro made sidumu aidani Midu ni hukunda Tansan-gasu no tameni tokasareru tame de aru.

Kokkai (Black Sea) dewa, Hyômen no Midu wa, Enbun ga sukunai node, Huyu Hyômen ga tumetaku nattemo Soko made sidumu koto ga dekinai. Soreyue, Soko no Midu wa Hyômen no to irikawaru koto ga dekinai. Nominarazu, Kokkai no Iriguti niwa asai Bosphorus no Kaikyô ga Sikii no yôni natte, sotono Umi to no Sakai wo sikitte iru node, Kokkai no Soko no Midu wa Soko ni tamatta mamade irikawaranai. Sonotameni Ryûkwasuiso (H_2S) ga takusanni hukumarete ite, Uo nado wa sumu koto ga dekinai.

8. Kaisui no Hidyû.

Kaisui no Hidyû wo hakaru Hôhō wo ôkiku wakete miruto 4-tôri aru:

- a. Ukibakari ya Hidyûbin wo tukau.
- b. Hikari no Kusseturitu wo hakaru.
- c. Denki no Teikô wo hakaru.
- d. Bunseki de Kwagaku-seibun wo sadameru.

(a) *Ukibakari* wa Toriatukai ga benri de, suguni Hidyû ga yomeru yôni natte iru ga, sonokawari Midu no Hyômen-tyôryoku no Eikyô ga iroiro kawaru tameni, amari seimituna Mokuteki niwa motiiru koto ga dekinai.

Kono Hyômen-tyôryoku no Eikyô wo nakusuru tameni, Uki wo zentai Midu no naka ni ireru yôni sita mono mo aru ga, amari benri dewa nai. Mata, Mohr no Hakari wo motiiru koto mo aru. Itiban seimituna no wa *Hidyûbin* de hakaru no de, kore nareba Hidyû no Mi-ayamari ga ± 0.00002 gurai ni naru.

(b) Kaisui no *Hikari no Kusseturitu* wa Enbun ni yotte tigau kara, Kusseturitu wo hakareba Enbun ga wakari, sitagatte Hidyû mo wakaru; sikasi, Ondo no Eikyô ga nakanaka ôkii kara, Ondo wo goku seimituni hakaru koto ga hituyô de aru (§ 9 A). Kaisui no Kusseturitu wo hakaru Kikai niwa, Pulfrich, Tornøe, Löwe⁽¹⁾ nado no ga aru.

(c) Kore mo (b) to onaziku kansetuno Hôhò de, Enbun no ôi hodo Denki-teikô no heru koto wo riyôsita mono de aru ga, amari benri de naku, seimitu demo nai kara, zissainiwa hotondo motiirarenai.

(d) Kaisui ni hukumarete iru Enso no Bunryô wo teiryôsûreba, zentaino Enrui no Ryô ga wakari, sitagatte, sore no Hidyû mo wakaru. Enso no Teiryô wo suru niwa, Kaisui ni, aru kimatta Kosa no Syôsangin-yôeki wo kuwaete Enkwagin no Tinden wo saseru. Enso ga tindensuru dake site simatta Toki wo siru tameni, arakazime Kurômusan-kari wo kuwaete oku; Tinden ga owareba Eki ga akaku naru node suguni wakaru. Konniti, Yôroppa no Kuniguni ga rengôsitate yatte iru Kokusai-Kaiyô-Kenkyûkwai dewa, mina kono iwayuru *Titration* no Hôhò wo motiite iru. Sosite, Kopenhagen ni aru Honbu de, Hyôzyun to narubeki Kaisui wo takusanni

(1) Löwe no wa, Kusseturitu no Tigai kara okoru Hikari no Kanyô wo tukatta atarasii Kikai de aru.

totte, seimituna Bunseki wo si, kore wo Kuniguni ni bunpaisite, Kekkwa ga tagaini kuitigawanai yôni site iru.

Maeni tabitabi nobeta yôni, Kaisui no Enbun to Hidyû no aidaniwa kimatta Kwankei ga aru ga, kono Kwankei ni tuitewa iroirono Hito no Kenkyû no Kekkwa ga aru. Sonoutide itiban tadasii to natte iru no wa Knudsen no de, 0° C. ni okeru Hidyû to Enso no Bunryô to no Kwankei wo simesita mono de aru.

$$\sigma_0 = -0.069 + 1.4708 Cl - 0.00157 Cl^2 + 0.0000398 Cl^3.$$

Tadasi, σ_0 wa 0° C. no toki no Hidyû S_4^0 (1) kara 1 wo hiite, kore ni 1000 wo kaketa Kazu, sunawati,

$$\sigma_0 = 1000(S_4^0 - 1);$$

mata, Cl wa 1 kg no Kaisui ni hukumareta Enso wo guramu de arawasita Kazu de aru.

Tugini, iroirono Kosa no Kaisui no Hidyû ga Ondo ni yotte kawaru Moyô wa, yahari Knudsen ga kuwasiku kenkyûsita Kekkwa, tugino Siki de arawasarete iru :

$$\sigma_t = 1000(S_4^t - 1) \quad (1)$$

$$= \Sigma_t + (\sigma_0 + 0.13241) [1 - A_t + B_t(\sigma_0 - 0.1324)].$$

Tadasi, Σ_t wa t° C. ni okeru Zyôryûsui no Hidyû de

$$\Sigma_t = -\frac{(t-3.98)^2}{503570} \cdot \frac{t+283}{t+67.26},$$

$$A_t = t(4.7867 - 0.098185t + 0.0010843t^2) \times 18^{-3}$$

$$B_t = t(18.030 - 0.8164t + 0.01667t^2) \times 10^{-3}.$$

Kono Siki kara keisansita Hidyû wa, Syôsûten ika 5-keta madewa tadasii kara, Kaiyôgaku no iroirono Moku-teki niwa zyûbun de aru. Kono Siki wo Moto ni site, iroirono Ondo ni okeru, iroirono Enbun no Kaisui no

(1) S_4^t wa t° C. no Kaisui wo 4° C. no Zyôryûsui ni kurabeta Hidyû.

Hidyû no Hyô wo tukureba, kattena Ondo de hakatta Hidyû kara sono Midu no Enbun mo sirare, mata tigatta Ondo ni okeru Hidyû wo onazi Ondo no mono ni kwansansuru koto mo dekiru.

Zyôryûsui wa 4°C. no tokini Hidyû ga mottomo ôkii ga, Kaisui no Saidai-mitudo ni sôtôsuru Ondo wa, sono Enbun ni yotte soresore tigau. Tatoeba, tugino Hyô no yôna Yôsu de aru :

$\frac{\text{‰}}{\text{Enbun}}$	Saidai-mitudo wo simesu Ondo °C.	σ
0	3.95	0.00
5	2.93	4.15
10	1.86	8.18
15	0.77	12.13
20	-0.31	16.07
25	-1.40	20.10
30	-2.47	24.15
35	-3.52	28.22

§ 9. Kaisui no, Hikari ni kwansuru Seisitu.

A. Kusseturitu.

Kaisui no Kusseturitu wa Ondo ga agaru hodo tii-saku, Enbun no masu hodo ôkiku naru. Ima, tatoeba 37% no Kaisui no, Natoriumu ga dasu kiroi Hikari ni taisuru Kusseturitu wa, Ondo 10° de 1.34092, 20° de 1.34011 de aru. Mamidu no 20° ni okeru onazi Hikari no Kusseturitu wa 1.33305 de aru. Sorede, Kusseturitu wo hakatte Enbun wo kimeru niwa, Ondo wo kanari seimituni hakaraneba naranai koto ga wakarû. Kono Ten ni tyûisite hakareba, Enbun wo 0.1% madewa seikakuni hakaru koto ga dekiru. Ukibakari nado wa,

yurete iru Hune no ue de tukau koto ga dekinai ga, Kusseturitu wo hakaru koto wa Hune ga ugoitemo Sasitukae ga nai.

B. Tômei-no-do.

Kaisui no *Tômei-no-do* wo hakaru niwa, tûrei, siroku nutta Ita no yôna Mono wo sidumete, sore ga mienaku naru Hukasa wo hakaru. Nettai-tihô no Rikuti ni tikai Umi de hakatta Kekkwa ni yoruto, taitei 20 m gurai made mieru; Baai ni yottewa 45 m made mieta. Taiseiyô no Mannaka ni aru yûmeina Sargasso-kai dewa 66.5 m no Soko ni aru siroi Ami ga yoku mieta sô de aru.

Sikasi, kono Hôhô wa amari kwanzenna mono de nai kara, iroiro kore ni kawarubeki Hôhô ga kuhûsareta. Spindler oyobi Wrangell wa, Yoru Kokkai (Black Sea) de 8-syokkôno Denkitô wo sidume, kore ga mienaku naru Hukasa wo hakatta ga, amari tasikana Kekkwa wa erarenakatta. Mata H. Fol oyobi E. Sarasin wa, Itaria no Kaigan de Syasin no Taneita wo Soko ni sidume, kore ga Hikari ni kanzuru Hukasa wo hakatta ga, 400 m guraino Hukasa madewa kanarini kanzita. Sonogo iroirono Hito ga kono Hôhô wo kairiyôsite, tigatta Basyo de sikensita Kekkwa demo, taitei 400 kara 500 m gurai ga Sakai de aru. Tikagoro Helland-Hansen ga Noruwê no Umi de goku Kanzi no yoi Taneita wo tukatte sikensita tokiniwa, 1000 m no Hukasa demo mada kanzita, sikasi 1700 m no Hukasa dewa 2 zikan oitemo sukosimo kanzinakatta.

Paul Regnard wa Genso Sereniumu (Se) ga Hikari ni yotte Denki-teikô wo kaeru koto wo riyôsite, iroirono Hukasa ni okeru Hikari no Tuyosa wo hakatta ga, Monaco no Kaigan dewa, 1 m no Hukasa de Hyômen

no $\frac{1}{2}$ ni nari, $4\frac{1}{2}$ m de $\frac{1}{3}$ ni naru to iu Wariai de atta. Regnard wa mata iroirono Hukasa de, 1 niti no utini Hikari no hairu Zikan wo hakatta ga, 30 m no Hukasa dewa 5 zikan guraino aida akarui ga, 40 m no Tokoro dewa wadukani $\frac{1}{2}$ zikan gurai sika Akari ga konai sô de aru.

Korerano Zikken wa, iduremo goku zattosita mono de, kuwasiku siraberu tameniwa dôsite mo Hikari wo bunsekisite iroirono Iro no Hikari ga Kaisui no tameni kyûsyûsareru Do wo hakaraneba naranai. Kore ni tuitewa, notini Kaisui no Iro no Koto wo noberu toki sarani kuwasiku noberu koto ni suru.

Zikken no Kekkwa ni yoruto, Kaisui no Tômei-no-do wa Ondo ni yotte amari kawaranai; Enbun ga tigattemo amari itizirusii Tigai wa nai. Sikasi, Enbun ga ôi Tokoro dewa Midu wo nigoraseru yôna tiisana Tindentutu ga hayaku tindensuru tameni, tûrei Sio no koi Tokoro wa Tômei-no-do ga ôkii. Mata, Huyû-seibutu ga ôi tokiwa, Tômei-no-do ga heru to iu Setu mo aru ga, kore wa mada tasika de nai.

C. Kaisui no Iro.

Tugini, Kaisui no Iro ni tuite noberu. Kaigan nado kara mita Umi no Hyômen no Iro wa Kaisui no Iro dewa nai. Kore wa, Sora no Iro ni yori, mata Nami no Moyô ni yotte itizirusiku tigau. Kaisui ni koyûna Iro wo miru niwa, Kuda no yôna mono wo Midu no naka ni sasikomi, hoka kara kuru Hikari wo huseide mineba naranai.

Kaisui no koyûno Iro ga Toki to Basyo to ni yotte tigau Moyô wo kuwasiku siraberu tameniwa, dôsite mo nanika kimatta iroirono Iro no Mihon wo kosiraete oite,

kore to Kaisui no Iro to wo kurabe, ato kara dôiu Iro de atta to iu koto ga wakaruru yôni sinakereba naranai.

Konniti itiban hiroku motiirarete iru *Iro no Mihon* wa, *Forel* to iu nadakai miduumi-senmonno Gakusya ga kosirae-hazimeta mono de aru. Kore wa Ao kara Midori, Kiiro to dandanni tigatta iroirono Ekitai wo garasuno Kuda ni hûzikometa mono ni suginai. Kore ni tukau Ekitai no Tyôgô wa tugino tôri de aru. Madu, 1 g no Ryûsandô wo 9 g no Anmonia to issyoni 190 g no Midu ni tokasu; kore wo karini *A-Eki* to nadukeru. Tugini, 1 g no tyûseino Kurômusan-kari wo 199 g no Midu ni tokasu; kore wo *B-Eki* to nadukeru. Ima *A-Eki* to *B-Eki* to wo iroirono Wariai de mazeruto, Ao kara Midori, Kiiro to dandan tigatta Iro ga dekuru. *A-Eki* wo 0 Gô to naduke, *A 99 B 1* no Wariai no mono wo 1 Gô, *A 98 B 2* no wo 2 Gô to iu Zyunzyo ni Bangô wo tuku. 2 Gô no Iro ga oyoso Supekutoru no Fraunhofer-sen no *F*, 20 gô ga *E* ni nita Iro de aru.

Kono Iro no Mihon ni Bangô wo tuketa mono wo *Forel no Bangô* to nadukeru. Sikasi, zissaino Umi no Iro niwa, dôsite mo *Forel* no Mihon ni nai yôna Iro ga aru node, kore ni Ryûsan-kobaruto wo kuwaete siken-sita Hito mo aru. Mata, Irogarasu wo kumiawasete, Iro no Mihon wo tukutta Hito mo aru ga, yahari *Forel* no ga itiban keibenna node ippanni motiirarete iru.

Ittai, Hikari ga Kaisui no naka wo tôru tokiniwa, Kaisui ni kyûsyûsarete dandan yowaku naru; kono Kyûsyû no Wariai wa Hikari no Iro ni yotte tigu.

Iroirono Hikari no utide, Aka no Hikari ga wariaini itiban ôku kyûsyûsare, tuginiwa Kaba, tuginiwa Ki ga kyûsyûsareru. Sorede, siroi Nikkô ga Kaisui no naka ni haitte yuku tokiwa, dandanni Supekutoru no akai

hōno Hikari ga wariaini sukunaku naru node, sidaini Aomi no katta Iro ni natte kuru. Zissai, Umi no Soko ni mogutte yukuto, dandanni aoi Hikari bakari ni natte, akai mono wa makkuroku mieru sō de aru.

Sate, Umi no Hyōmen kara Soko wo nozoku tokini mieru aoi Hikari wa doko kara kuru ka to iuto, kore wa Hyōmen kara irikomu Nikkō ya, Sora no Hikari ga, Midu no naka ni aru goku komakai Mono, tatoeba Huyū-seibutu ya, Doro no Kona no yōna mono kara hansyasarete, hutatabi Midu no Hyōmen ni okuri-kaesareru no de aru. Mosi Midu no nakani, nani mo Hikari wo okuri-kaesu Mono ga nakereba, goku hukai Midu wa, ue kara mireba, makkuroku mieru Wake de aru. Mosi, Midu ga nigotte ite, Hikari wo hansyasuru Bibunsi ga ōku areba, ue kara hairu Hikari wa omoni asai Tokoro kara hansyasarete dete kuru kara, sore no Iro wa asai Midu wo tōtta ato no Iro, sunawati midorigakatta Iro ni naru. Kore ni hansite, Midu ga goku sunde ite, Hikari wo saegiri mata hansyasuru Mono ga sukunai tokiwa, ue kara hairu Hikari wa daibubun hukai Tokoro made haitte dandan kyūsyūsare, nokoru Bubun ga hansyasarete kuru; sitagatte, sono Hikari wa Aka, Ki, Midori wo usinatte, Ao ga omoni natte iru no de aru.

Kono Setumei ga tadasii to sureba, Umi no Iro to Tōmei-no-do to no aidaniwa hanaregatai Kwankei ga aru Wake de aru. Zissai, korerano hutatu wo kurabete miruto, Tōmei-no-do no sukunai hodo, Iro ga midorigakatte iru. Arū Hito no kwansokusita Kekkwa ni yoruto, Midu no naka ni ireta siroi Ita no mieru Hukasa to Iro to no Kwankei wa tugino yō de atta :

Iro	Forel no Mihon no Bangô	Ita no mieru Hukasa (heikin)
Ao	0 kara 2	26.7
"	2 " 5	23.2
Midori-gakatta Ao	5 " 9	16.2
Midori	9 " 20	15.5

Tômei-no-do no mottomo ôkii no de nadakai Sargasso-kai wa, zissai hizyôni koi Aoiro wo site iru. Kono Umi dewa, hoka ni kurabete Huyûseibutu ga hizyôni sukunai sô de aru. Kurosio no Iro ya Tômei-no-do wa, mada kenkyûsarete inai kara wakaranai ga, osoraku Midu no itizirusiku tômeina tameni kuroi no de arô to omowareru. Hokuhyôyô kara Minami ni nagaredete kuru tumetai Kairyû no Midu wa, tûrei takusanni Keisô (*E.*, diatom) wo hukunde iru node, tokubetuna oriibu-gakatta Midoriiro wo site iru sô de aru. Mata, Huyûseibutu ga hizyôni takusanni naruto, sore no Iro no tameni tokubetuna kawatta Iro wo simesu koto ga aru. Tatoeba, *Calanus finmarchicus* to iu komakai Seibutu no tameni Umi ga akaku naru koto ga aru. Wagakuni no Engan de *Akasio* to iu no mo, yahari Huyûseibutu no tame da to iu koto de aru.

§ 10. Kaisui no, hokano iroirona buturitekino Seisitu.

Hyôzyunno Aturyoku ni okeru, Kaisui no *Hyôten* to *Huttôten* wa tugino Hyô ni simesu tôri de aru:

Enbun ‰	Hyôten(°C)	Huttôten(°C)
0	0	100.00
5	-0.27	100.08
10	-0.53	100.16
15	-0.80	100.23
20	-1.07	100.31
25	-1.35	100.39
30	-1.63	100.47
35	-1.91	100.56

Kore wo § 8 no Hyô to kurabete miruto, 25% izyôno Kaisui wa Saidai-mitudo ni sôtôsuru yorimo takai Ondo de kôri-hazimeru koto ga wakaruru. Sore ni kakawarazu, Hyô ni Saidai-mitudo no Ondo ga kaite aru no wa, Kwayûkai⁽¹⁾ no Arisama ni aru Ekitai ni taisuru no de aru.

Kaisui no *Zyôhatu* wa, yahari Kûki no Aturyoku, Ondo, Situdo oyobi Kaze no Sokudo ni yoru ga, mata Kaisui no Enbun ni yottemo tigau. Seto-naikai no Engan no Adino de kwansokusita Kekkwa wo, Okada Hakusi no sirabeta tokoro ni yoruto, itinen no aidani zyôhatusuru Kaisui to Tansui to no Wariai wa 95 to 100 no Wariai ni naru. Mata, Adria-kai no Triest de sirabeta no dewa 81 to 100 no Wariai de atta.

Kaisui no *Hinetu* wa Tansui no sore yori sukosi sukunakute 0.93 gurai de aru.

Kaisui no *Netu-dendôritu* ni tuitewa amari kuwasii Kenkyû wa nai ga, Mamidu to amari tigawanai.

Kaisui no *Hyômen-tyôryoku* wa, onazi Ondo dewa Mamidu yori sukosi ôkii. Sore no Ookisa *T* wa tugino Siki de ôyoso ataerareru :

(1) Hyôten yôri sita de Ekitai no mama de iru koto.

$$T = 77.09 - 0.1788 t + 0.02213 s \frac{\text{dain}}{\text{cm}}$$

Tadasi, t wa Ondo, s wa % de arawasita Enbun de aru.

Kaisui no *Nebasa* (Naibu-masatu) wa Ondo ga takai hodo sukunaku, Enbun no ôi hodo ôkiku naru. Ima, 0° ni okeru Zyôryûsui no *Nebasa* wo 100 to sureba, Ondo to Enbun no Eikyô wa tugino Hyô de ôyoso siru

En- bun Ondo	0%	20%	35%
0°	100.0	103.2	105.2
15°	63.2	66.2	68.2
30°	44.9	47.0	48.9

koto ga dekiru. *Nebasa* wa mata Aturyoku nimo kwankeisuru ga, Kaisui ni tuitewa mada yoku Kenkyû ga dekite inai. Kaisui no *Nebasa*

wa, Umi ni takusan oru Huyûdôbutu no Undô nimo kwankeisi, mata komakai Dorô ya Suna nado ga, Soko ni sidunde yuku Hayasa nimo kwankeisuru kara, kenkyûsuru Neuti no aru Mondai de aru.

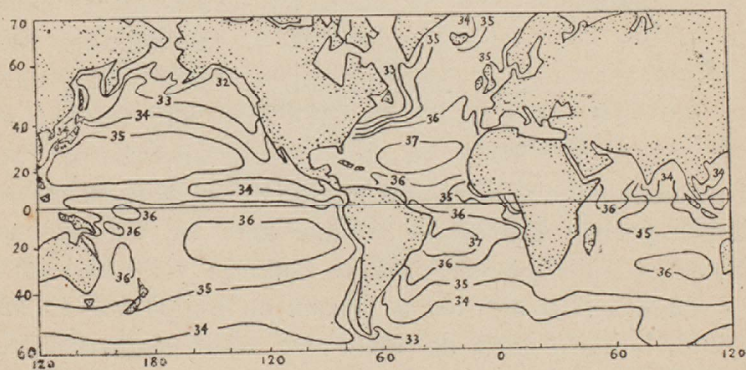
Kaisui ga Aturyoku no tameni ositidimerareru Doai, sunawati *Ositidime-yasusa* (*E.*, compressibility) mo mada yoku wakatte inai. Mamidu ni tuitewa, Amagat no Kenkyû ni yoreba, Ondo 0°C., Aturyoku 0—20-kiatu no aida dewa, 1-kiatu masu gotoni, motono Taiseki no 525×10^{-7} dake genzuru to iu koto ni natte iru. 35% no Kaisui dewa hobo Tansui no Baai no 92% gurai de aru. Idure ni sitemo, tatoeba Mariana-kaigô no yôna Hukami no Soko dewa, Midu no Taiseki wa $\frac{1}{100}$ gurai tidimatte iru Wake de aru. Arû Hito no Keisan ni yoreba, ima mosi Kaisui no Aturyoku ga, Hyômen kara Soko made mina 1-kiatu ni natta to sureba, Kaisui wa bôtyôsite, Umi no Hyômen zentai ga 30m hodo takaku naru Wake da to iu koto de aru.

§ 11. Kaisui no Enbun no Bunpu.

Madu *Umi no Hyômen ni okeru Enbun no Bunpu* wo noberu.

Rikuti ni tikai Umi no Hyômen no Midu wa Kawa kara nagarekomu Mamidu no tameni ippanni Enbun ga sukunai; tatoeba, Baltic-kai no yôna Rikuti ni kakomareta Tokoro dewa 7.8% gurai de aru⁽¹⁾. Mata, Hokkyoku ya Nankyoku ni tikai, Kôri ga tokeru Tokoro demo Enbun ga sukunai; tatoeba, Hokuhyôyô dewa heikin 25% de aru. Mata, Sekaidyû de mottomo Enbun no ôi Tokoro wa Kôkai (Red Sea) no itiban Oku ni aru Wan de, 40 kara 40.6% gurai aru.

Korera wa mina kyokutanna Rei de aru ga, Ooumi (Taiyô) no naka dewa heikin 35 % de aru. Taiseiyô wa, Taiheiyô ya Indoyô ni kurabete sukosi Enbun ga ôi.

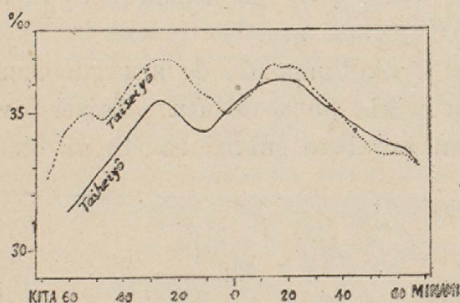


Du 10.

Ima Ooumi ni okeru Enbun no Bunpu wo miruto (Du 10), 'sizenni itteino Kisoku ga aru. Taiseiyô demo

⁽¹⁾ Amazon-gawa no Midu wa Kawaguti kara 150 km no Oki mademo Hyômen no Enbun wo sukunaku site iru.

Taiheiyô demo, Tairiku kara hanareru hodo Enbun ga masu. Mata Sekidô no atari dewa Enbun ga sukosi sukunakute, kita to minamino Kwaikisen no atari ni mottomo Enbun no ôi Tokoro ga aru. Kore wa dôiu Wake de arô ka? Kono, Enbun no mottomo ôi Tokoro wa Kûki no Ondo ga takai nominarazu, iwayuru Bôeki-hû ga nendyû huite iru node, Zyôhatu ga mottomo sakan de, taezu Hyômen no Midu no Enbun wo masu yôna Sayô wo site iru. Kore ni hansite, Sekidô no atari dewa, Ondo wa takai ga, Kaze ga sukunakute Ame ga ôku, sorede Enbun ga sukunai no de aru.



Du 11

Ooumi no Hyômen wo, Ido 5-do dutu no Haba no Obi ni wakete, onôno-Obi no naka no heikinno Enbun wo motome, kore wo Du ni arawasuto, Du

11 no yôni naru. Sekidô no Tikaku dewa, Kwaikisen no Kinpen yorimo Enbun ga sukunai koto ya, Taiseiyô no Enbun ga Taiheiyô yori ôi koto nado ga yoku wakaruru.

Tugini, Umi no naka no Enbun no Bunpu wa dô ka to iuto, hukai Tokoro no Midu wo totte siraberu koto wa kantanni dekinai node, imamade kore wo sokuteisita Kekkwa ga takusan nai kara, tasikana Koto wa wakaranai ga, madu heikin 34.7% gurai da to iu koto de aru; sunawati, Hyômen no Heikin to amari tigawanai no de aru. Hokuhyôyô dewa, Hyômen no Enbun wa wadukani 25% de aru ga, Soko made no Heikin wa

34.8 % de aru ; sunawati, Enbun no sukunai no wa Hyômen ni tikai wadukana Bubun dake de aru. Kawa no Kuti ni tikai Tokoro demo, Soko no hô no Enbun wa taitei hoka to kawaranai no de aru. Hukai Umi no naka no Enbun wo mottomo kuwasiku sirabete aru no wa, Noruwê to Greenland no aida de aru. Enbun nominarazu, Midu no Ondo mo kuwasiku sirabeta tameni, Taiseiyô kara kuru *W a n r y ū* (Gulf Stream) no nageru Moyô ga yoku wakaruru yôni natta.

12. Ondo no Bunpu.

A. Kaisui ni hairu Netu.

Umi no Midu wa, Soko no Dimen karamo taezu Netu wo uketotte iru Wake de aru. Kono Netu no Ryô wa, Tikyû no naka no Ondo no Bunpu kara oyoso kandyôsuru koto ga dekiru ga, kore wa kiwamete wadukana mono de aru. Goku hukai Umi no Soko ga, sukosi ueno Bubun yorimo, kaette atatakai yôna Tokoro mo aru ga, zissai Dimen kara kuru Netu no tame de aru ka dôka utagawasii. Umi no Midu ga uketoru Netu no Daibubun wa, yahari Hi kara kuru mono de aru.

Tikyû no Hun'iki no itiban Sotogawa de, Hi no Hikari ni suityokuna 1 heihô-cm no Menseki ga 1-pun no aidani ukeru Netu wa 2.2 *gram-calorie* de aru. Ima. Tikyû no Hyômen wa itumo hanbun dake Taiyô no Kôsen ni terasarete ori, mata ippanni nanameni Kôsen wo uketoru. Kono Koto wo Kandyô ni irete itiniti no aidani heikinsite miruto, Sekidô no Tokoro demo, kore no $\frac{1}{3}$ gurai ni naru. Koredake no utide, daibubun wa Kûki ni kyûsyûsare, matawa Kumo ni hansyasare, Dimen made todoku no wa 2-wari ka 3-wari gurai de aru. Sikasi, konohokan

Sora kara tirasarete kuru Hukusya-netu ga, motono Bunryô no 2-wari gurai aru. Sorede, *Sekidô no hen de Umi no Hyômen* 1 cm^2 (*heihô-cm*) ga 1 nen no aidani uketoru *Neturyô wa oyoso 159 000 gr-calorie de aru.*

Kono Netu wa Umi no Midu wo zyôhatusuru to atatameru to ni tukawareru. *Sekidô no hen no Zyôhatu no Wariai wa 1 cm^2 ni tuite, 1 nen no aidani 250 cem to mitumoreba, kore ni yôsuru Netu wa 145 000 gr-cal. de aru kara, sasihiki 14 000 gr-cal. no Netu ga Kaisui wo atatameru tameni tukawareru mono to omowareru.*

Kaisui wa Hukusya-netu wo yoku kyûsyûsuru kara, *Hyômen kara irikomu Netu no omona Bubun wa Hyômen ni tikai Tokoro de kyûsyûsareru; sore no Wariai wa 0.01 cm no Sô wo tôruto $\frac{6}{1000}$ dake kyûsyûsare, 13 cm gurai tôruto mô hanbun ni natte simau. Sorede, tyokusetuni Hukusya-netu no tameni atatamerareru no wa Hyômen no usui Sô ni kagirarete iru.*

B. Netu no tutawaru koto.

Atatakai Hyômen kara Netu-dendô ni yotte Netu ga tutawatte yuku no wa hizyôni noroi mono de aru. Sikasi, konohokani mata Midu ga ue-sitani nagare-kawaru tameni Hyômen no Netu ga sitano hô ni utusareru. Hyômen ga atatamerareruto, Mitudo ga tiisaku naru ga, kore to dôzini Zyôhatu ga sakanni naru node Enbun ga masi, sitagatte Mitudo ga masu yôni naru. Tûrei, Zyôhatu no Eikyô no hô ga ôkii node, Hyômen no Midu ga omoku nari, Soko no hô e sidumi, sitano Midu wa kore wo oginau tameni nobotte kuru. Konotokini sidumu Bubun to agaru Bubun to wa, tyôdo Ito wo tareta yôni komakani wakareru kara, ryôhô ga hayaku tagaini maziriau no de aru. Kôiu ue-sitano Tairyû ga okonawareru no

wa Hyômen kara 10-20 m guraino aida de atte, sore yori hukakuwa todokanai.

Tugini *Ame no Eikyô* wa dô ka to iuto, kore wa, tûrei Zyôhatu no Eikyô to hantai de aru. Ame no Midu wa ippanni Umi no Hyômen no Midu yorimo tumetai ga, sonokawari Enbun ga nai kara, taiteino Baai ni Kaisui yori karuku, sitagatte Soko ni sidumu yôna koto wa nai.

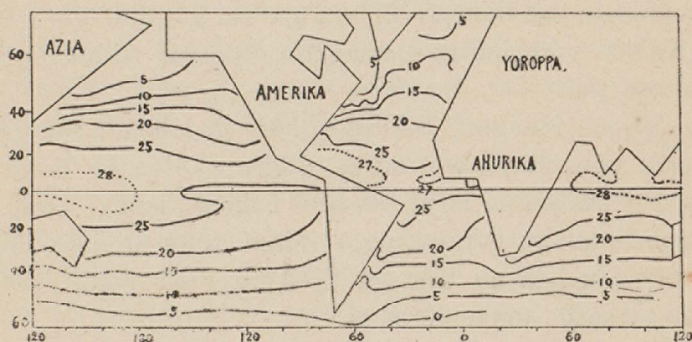
Nami ga hagesii tokiniwa, kore ga Kaisui wo kakisazeru yôna Sayô wo suru. Heizeiwa Ue to Soko to itizirusii Ondo no Tigai no aru Tokoro demo, Arasi no tameni *Nami* ga takaku, nagai Zikan areta atodewa, 30 m guraino Hukasa no Umi ga Ue kara Soko made itiyôna Ondo ni natte simau koto ga aru.

Ue ni nobeta no wa mina Kaisui no Netu ga ue-sitani irimaziru koto de atta ga, nao Kaisui ga *suiheino Hôkô* ni uturi-ugoku tameni, Netu ga *tôi Tokoro e hakobarete yuku* Baai mo aru; Kurosio ya Taiseiyô no Wanryû (Gulf Stream) nado wa sore no itizirusii Rei de aru.

C. Hyômen no Ondo.

Umi no Hyômen no Midu no Ondo wo hakaru koto wa tayasuku dekiru. Atarimaeno Kandankei no Tama no mawarini Midu no tamaru Tokoro wo torituketa mono wo, sibaraku Suimen ni hitasite oite, kore wo hikiagete Ondo wo yomu koto mo aru ga, tûreiwa, zukkuno tiisana Oke de Hyômen no Midu wo kumiagete sore no Ondo wo hakaru; tadasi, kono Oke ga Umi to onazi Ondo ni naru tameni, sore wo sibaraku hitasite oku koto ga hituyô de aru. Kono Kwansoku wa Hune ga susunde iru toki demo dekiru kara, Oumi wo kôkaisuru ôkuno Hune wa, kimatta Zikoku ni kore wo kwansokusite iru.

Kono Kwansoku no Kekkwa wo takusanni atumete miruto, *Sekai no Umi no Hyômen-ondo no Bunpu* ga wakarû. Hyômen-ondo wa motoyori Kisetu ni yotte tigau ga, nendyûno Heikin wo totte miruto, oyoso Du 12 no yôna



Du 12.

mono de aru. Itiban Ondo no takai Tokoro wa Kôkai (Red Sea) de, 29°C . ni tikai ga, kono Du niwa ryakusite aru. 28°C . no Tôonsen wa, Indoyô kara Java, Boruneo e kakete Taiheiyô no Itibubun made hirogatte iru. Minami-hankyû dewa Tôonsen ga oyoso heikôsitate Tôzai ni wasitte iru ga, Kita-hankyû dewa amari kantan de nai. Mottomo itizirusii Koto wa, Kurosio ya Wanryû no tameni Tôonsen ga kitano Hô ni magatte iru koto de aru. Ippanni, Nettai kara Ontai e kakete, Tairiku no Nisi-gawa dewa Tôonsen ga Sekidô no Hô e magari, Higasi-gawa dewa kore to hantaino Hôkô ni magatte iru yôna Katamuki ga aru. Kore wa, Tairiku no Nisi-gawa niwa, tûrei Kyoku ni tikai tumetai Tokoro kara Sekidô no Hô ni mukau Kairyû ga ari, Higasi-gawa dewa kore ni hân-site atatakaî Sekidô no Hô kara Kyoku no Hô ni mukau Danryû (p. 94) ga aru tame de aru. Kore no Kekkwa

tosite, Tairiku no Ryôgawa ni okeru Kikô no Tigai ga okoru no de aru.

Umi no Hyômen no Midu no itinendyûno Heikin-ondo wo, Umi no ue no Kûki no Heikin-ondo to kurabete miruto, Umi no hô ga tûrei 0.2-0.4° gurai takai⁽¹⁾. Mata Tairiku no Hyômen no Heikin-kion⁽²⁾ to kuraberuto, Umi no Midu no hô ga 3° hodo takai.

Umi no Hyômen no Ondo no *nitinitino Henkwa* wa, Ooumi no naka dewa seizei 1° guraino mono de aru. Sikasi, Rikuti ni tikai Asase dewa kanari ôkii koto mo aru. Taitei, Asa no 5 zi goro ga itiban hikuku, Ban no 5 zi goro ga itiban takai.

Hyômen no Ondo no *itinendyûno Henkwa* mo, Ooumi dewa ippanni sukunai. Ooumi zentai no 74% dewa nendyûno Henkwa ga 5° yori sukunaku, 24% dewa 2° yori sukunai; Sekidô no hen dewa taitei 1° ika de aru. Sikasi, Kaigan ni tikai asai Umi dewa nakanaka ôkii koto mo aru; tatoeba Baltic-kai dewa 24°, Bokkai-wan dewa 27° no Henkwa ga aru. Ooumi no Hyômen no itiban atatakai Tuki wa, Kita-hankyû dewa 8 gwatu kara 9 gwatu, itiban tumetai no wa 2 gwatu kara 3 gwatu de aru; sunawati, Rikuti ni kurabete Ondo no Saikô, Saitei no Toki ga 1-2-tuki okureru.

D. Umi no naka no Ondo.

Umi no Hyômen yori sita no, hukai Tokoro no Ondo wo hakaru omona Hôhô ga hutatôri aru.

Hitotu wa maeni nobeta *Saisuiki* wo motiiru no de

(1) Kairyû no tameni atatakai Midu ya tumetai Midu no nagarete iru Baai niwa, Kion to no Tigai ga sù-do ni naru koto ga aru.

(2) Kaimen ni naosita Heikin, sunawati Tairiku no takai koto kara syôzuru Tigai (100 m ni tuki 0.5°) wo kuwaeta Kazu.



Du 13.

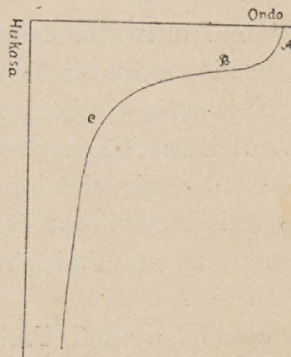
aru ga, goku hukai Tokoro de tukau niwa Netu no dehairi-sinai yôni tukuraneba naranai, mata hikiageru tokini Aturyoku no heru tameni, Kikai no iroirono Bubun ga bôtyôsitate Ondo no sagaru koto ni Ki wo tukenakereba naranai.

Mô hitotuno motto benrina Hôhò wa, *Tentô-kandankei* wo tukau no de aru. Kandankei no Tama wo sita ni site Umi no naka ni orosi, kore ga sono Basyo no Ondo ni natta tokini, tyôdo Saisuiki no Huta wo suru to onazyôni, Nedibane (propeller) matawa *Messenger* (Otosihundô) ni yotte, kyûni Kandapkei wo sakasani suru. Sonotokini Kuda no naka no Suigin no Ito ga kimatta Tokoro de kirete, hantaino Hasi (Du 13 no A) ni atumaru. Kore ni tekitôna Domori ga môkete atte, sakasani natta Toki no Ondo ga yomeru yôni natte iru. Hikiagete kuru Totyû de, sita yorimo atatakai Tokoro wo tôreba, Suigin ga bôtyôsitate atokara otite kuru Osore ga aru. Kore wo husegu tameni, Tama ni tikaku tiisana Tamari (Du no T) wo môkete aru. Mata, Midu no Aturyoku no tameni Tama ga tidimanai yôni, Zentai wo garasuno Kuda (K) ni hûzikomete aru. Hikiageta notinimo, Suigin no Nagasa ga Ondo ni yotte kawaru kara, sono Ondo wo hakaru tameni, mô hitotu tiisana Kandankei (S) wo soeta no mo aru. Du 13 wa konogoro itiban yoi to

natte iru, Doitu no Richter no Kikai de aru. *E* wa, Suigin ga kimatta Tokoro kara kireru tameni, wazawaza tuketa Eda de aru. Kandankei no Tama to sotonô Kuda to no aida *G* niwa Suigin wo irete, yoku Netu wo miti-biku yôni site aru.

Tonikaku hukai Tokoro no Ondo wo hakaru no wa, kantanniwa dekinai kara, seikakuna Kwansoku ga amari ôku nai ga, koremadeni wakatta omona Kotogara wo simo ni noberu.

Umi no Hyômen kara Soko no Hô e Ondo no kawatte yuku Moyô wa, motoyori iroiro de aru ga, hutûniwa, ue kara sita e dandanni tumetaku natte iru. Sonô Moyô wa Du 14 no yôni, Hyômen kara, 50 kara 150 m gurai (*AB*) madewa Ondo no Tigai ga wariaini soku-naku, sorekara sita de kyûni Ondo ga sagari (*BC*), 1000 m gurai kara sita dewa mata Henkwa ga sukunaku natte iru. Kono Moyô wa tyôdo, moto Umi zentai ga Soko to onazi Ondo de atte, Hyômen kara dandanni Netu ga haitte yuku Totyû no yôna Arisama de aru. Mosi, Umi no Midu ga mukasi kara ugokazuni tomatte ita naraba, kôiu Koto wa nai Hazu de aru node, kore wa tumari, Soko no Nagare no tameni, Kyoku no Hô kara taezu tumetai Midu ga oginawareru tame da to omowareru.



Du 14.

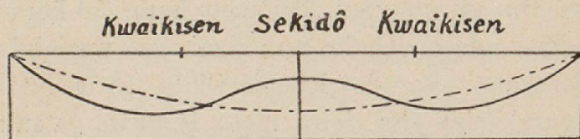
Mata Hyômen kara sûzyû-mêtoru made no Ondo ga amari tigawanai no wa, maeni nobeta ue-sitano Tairyû no tame de aru.

Tikagoro no kuwasii Sirabe ni yoruto, 5000 m gurai-

no Hukasa karawa, Soko no Hô ni yuku hodo kaette Ondo ga sukosi dutu (1000 m ni tuite 0.2° C. gurai) masite iru. Kore wa, Soko no Midu ga uestitano Tairyû wo suru tokini, Hukasa ni yotte ukeru Aturyoku ga tigau node, Yôseki ga kawari, sonotameni iwayuru *Dan-netu-henkwa* wo site Ondo ga kawaru mono to site Setumei ga dekiru.

Tikyû zentai no Kaisui no Heikin-ondo wa 3.8° C. gurai de aru. Hyômen no Heikin ga 17° gurai de aru kara, Umi no naka ga ittaini tumetai koto ga wakaru.

Du 15 wa Ooumi no naka no daitaino Ondo-bunpu wo simesu tameni, Hokkyoku kara Nankyoku made Umi



Du 15.

wo tateni tatiwatta Du de, kuroi Sen wa zissaino Tôonsen (Ondo no hitosii Ten wo turaneta Sen) de aru. Umi no Hyômen ga ukeru Netu no Ryô wa Sekidô ni tikai hodo ôi kara, Tôonsen wa Du no Tensen no yôni narisô de aru noni, zissainiwa kuroi Sen no yôni natte iru, sunawati aru Hukasa dewa Sekidô kara hanareta Tokoro ga mottomo atatakai yôni natte iru. Kore wa naniyue de arô ka?

Sekidô ni tikai Umi no Hyômen no Midu wa, Kairyû no tameni taezu hakobi-sarareru node, kore wo oginau tameni Soko no tumetai Midu ga agatte kuru. Kore ni hansite, Kwaikisen no Hen dewa, Zyôhatu ga sakanna tameni, Hyômen no Midu ga sidumu koto ga ôi node, wariaini sitano Hô made atatakai. Mata, Sekidô no

Tokoro de, Hyômen no Hô ni agaru Midu wo oginau tameni, Kyoku no Hô kara tumetai Midu ga taezu Umi no Soko wo nagarete kuru Wake de aru. Sikasi, kono Soko-no-nagare wa, hizyôni yuruyakana mono de nake-reba naranai. Arû Hito no keisansita Kekkwa dewa, Ido 30-do kara Sekidô made nagarete kuru noni, 150 nen mo kakaru darô to iu koto de aru.

§ 13. Umi no Kôri.

Enbun wo hukunda Midu no Hyôten wa, § 10 ni nobeta tôri, Enbun no masu ni sitagatte hikuku naru. Umi no Midu ga Hyômen kara hiyasareru Baai niwa, Hyômen no hieta Midu wa omoku natte sidumi, ue-sitano Tairyû wo okosu. Zentai ga Hyôten ni tassuruto, Hyômen kara kôri-hazimeru. Yuki ga hutte Hyômen ni ukabu yôna Baai niwa, kore ga Kôri no dekiru no wo tasukeru. Hazimeni dekita Kôri no Sô wa yawarakai mono de aru ga, kore ga dandanni sitano Hô e mukatte Atusa wo masu. Hazimewa hayaku masu ga, sukosi atuku naruto, sorekarawa dandanni osoku seityôsuru.

Umi no Midu ga kôru tokiniwa, sono Kôri no Kata-mari no naka ni, takusanno tiisana Ana ga dekite, sononaka niwa koi Siomidu ga haitte iru. Kono Midu no Seibun no Wariai wa, kôru mae no Umi no Midu no to tigatte, Syokuen ni taisuru Nigari no Ryô ga wariaini ôi.

Zyôryûsui wo kôrasete dekiru Kôri no Mitudo wa, 0° C. no tokini 0.9167 de aru ga, Umi no Kôri no Hidyû wa iroiro de, Makaroff no hakatta Kekkwa ni yoruto, 0.85 kara 0.96 gurai made aru. Zyunsuina Kôri wa, Ondo ga sagaru ni sitagatte syûsyukusuru ga, Umi no Kôri wa, Ondo ga sagaruto, arû Ondo madewa bôtyôsite,

arû Ondo de saidaino Taiseki ni tassi, nao Ondo ga sagareba dandan syûsyukusuru. Kore wa naniyue ka to iuto, Umi no Kôri wa zyunsuina Kôri to Enrui no Yôeki to no mazitta mono de aru ga, Ondo ga sagaru tokiniwa, Kôri no Bubun wa syûsyukusuru ga, sonokawarini Yôeki no Midu ga itibubun aratani kôru tameni Taiseki wo masu. Ondo ga amari hikuku nai tokiwa, sasihikisita tokorode, sudeni dekite iru Kôri no Syûsyuku yorimo aratani dekiru Kôri no tame no Bôtÿô ga katte, zentaino Taiseki ga masu koto ninaru. Sikasi, Ondo ga zutto hikuku nareba, zyunsuina Kôri no Wariai ga masi, dôzini atarasiku dekiru Kôri no Ryô ga sukunaku naru node, zentaino Taiseki wa heru no de aru.

Kôri no Netu ni taisuru Dendôritu wa tiisai mono de aru kara, amari atui Kôri wa deki-nikui Wake de aru ga, sikasi dekita Kôri ga Nami ya Kaze ya Usio no Undô no tameni osare, katamatte ôkina Katamari ni naru koto ga aru. Eigo de *pack-ice* to iu no wa kore de aru.

Umi de dekiru Kôri no hokanî, mata Rikuti kara Umi ni nagare-deru mono mo aru. *Hyôzan* (Kôri no Yama) wa konoyôni site dekiru mono de aru. Rikuti ni nannenmo no aida huritumotta Yuki ga, zibun no Omosa ni osarete katamatta mono de aru kara, Kôri no nakaniwa takusanno Sô ga aru koto ga mieru. Hokuhyôyô no Hyôzan wa, Hyôga ga Umi ni osidasarete dekita mono de aru kara, sono Ookisa mo amari ôkiku naku, Katati mo hukisoku de aru ga, Nankyoku no hiroi Kôri no Hara kara tigurete kuru mono wa, Katati ga ippanni hiratakute, Ookisa mo ôkiku, Nagasa 40 kara 60 kairi no mono sae aru. Hyôzan no Kaimen kara uki-agatte iru Takasa wa 130 m gurai no mo aru; Kaimen kara sitano Hazi made no Takasa wa, sono Hidyû ya

Katati ni yotte iroiro tigau ga, oyoso ukideta Bubun no 7-bai kara 8-bai tikaku made aru rasi.

Hyôzan ga atatakai Umi ni nagare-dete kuruto, dandanni tokeru ga, Midu no Hyômen ni tikai Bubun ga itiban hayaku tokeru. Tokekata ni yotte, Kôri no Turiai ga torenaku natte hikkurikaeru koto mo aru. Hyôzan no tokete iru Kinzyo no, Umi no Hyômen no Ondo wa itizirusiku hikui koto ga aru. Sikasi, tikagorono Kenkyû ni yoreba sô de nai Baai mo aru node, Hyômen no Ondo wo hakatta bakari dewa Hyôzan ga Tikaku ni aru ka nai ka to iu Koto wo siru no wa mudukasii to iu koto de aru.

DAI NIHEN.

Kaisui no Undô.

NAMI.

§ 14. Nami no Riron.

Ippanni, *Nami* wa, hikituduite oru Bussitu no Bubun ga sore no Turiai no Iti kara hanareta toki, kore wo motono Iti ni kaesô to suru Tikara ga hataraku tokini okoru Gensyô de aru ga, Midu no Nami dewa kono Tikara wa, Dyûryoku no tameni okoru Aturyoku no Sa to, Midu no Hyômen-tyôryoku to de aru. *Nami no Nagasa*, sunawati Nami no Mine kara Mine made no Nagasa ga sû-em gurai made no Nami dewa, Hyômen-tyôryoku no Eikyô ga itizirusii kara, kore wo *Môkwan-nami* (*E.*, capillary waves) to nadukeru. Sikasi, sûzyû-em izyô ni naruto,

mohaya Hyômen-tyôryoku no Eikyô wa sukunaku nari, Nami no Undô wa omoni Dyûryoku ni nomi sihaisareru koto ni naru node, kore wo *Dyûryoku-nami* to nadukeru. Koko dewa kotoni kono Dyûryoku-nami ga yôyô de aru.

Dyûryoku-nami wo, bengizyô hutatôrini wakeru koto ga aru :—

Hyômen-nami. Wareware ga Umi de miru yôna Nami wa, sore no Nagasa ga Umi no Hukasa ni kurabete itizirusiku tiisai ; sosite, kono Nami no Undô wa, Soko ni tikaduku hodo sukunaku natte, sukosi hukai Tokoro no Midu wa hotondo Nami no Eikyô wo ukete oranai. Tumari, kôiu Nami wa, omoni Hyômen no Midu no Undô de aru node, kore wo *Hyômen-nami* (*E.*, surface waves) to nadukeru. Konoyôna Nami no tutawaru Sokudo wa, Nami no Takasa ga Nagasa ni kurabete tiisai tokiniwa, rironzyô

$$v = \sqrt{\frac{g\lambda}{2\pi}}$$

ni naru Hazu de aru ; tadasi, g wa Dyûryoku no Kasokudo, λ wa Nami no Nagasa de aru. Sunawati, Nami no Sokudo wa, Midu no Hukasa ni kwankeinaku, Nami no Nagasa ni nomi yoru to iu koto ga itizirusii Ten de aru. Nami no Nagasa ga Hukasa no $\frac{1}{10}$ gurai made-wa, ôyoso kono Siki wo tadasii mono to omotte yoi.

Naga-nami. Kore ni hansite, Nami no Nagasa ga Midu no Hukasa yorimo yohodo ôkii tokiniwa, Midu ga Soko made Nami no Eikyô wo uke, Midu no suiheini ugoku koto wa Hyômen mo Soko mo amari tigawanai yôni naru. Konoyôna Nami wo *Naganami* (*E.*, long waves) to nadukeru. Kore no tutawaru Sokudo wa

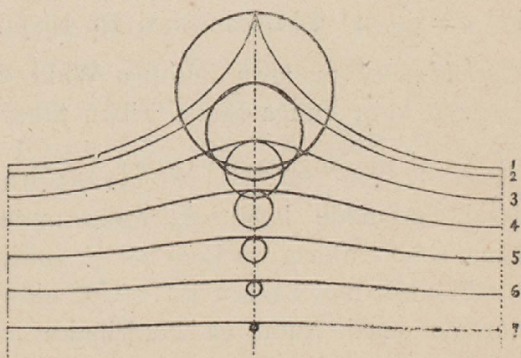
$$v = \sqrt{gh}$$

de ataerareru ; tadasi h wa Midu no Hukasa wo arawasau. Sunawati, Sokudo wa Nami no Nagasa ni yorazu, tada

Hukasa nomi ni yoru koto ni naru. Kono Siki wa Nami no Nagasa ga Hukasa no 5-bai izyô nareba tukatemo yoi no de aru. Naga-nami ni tuite, mô hitotu taisetuna Koto wa, Midu no naka no onônono Ten no Aturyoku ga, itudemo sono Ten kara ue ni aru Midu no Mekata ni hitosii koto de aru.

Nami no Nagasa ga Midu no Hukasa to oyoso onaziguraina Baai niwa, sore no Sokudo wa ueno yôni kantande nai ga, zissaino Mondai ni mottomo hituyôna no wa ueno hutatuno Baai de aru.

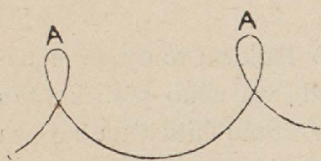
Torokoido-nami. Korerano Nami ni kwansuru Riron wa hukwanzenna mono de atte, Nami no Takasa (amplitude) ga Nagasa ni kurabete goku tiisai toki no hokawa, ippanno tadasii Kaisiki wa dekite inai. Tada, hukai Midu no Hyômen ni deki-uru tokubetuna Nami ni tuite kwanzenna Kaisiki ga dekite iru; sore wa Torokoido-nami (E., trochoidal waves) to nadukeru mono de aru (Du 16).



Du 16.

Kono Nami no Hyômen no Katati wa Torokoido (Du 16 no 2 kara 7 made) to iu Kyokusen de, sore no susumu Sokudo wa $\sqrt{\frac{g\lambda}{2\pi}}$ de aru. Kore ga susunde yuku toki ni, Midu no Bubun wa sorezore En no ue wo mawatte ugoku; sosite, sono En no Hankei wa Hyômen kara Soko

e mukatte Hukasa no masu ni sitagatte, Kika-kyûsû wo nasite hette yuku no de aru. Hyômen no Midu ga egaku En no Tyokkei ga tyôdo Nami no Takasa ni naru. Ima Nami no Takasa wo a , Nagasa wo λ to sureba,



Du 17.

$$a < \frac{\lambda}{2\pi}$$

de aru aidawa Nami no Mine ga maruku naru ga,

$$a > \frac{\lambda}{2\pi}$$

ni naruto, Nami no Katati wa Du 17 no yôna, *Epi-trochoid* to iu Kyokusen ni naru Wake de aru ga, konoyôna Nami wa muron zissai dekinai. Sorede, tyôdo $a = \frac{\lambda}{2\pi}$ no toki, sunawati Du 16 no 1 no yôna Nami (*Cycloid-nami*) madewa deki-uru Wake de aru. Sunawati, rironzyô kara kangaerareru itiban takai Nami no Takasa wa Nami no Nagasa no oyoso $\frac{1}{2\pi} \doteq \frac{1}{6.3}$ de aru. Sikasi, zissai koremade kwansokusareta mottomo takai Nami demo, sono Takasa wa kore no $\frac{1}{4}$ gurai no mono de aru.

Mure no Sokudo. Ue ni nobeta Riron wa iduremo onazi Nami ga kagirinaku mae-usironi hikituduite susumu Baai ni tuite atehamaru mono de aru. Zissaino Baai niwa, tatoeba sidukana Midu no ue ni Isi wo nagekonda tokini dekiru Nami no yôni, ikutu ka Kazu no kagirareta Nami no Mine ga narande susunde yuku koto ga ôi. Kôiu Baai niwa, Nami no hitotu-bitotuno Mine wa $\sqrt{\frac{g\lambda}{2\pi}}$ no Sokudo de susunde ittemo, sono Nami no Mure ga Zentai to site susunde yuku Sokudo

wa kore yorimo osoku, tyôdo kore no hanbun ni naru Kandyô de aru. Sorede, Mure no maeno Bubun no Nami wa dandanni kiete, Mure no usiro e aratana Nami ga dekite yuku. Kôiu Koto wa, ippanni donna Nami demo, Sokudo ga Nami no Nagasa ni yotte kawaru Baai ni okoru Koto de aru. Konoyôna Nami no Mure no Sokudo wo *Mure no Sokudo* to nadukete, *hitotu-bitotuno Nami no Sokudo* to kubetusuru.

Naganami no Sokudo wa, sono Nagasa ni mukwankei de aru kara, kore niwa Mure no Sokudo wa nai Wake de aru.

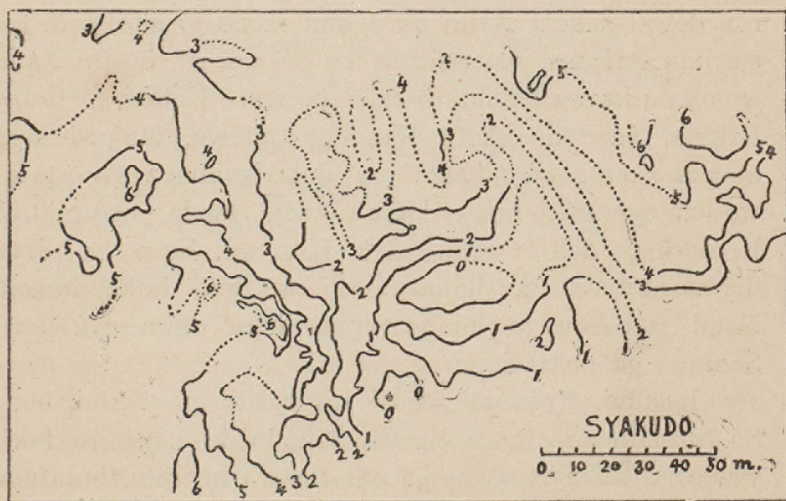
Nami no okoru Wake. Hutûno Nami no Riron dewa, sudeni Nami ga dekita mono to site, sore ga susumu Arisama wo ronozuru no de aru ga, dôsite Nami ga okoru ka wa betuno Mondai de aru. Kotoni, mottomo hutûna, Kaze de okoru Nami ni tuitewa, mukasi kara amatano erai Sûgakusya ya Buturigakusya ga Atama wo nayamasita nimo kakawarazu, mada manzokuna Kenkyû ga dekite inai. Arû Hito wa, Kaze ga sizyû itiyôna Tuyosa de hukazu, Iki wo site huku tameni Nami ga okoru to kangaeta ga, kore dewa zyûbunna Setumei ga dekinai.

Ippanni, Ryûdôtai ga Sô wo nasite iru tokini, ueno Sô to sitano Sô to ga tigatta Sokudo de nagareru tokiwa, sono Sokudo no Sa ga arû Do wo koeruto, hutatuno Sô no Sakai ga antei de naku natte, Nami ga okori, kore ga dandanni takaku naru. Kaze ga Nami wo okosu no mo, kôiu Sayô ni yoru mono de arô to iu koto wa ippanni sinzerarete iru ga, sore izyôni tatiitta kuwasii Koto wa mada yoku wakaranai. Kore wa syôrai rironzyô nominarazu zikkenzyô karamo kenkyûsite akirakani sitai Mondai de aru.

§ 15. Nami no Katati, Sokudo, Takasa nado.

Katati. Zissaino Umi no Nami no Katati wa nakanaka hukuzatuna mono de aru. Iroirono Nagasa no Nami ga iroirono Hôkô ni kasanatte, sore ga mata tigatta Sokudo de susunde yuku node, tyotto mita tokoro dewa taihen hukisokuna Katati wo site iru.

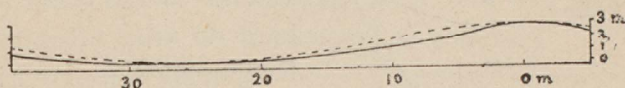
Tikagoro ni natte, Syasin-sokuryôzyutu no Ooyô ga sakanni natte kita node, kore ni yotte arû Syunkan no Nami no Katati wo sadameru koto ga dekiru yôni natta. Du 18 wa kono Hôhô de kosiraeta Nami no Heimendu



Du 18.

de, iroirono Kyokusen wa onazi Takasa no Ten wo tura-neta mono de aru. Kimatta Basyo de, mizikai Zikan no aidani, Syasin wo hikituduite takusan totte, konoyôna Du wo takusan tukureba, sore kara Nami no heikinno Katati ga sireru.

Konoyôna Kenkyû wa mada amari takusan sita Hito wa nai ga, koremadeni wakatta tokoro dewa, Nami no zissaino Katati (Du 19 no kuroi Sen) wa, Torokoido ni



Du 19.

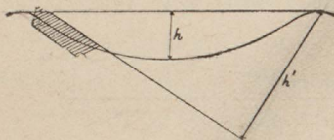
yoku nite iru ga sukosi tigau. Onazi Takasa no Torokoido (Du no Tensen) ni kuraberuto, Syamen no Tokoro ga sukosi hikuku natte iru.

Undô. Mosi, Torokoido-nami nareba, Midu no naka no Bubun wa mina En wo egaite undôsuru Hazu de aru ga, zissaino Umi de Midu no Bubun no Undô no Moyô wo kwansokusuru koto wa mudukasii. Wariaini asai Tokoro de, Soko ni Bin wo sidume, sore kara Awa ya Abura wo dasite, kore ga ukiagatte kuru aidani sindôsuru Moyô wo kwansokusita Hito mo aru.

Nami no Dôyô ga doreguraino Hukasa made todoku ka to iu koto wo sikensuru tameni, Soko e tokubetuna Kikai wo irete kwansokusita Kekkwa ni yoruto, 40 m guraino Hukasa no Umi dewa, Soko no Tokoro demo itizirusii Dôyô ga atta.

Takasa. Hune no ue kara Nami no Takasa wo hakaru koto wa zongwai mudukasii. Aneroido-seiukei wo tukatte Nami no tameni Hune ga agari-sagari-suru Takasa wo hakatta mono mo ari, mata Zyôgedô-disinkei no yôna Kikai wo tukatte sikensita Hito mo aru ga, iduremo amari umaku yukanai. Koremadeno Kiroku wa taitei mina, Me de mite hakatta mono de aru. Sikasi, zyûbunna Kokoroe no nai Hito no Kiroku nado wa, takusan attemo Sinyô ga dekinai. Ookuno Baai ni, Sirôto wa

Nami wo takaku misugiru Katamuki ga aru. Sore no Wake wa, Du 20 no yôni, Hune ga katamuita tokini, Du no h' wo Nami no Takasa h no yôni omou kara de aru. Huransu no Kaigun-sikwan Pâris to iu Hito no takusanna Kwansoku no Kekkwa ni yoruto, tugino Hyô ni simesu tôri,



Du 20.

Basyo	Takasa (m)		Nagasa Takasa
	Heikin	Saidai	
Taiseiyô no Bôekihû no Kuiki	1.9	6.0	35.2
Indoyô no " " "	2.8	5.0	35.3
Taiseiyô no Nisikaze no Kuiki	4.3	7.0	31.0
Indoyô no " " "	5.3	11.5	21.5
Sinakai oyobi Nipponkai	3.2	6.5	24.5
Nisi Taiheiyô	3.1	7.5	33.0

mottomo takai Nami wa 11.5 m de atta ; kore yori takai Nami wo mita to iu Kiroku mo aru ga, amari Ate ni naranai. Utiumi nado dewa, muron, ueno Hyô no yôna takai Nami wa nai.

Ippanni, goku takai Nami no kita atodewa, wariaini hikui no ga ikutuka tuduite kite, sonoatode mata takai no ga kuru. Arû Hito wa, kore wo, Kaze no Tuyosa ga syûkitekini kawaru koto de setumeisite iru ga, amari hakkirisinai. Kore mo kenkyûsubeki Mondai de aru.

N a g a s a. Koremade kwansokusareta utide mottomo nagai Nami no Nagasa wa 824 m de aru. Sikasi, hutûni Ooumi de Arasi no Toki ni miru Nami no Nagasa wa 70 kara 90 m gurai de, konniti no ôkina Kisen nareba

konoyôna Nami demo hutatu guraiwa siku Wake de aru.

Sokudo. Nami no Sokudo to Nagasa no Kwankei wa, Kwansoku no Kekkwa to Torokoido-nami no rironzyôno Kekkwa to kanarini yoku atte iru. Tatoeba, Pâris to iu Hito no Kwansoku ni yoreba,

Kwansoku no Basyo	Sokudo ($\frac{m}{byô}$)	
	kwansokusita Atai	$\sqrt{\frac{g\lambda}{2\pi}}$
Taiseiyô.....	11.2	10.8
”	14.0	15.5
Indoyô	12.6	13.1
”	15.0	15.2
Sinakai	11.4	11.4
Taiheiyô	12.4	13.6

Ue ni iuta 824 m no Nami no Hayasa wa $35.8 \frac{m}{byô}$ de atta.

§ 16. Kaze to Nami to no Kwankei.

Kaze no tameni okoru Nami no Takasa wo iroirono Baai ni kwansokusita Kekkwa kara, tugino yôna Zikken-siki ga dekite iru (Boergen no Siki);

$$H = \frac{H_m}{\left(1 + \frac{a}{t}\right) \left(1 + \frac{1.94}{D} w a\right)}$$

H wa Nami no Takasa; mêturu de arawasu.

w wa Kaze no Sokudo; $\frac{\text{kairi}}{\text{zikan}}$ de arawasu.

D wa Nami wo kwansokusuru Basyo kara Kazakami ni aru Rikuti made no Kyori; kairi de arawasu.

t wa Kaze ga huki-hazimete kara no Zikan (¹).

(¹) Kaze no Tuyosa wa kawaranai mono to minasu.

H_m wa $t=\infty$ $D=\infty$ no toki no Takasa; Boergen wa

$H_m = (\text{Kaze no Sokudo } \frac{m}{\text{byō}})$ to sita.

a wa Zyôsû; Boergen wa kore wo 10 to oita.

Kono Siki wa motoyori seikakuna mono dewa nai ga, Kaze no huki-tuduku ni sitagatte Nami no takaku naru Moyô ya, Kazakami no Umi no Hirosa ni yotte Nami no Takasa no tigau koto wo daitai simesu niwa Tugô ga yoi. Sunawati, Kaze ga hukidasita Hazime niwa wariaini hayaku Takasa ga masite, notiniwa sukosi sika masanai; mata, Kaze ga tuyokutemo, Kazakami ni, tikai Rikuti ga areba, Nami wa wariaini hikui koto ga wakaruru.

Kaze to Nami no Nagasa to no Kwankei wa, mada amari yoku sirabeta Hito ga nai.

§ 17. Uneri.

Hiroi Umi no ue de Arasi ga aruto, sono Kaze no tameni okotta Nami ga dandanni hirogatte, Arasi no Basyo kara harukana Enpô made tutawatte yuku. Konyôna Nami wo Uneri (*E.*, swell) to iu. Wagakuni no Kaigan de *Doyôname* to nadukeru no wa kore de aru.

Uneri wa, Bôhû no susumu yori zutto hayaku, mata massuguni susunde yuku node, kore ni yotte Enpô no Bôhû wo siri, mata Umi no ue de Uneri no kuru Hôkô wo mireba ôyoso dono Hôkô ni Bôhû no Tyûsin ga aru ka to iu Koto mo wakaruru. Uneri wa nakanaka tôte Tokoro made todoku mono de, tatoeba Iceland no Kinpen de okotta Uneri ga Taiseiyô wo Minami ni susumi, Sekidô wo koete Minamihankyû ní tassita koto ga aru.

Uneri ga Hamabe ni yosete kudakeru Oto wa tokitositewa Kaigan kara nanri mo hedatatta Tokoro made

kikoe, Basyo ni yottewa kono Oto de Bôhû no tikayotta koto wo siru koto ga dekiru. Zokuni "Uminari" to tonaeru Gensyô niwa iroirono mono ga hukumarete iru yô de aru ga, sonoutidemo itizirusii no wa kono Nami no Oto de aru.

Koko de tyûisubeki Koto wa, Uneri wa Umi no kagirareta Bubun de okotte, hoka e tutawaru *Nami no Mure* (p. 44 wo miyo) de aru node, kono Mure no susumu Sokudo wa hitotu-bitotuno Nami no Sokudo towa betuno mono de aru; sosite Uneri wa Hyômen-nami de aru kara, Mure no Sokudo wa Nami no Sokudo no tyôdo hanbun ni naru Hazu de aru. Wagakuni no yôna, tabitabi Bôhû ni osowareru Umiguni dewa, kono Uneri no Kenkyû wa mottomo hituyô de, mata omosiroi Koto de aru.

§ 18. Nami wo sidumeru koto.

Abura wo nagasite Nami wo sidumeru koto wa, mukasi kara sirete ite, ima demo zissaini okonawarete iru. Liverpool no Minato no Iriguti dewa, Tôdaibune kara Abura wo nagasite Nami wo sidumete iru. Sikasi, naze Abura ga kôiu Sayô wo suru ka ni tuitewa Giron ga aru. 'O. Reynolds no Setu dewa, Abura ga Midu no ue ni usui Sô ni natte hirogatte ireba, sore no Hyômentyôryoku wa Sô no Atusa ga usui hodo ôkii; Nami ga susumu tokiniwa, Midu no Hyômen wa sizyû nobitidimi-suru node, kono Sô no Atusa ga taezu kawari, sonotameni Hyômen no Bubun wa taezu Midu no Men ni sôte atira-kotira ni hikare, sonotoki Masatu no tameni Nami no Seiryoku (Enerugii) ga usinaware, sitagatte Nami ga sidumaru to iu no de aru.

Umi no ue de, Hune no tōtta Ato ga, Sazanami ga nakunatte tokubetuni namerakani mieru koto ga aru; kore wo Eigo de *keel-water* to iu. Kore wa, Hune ga tōru tokini dekita tiisana Udu ga, Nami no Undō wo samatageru tame da to kangaerarete iru. Mata, Midu no naka ni Umikusa ya Akuta no yōna mono ga takusan aru tokiniwa, Nami wo yowaku suru. Kore wa, Akuta nado ga Midu to issyoni tuite ugokanai node, Masatu no tameni Seiryoku ga syōhisareru kara de aru.

§ 19. Nami no Katati no kawaru koto.

Hamabe ni tatte, yosete kuru Nami wo miruto, Nami no Mine ga mina Kisi ni heikōsite susunde kuru. Hukai Umi no ue dewa, Nami no Mine wa kanarazu Kaze no Hōkō ni suityokuni natte iru ga, Kisi ni tikai Asase ni tikaduku ni sitagatte, Nami no Nagasa ga Hukasa ni kurabete tiisaku nai yōni naru node, Naganami no Seisitu wo obite kite, Sokudo wa Hukasa no Heihōkon ni hireisuru yōni naru. Sunawati, asai Tokoro hodo Sokudo ga tiisai kara, Kisi ni tikaduku hodo osoku nari, hukai Bubun no Nami ni dandan oitukareru Katamuki ga aru. Sorede, hazimewa Nami no Mine ga Kisi ni taisite aru Kakudo wo site ottemo, Kisi ni tikaduku ni sitagatte dandan kore to heikōni naru no de aru.

Kōkaisya no osoreru *Sankalu-nami* to iu no wa, tigatta Hōkō ni susumu hutatuno Nami ga kasanatte dekiru mono de aru.

Kaze no tuyoi tokini, Nami no Mine ga siroku awadatu no wa, tugino yōni setumeisarete iru. Nami no Mine to Tani to ni okeru Kaze no Sokudo wo kuraberuto, Mine no hō ga okii. Sonotameni, tyōdo Kirihuki no yōna

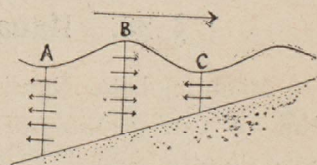
Wake de, Mine no Tokoro no Midu ga suiagerareru no de aru.

Nami ga Asase ni tikaduku tokiniwa, Takasa ga dandan takaku naru. Naganami ga susumu Totyû ni Hukasa no kyûni kawaru Tokoro ga aruto, Nami no Katati ga kudureru. Mata, Naganami ga dandanni semai Wan no Oku ni haitte yuku tokiniwa, yahari Takasa ga masite kuru. Nami no tôru Tokoro no Haba wo b , Hukasa wo h to suruto, Takasa wa $\frac{1}{\sqrt{b} \sqrt[4]{h}}$ ni hireisuru no de aru.

Nami ga entyokuna, Zeppeki no yôna Tokoro ni ataruto, kore ga hansyasarete, Zeppeki ni mukatte kuru Nami to kansyôsitate, iwayuru *Teizyô-nami* (sindôseino Nami) wo tukuru. Kore wa Hatoba no Dote nado demo miru Gensyô de atte, Kisi ni tikai Midu wa tada ue-sitani sindôsuru nomi de aru.

Mata, Nami ga tôasano Hamabe ni susunde kuru tokiniwa, Nami no Kasira ga dandan Kisi no Hô e katamuki, tuini orekaeru; kore ga *Isonami* (*E.*, roller) de aru. Kore no Setumei wa tugino yôni natte iru. Du 21 de,

A , B , C , nado wo tôtte, Nami no susumu Hôkô ni suityokuna Men wo kangaeruto, Nami ga Hyômen no Katati wo kaezuni susumu tameniwa, Du ni arawasita Syunkan ni oite, A ,



Du 21.

C no Danmen wo Oki no Hô ni deru Midu no Ryô mo, B no Danmen wo Kisi no Hô ni hairu Ryô mo onazi de nakereba naranai. Sikaruni, Kisi no Hô e yuku hodo asai tameni, AB no Kuiki wo deru Midu no Ryô mo, BC ni irikomu Ryô mo, husoku-

suru kara, Hyômen AB no Bubun wa atarimae yorimo takaku nari, BC no Bubun wa hikuku nari, kekkyoku Nami no Zenmen ga hikuku nari, tuini orekaeru yôni naru to iu no de aru. Arû Hito wa mata, Kisi ni utikakeru Midu ga Nami no Soko wo sizyû Oki no Hô e nagareru tameni, issô Nami no taoreru no wo tasukeru to ronžite iru.

Nami ga Kisi ni buttukaru toki no Aturyoku wa, *Haryokukei* to nadukeru Kikai de hakaru koto ga dekiru. Arasi no Nami no hagesii tokini hakatta mottomo ôkina Aturyoku wa 1 heihô-m ni 20 ton kara 30 ton gurai de aru. Mata, Nami ga Kisi ni tukiataru tameni, Rikuti wa dandanni kedurarete yuku. Tisitu-zidai kara ima madeni, Nami ga Tikyû no Hyômen no Sugata wo kaeta koto wa, zituni igwaini hanahadasii mono de aru.

Wiechert nado no Setu ni yoruto, Kaigan ni Nami no utikakeru koto de Rikuti ni Bidô wo okosu. Zissai, Bidôkei ni kanzuru Bidô no Ookisa ga, Kaigan kara Naiti ni yuku ni sitagatte sukunaku naru no wa Zizitu de aru.

§ 20. Hanare-nami. Tunami.

Maeni nobeta Nami wa mina onaziyôna Katati no Mine ya Tani ga kimatta Aida wo oite hikituduite susumu mono de atta. Sikasi, konohokani *Hanare-nami* (*E.*, solitary wave) to itte, Du 22 no yôna tada hitotuno Nami ga,



Du 22.

no Hyômen no Katati ga susunde yuku no de, Midu no

Katati wo kaezuni, susunde yuku koto mo dekiru. Kore mo yahari issyuno Nami de aru kara, Midu

Zissitu wa, Nami no tôru tokini sukosi ugoku bakari de, ippôni nagareru no dewa nai. Du no yôni Hyômen no takamatta no de naku, hantaini kubonda Katati wo site iru Baai niwa sonomamade susumu koto ga dekinai; susunde yuku utini, ikutu ka no Mine to Tani to ni wakarete simau no de aru. Kore wa, Riron karamo Zikken karamo, syômeisuru koto ga dekiru. Hanare-nami no Sokudo wa

$$v = \sqrt{g(h+a)} ;$$

tadasi h wa Nami no nakatta Baai no Hukasa, a wa kono Baai no Suimen kara Mine made no Takasa de aru. Mosi a ga h ni kurabete tiisakereba, Naganami no Sokudo to onazini naru no de aru. Disin nado no tokini okoru *Tunami* wa ikuraka kôiu Seisitu no Nami da to kangaerarete iru.

Java to Sumatra no aida ni aru *Krakatoa* to iu Kwazan-zima ga bakuhatusita tokini okotta Nami wa, Indoyô wa motoyori, Taiheiyô, Taiseiyô mademo hirogatta. Mata, Wagakuni no Ansei no Oodisin no tokini okotta Nami wa, Taiheiyô wo yokogitte, tôku San Francisco ni todoita. Kôiu Baai no Nami wa, motoyori tada hitotuno Nami dewa nai ga, sikasi Midu no aru Bubun ni kagirareta Seiryoku (Enerugii) ga sonomama Eupô ni hakobareru Arisama wa dôyô de aru.

Tunami ga okotta Zikoku to, sore ga iroirono Basyo ni tôtyakusita Zikoku to ga sirereba, sore no Sokudo ga wakaruru; sunawati, Nami no okotta Basyo kara no Kyori wo Zikan de wareba yorosii. Zissaino Tunami no Baai ni, konoyôni site Sokudo wo keisansite, kore wo Riron kara sirareru Naganami no Sokudo to kurabete miruto, taigai zissaino Sokudo ga Naganami no yorimo osoi yôni natte iru. Ansei no Tunami no San Fran-

cisco ni todoita no wa, Nami no Nagasa ga 390 km mo
atta kara, mûron $v = \sqrt{gh}$ (1) no Siki wo atehamete yoi
Wake de aru noni, kore ga Zissai to awanai no wa
dôiu Wake de aru ka, kono Gen'in wa mada tasikani
wakaranai.

Umi no Soko de tuyoi Disin no okotta tokiniwa, Midu
no *Tatenami*, sunawati, Kûki no Baai no Oto-no-nami to
onaziyôna, Bôttyô-syûsyuku no Nami ga Midu no Zissitu
no naka wo tutawaru koto ga aru. Disin no Moto ni
tikai Umi no ue ni iru Hune wa, kono Nami wo ukete,
tyôdo Ansyô ni demo noriageta ka to omou yôna Gekidô
wo ukeru sô de aru.

§ 21. Sokonami. "Sinda Midu." Nami no Atozirusi.

Nami wa Ekitai to Kitai to no Sakai ni okoru nomi-
narazu, mata hutatuno tigatta Ekitai ga Sô wo nasite
kasanatte iru tokini, sono Sakai nimo okoru koto ga
dekiru. Konoyôna Nami wo *Sokonami* (*E.*, internal wave)
to tonaeru. Kore wo zikkensite miru niwa, Ryômen wo
Garasu de hatta Hako ni Midu to Abura to wo irete oite,

(1) $v = \sqrt{gh}$ no Siki wa, Hukasa no itiyôna tokini atehamarubeki
mono de aru. Mosi, Hukasa ga itiyô de nai Baai niwa, *A* no Basyo
kara *B* no Basyo made susumu ni yôsuru Zikan wa,

$$t = \sum_A^B \frac{\Delta S}{\sqrt{gh}}$$

de aru; tadasi ΔS wa *AB* no Miti wo takusanna Bubun ni waketa sono
hitotu-bitotuno Nagasa de aru. ΔS wo tiisaku sureba, sono aida dewa
Hukasa *h* wo itiyô to minasitemo yoi kara, $\frac{\Delta S}{\sqrt{gh}}$ wa ΔS dake susumu ni
yôsuru Zikan de aru. Kore wo *A* kara *B* made no aida ni tuite yose-
atumereba yoi no de aru.

kore ni Bô no yôna Monô wo sasikomi, tekitôna Syûki de nukisasi-sureba yoi. ^N Mottomo, kono Baai niwa, Haka no Kabe kara hansyasuru Nami no tameni, Teizyô-nami ga dekiru no wa motiron de aru.

Hutatuno Ekitai ga kasanatte ite, ueno Ekitai ga Kûki ni sessite iru tokiniwa, *hutatôrino* Baai ga aru. Daiitino Baai wa, Sokonami no Mine ni ataru Tokoro ga ueno Ekitai no Hyômen no Mine ni natte ori, Sokonami no Tani no ue niwa Hyômen no Tani ga aru, to iu Baai de, konotoki no Ekitai no Undô no Moyô wa hitotuno Ekitai nomi no Baai to onazi de ari; mata, Hukasa ga Nami no Nagasa ni kurabete ôkii tokubetuna Baai niwa, Sokudo mo mattaku onazi de aru.

Dainino Baai wa, kore to hantai de, Sokonami no Mine no ue ni Hyômen no Tani ga kuru Baai de aru. Kono Baai no Sokonami no Sokudo wa, Nami no Nagasa ga Hukasa ni kurabete ôkiku, mata uesitano **Hidyû** no Sa ga tiisai tokiniwa, tugino Siki de ataerareru:

$$v = \sqrt{\frac{\sigma_2 - \sigma_1}{\sigma_2} \frac{g}{\frac{1}{h} + \frac{1}{H}}};$$

tadasi,

σ_1 wa ueno Eki no Hidyû,

σ_2 ,, sitano ,, ,, ,, ; $\frac{\sigma_2 - \sigma_1}{\sigma_2}$ wa tiisai to suru.

h ,, ueno ,, ,, Hukasa,

H ,, sitano ,, ,, ,,

de aru. Mosi H ga h ni kurabete itizirusiku ôkii tokiniwa

$$v = \sqrt{\frac{\sigma_2 - \sigma_1}{\sigma_1}} \sqrt{gh}$$

to sitemo taisita Ayamari wa nai. Kono Siki de suguni wakaru tôri, Sokonami no Sokudo wa, ue-sitano Ekitai no Hidyû no Tigai ga sukunai hodo tiisaku naru.

Umi no naka niwa, ue de kangaeta yôna hakk

sita Sô wa motoyori nai ga, iroirono Baai ni, Ondo ya Enbun no tigau tameni, kanari itizirusiku Hidyû no tigatta Bubun ga, Sô no yôni natte kasanatte iru koto ga aru. Tatoeba, Kawa no Kuti ni tikai Umi ya, Kyoku ni tikai Tihô de Kôri no tokete iru Tokoro nado wa kotoni itizirusii. Konoyôna Tokoro dewa, mosi Midu no Nagare ga kawaru toka, aruiwa nanika hokano Gen'in de, kono Sô no Sakai no Men ga midasareru tokiniwa, Sokonami ga okoru Wake de aru.

Kono Baai niwa, maeno Siki ni aru $\frac{\sigma_2 - \sigma_1}{\sigma_1}$ ga tiisai kara, Sokudo wa hizyôni tiisai mono de nakereba naranai. Mosi, zissai konoyôna osoi Nami ga areba, arû kimatta Basyo de, Hyômen kara Soko made no Ondo ya Hidyû wo tokidoki hakatte mireba, Sô no Sakai ga agari-sagari-suru no ga wakarû Hazu de aru. Nansen wa, zissaini konoyôna Kwansoku wo sita Kekkwa kara konoyôna Sokonami wo mituketa. Sono Nami no Nagasa wa 80 km de, Takasa wa 60 m atta; Syûki wa 24 zikan hodo ni naru Kandyô de aru. Scotland no arû Kosui demo, konoyôna Sokonami ga itizirusii Teizyô-nami to natte arawareru koto ga wakatta. Triest no Wan demo dôyôna Gensyô wo kwansokusita Hito ga aru.

Sokonami no tameni, Ondo ya Enbun no tigatta Midu ga agari-sagari-suru node, kore ni tomonatte, tokubetuna Midu ni sumu Sakana made mo uki-sidumi-suru kara, kôre wa Gyogyôsyô ni tottewa kanari taisetuna Mondai de aru.

Sokonami to kwankeisita Koto de, Eigo de *dead water* (sinda Midu) to iu medurasii Gensyô ga aru. Nansen ga, Hokuhyôyô no Tanken no tokini kore wo kwansokusite, atode iroiro Zikken wo yatte, kore wo

tasikameta. Umi no Hyômen ni, wariaini asai, karo Midu no Sô ga aru tokini, sore no ue wo yuku Hune wa hizyôna Teikô wo ukeru. Itizikan 4-5 kairi guraino Sokuryoku no Hune dewa hotondo ugokenai hodoni naru. Kore wa tumari, Hune no Kikwan no Seiryoku ga, Sô no Sakai ni Sokonami wo okosu tameni tuiyasarete. Hune wo susumeru hô no Hataraki ga heru tame da to iu no de aru. Hokuhyôyô dewa, Kôri ga tokete, Hyômen ni Enbun no sukunai Sô ga dekiru node, konoyôna Baai ga ôi ga, mata Kawa no Kuti demo tokidoki *dead water* ni au koto ga aru.

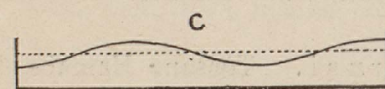
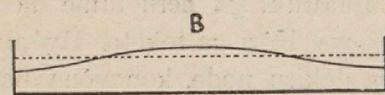
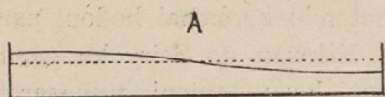
Nami no Atozirusi. Tôasano Hamabe de, Usio no hiita tokini, Suna ya Doro nado ga utukusii Nami no Katati wo site iru koto ga aru. Mata, Usio no hiite inai Tokoro demo, Namiutigiwa ni tikai Midu no Soko ni, Suna ga Namigata ni natte iru no wo miru koto ga aru. Kore wa *Nami no Atozirusi* (*E.*, ripple mark) to iu Mono de, omosiroi Gensyô de aru ga, sore no Dekikata nado ni tuitewa mada Giron ga itteisite inai. Nami no tameni Soko no Midu ga atira-kotira ni ugoku tokini, Soko no sukosino Takahiku no tameni, Udu ga okotte, Suna wo konoyôna Katati ni yose-atumeru no de arô. Kono *ripple mark* no Mine to Mine no aidano Nagasa wa, Midu no Hukasa ya, Suna no Tubu no Ookisa, mata Nami no Takasa nimo kwankeisuru.

§ 22. Miduumi no Seiches⁽¹⁾. Usio no
Hukusindô.

Hako ya Tarai ni Midu wo irete, kore wo ippôni katamukete oite, kyûni motono Iti ni kaesuto, sono Midu

(1) *Seisi* to yomu.

ga kimatta Syûki de atira-kotirani sindôsuru. Sonotoki, Suimen wa, ryôhono Hazi ga kawaru-gawaru agari-sagari-site, Mannaka wa tomatte iru (Du 23, A). Sikasi, man-



Du 23.

nakano Tokoro dewa. Midu no suiheino Hôkô no Sindô wa, hokano Tokoro ni kurabete itiban ôkii. Kosui no Midu mo, Kiatu no kyûna Henkwa nado no tameni konoyôna Sindô wo suru node, kore wo *Seiches* to nadukeru.

Seiches no Sindô no Syûki wa, Kosui ga

nagai Katati wo site iru tokiniwa,

$$T = \frac{2L}{\sqrt{gh}}$$

de ataerareru; tadasi, L wa Kosui no Nagasa, h wa heikin-no Hukasa de aru. Wagakuni no omona Kosui demo, Seiches no Kenkyû ga dekite iru ga, idureno Baai nimo, omona Sindô no Syûki wa, ueno Siki kara keisan-sita mono to yoku au. Mata, kono omona Sindô no hokani, Du 23 no B ya C no yôni, ikutamo Husi wo motta Sindô mo okoru koto ga aru. Husi no Kazu ga n nareba, Syûki wa

$$T = \frac{2L}{n\sqrt{gh}}$$

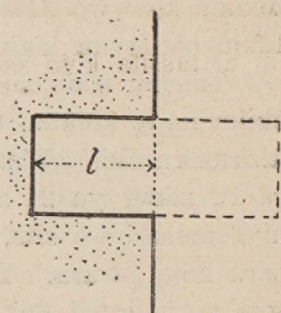
de aru. n ga 3 ka 4 gurai yori ôi Baai niwa, zissaiwa konoyôna kantanna Siki wa motii-gatai.

Seiches to onazyôna Sindô ga, Umi no Wan ya Irie nimo okoru. Usio no Mitihi no tameni Wan no Suimen

ga agari-sagari-suru hokani, nao Wan no Midu no moti-
maeno Sindô no tameni Suimen ga syûkitekini kawaru.
Kore wo *Usio no Hukusindô* to nadukeru. Seiches no
Baai to kuraberu niwa, Kosui wo hanbun ni tatikitte
sono Kirikuti wo Umi e tunaida mono wo sôzôsûreba
yoi (Du 24). Suhawati, Wan no
Kuti wa Sindô no Husi ni nari,
Wan no Oku ga Hara ni naru;
sorede, sono Sindô no Syûki wa

$$T = \frac{4l}{\sqrt{gh}};$$

l wa Wan no Nagasa, h wa hei-
kinno Hukasa de aru. Sita ni
iroirona Wan no Hukusindô no
Syûki no Rei wo ageru⁽¹⁾ :



Du 24.

Wan no Na.	Syûki (hun)	
	Kwansoku	Keisan
Otaru	14-16	17.3
Hakodate	45-57	45.3
	22-24	23.6
Aomori	295	284
Turuga	57-68	59.0
Ayukawa	7-9	8.9
Simoda	14-18	15.9
Nagasaki	34-38	37.5
	22-25	22.6

Konoyôni, zissaino Syûki wa mina Wan no Nagasa
to Hukasa kara kandyôsita Atai to oyoso ôte iru.

(1) Wan ni yottewa, Sindô no Sikata de Syûki ga iroironi naru.
Hakodate, Nagasaki nado wa sore no Rei de aru.

Mosi Umi kara yosete kuru Naganami no utini, Wan no koyûno Syûki to onazi no ga areba, Wan wa Tomonari wo site itizirusii Sindô wo okosu. Kono Hukusindô no Takasa wa, Basyo ni yottewa Usio no Takasa to hotondo onaziguraini naru. Nagasaki dewa zokuni kore wo *Abiki* to tonaeru; kore no Takasa wa 1.5 m ni tassita koto sae aru.

Tunami nado no tokiniwa tokubetuni Hukusindô ga ôkiku naru. Mata, Bôhû no Tyûsin ga tôru tokinimo itizirusiku ôkii. Wan no koyûno Hukusindô no Syûki ga 12 zikan ya 24 zikan hodo de aruto, Usio no Nami ni Tomonari wo site, Usio no Takasa ga hizyôni ôkiku naru koto ga aru. Yûmeina *F u n d y* no Wan nado wa sore no itizirusii *Rei* de aru.

Kaikyô wa hutatuno Wan wo senaka-awaseni tunaida yôna mono de aru node, kore no Midu mo dôyôni Hukusindô wo okosu koto ga aru. Yûmeina *K r a k a t o a* no Kwazan no bakuhatusita tokini, Sekai ni hirogatta Naganami no Syûki wa, Java to Sumatra no aidano Kaikyô ni syôzuru Hukusindô no Syûki to onazigurai de atta.

USIO NO MITIHI.

§ 23. Kentyôgi.

Umi no Hyômen ga, Usio no Mitihi, sunawati *Tyôseki* no tameni agari-sagari-suru Moyô wo siru tameni iroirono Dôgu wo tukau.

Itiban kantanna no wa, Kaigan ni Syakudo wo motta Hasira wo tatete oite, maizikan Suimen no Takasa wo yomu

no de aru. Konoyôna Tekazu wo habuki, mata kore yorimo issô kuwasiku siraberu niwa, *Ziki-kentyôgi* wo tukau. Kore wa Tokeizikake de ugoku Kami no ue ni, Suimen no Agari-sagari wo hikituduite kaki-sirusu mono de aru.

Hutûno Kentyôgi ni hutatôri aru. Hitotu wa, Uki wo Suimen ni ukabete, sore no Agari-sagari wo Kassya ya Haguruma de, Zissai no $\frac{1}{10}$ toka $\frac{1}{20}$ toka ni tiisaku site kakaseru mono de aru. *Kelvin-siki* ya *Seibt-Fuess-siki*, *Richard*⁽¹⁾ no *Uki-siki* nado wa kore de aru. Kono Syurui no Siki dewa, Hyômen-nami no tame ni Uki ga hagesiku undôsuru no wo husegu tameni, Kisi ni tikaku hotta Ido ni, Kuda de Umi no Midu wo mitibiki, kono Ido no naka ni Uki wo irete oku. Kuda ga amari tiisa-sugi matawa naga-sugiruto, Syûki no tiisai Hukusindô nado wa yoku arawarenai. Usio no Mitihidake wo arawasu niwa kaette kono hô ga yoi Koto mo aru ga, Hukusindô wo siraberu niwa Kuda ga tiisa-sugitewa ikenai.

Uki wo tukawanai hôno Siki wa, Midu no Soko ni ireta turigane-gatano Entô, aruiwa gomuno Hukuro nado no naka no Kûki ga Midu kara ukeru Aturyoku wo kakaseru Sikake de aru. *Honda-siki* dewa, kono Aturyoku wo, U-zi-gatano Kuda ni ireta Suigin de turiawase, Suimen no Agari-sagari ni turete, Suigin no Men ga agari-sagari-suru no wo, Uki to Pen to de kakaseru.

Konohoka, usui Kinzoku de dekita magatta Kuda ga Aturyoku no Henkwa ni turete nobi-magari-suru no wo riyôsita Siki mo aru. Mata, agari-sagari-suru Midu no Hasira no Denki-teikô no Henkwa wo riyôsita no moatta ga, kore wa umaku yukanai.

(1) *Risyâru* to yomu.

Goku Kikô no samui Tokoro dewa, Ido nado no Midu ga kôru no wo husegu Hituyô ga aru; kore niwa tûrei Sekiyû no Ranpu wo hitotu tomosite okeba yoi.

Kentyôgi wo suetukeru Basyo wo eramu koto wa taisetu de aru. Tyôseki no omona Bubun wo sirabe, matawa Heikin-kaimen nado wo motomeru Mokuteki naraba, amari Hukusindô no itizirusii Wan no Oku nado wa omosiroku nai. Mata, Kuti no goku tiisai, Oku no hiroi Wan dewa, Tyôseki no Takasa mo Zikoku mo, Wan no Soto towa itizirusiku tigau mono to omowaneba naranai.

§ 24. Tyôseki no Gensyô oyobi Takasa. Tyôkôritu.

Tyôseki (Usio no Mitihi) wa yahari Nami no issyu de aru ga, sore no omona Bubun wa, oyoso 24 zikan guraino Syûki no Nami to, oyoso 12 zikan guraino Syûki no Nami to no kasanatta mono de aru. Arû Tokoro dewa 24 zikan no Syûki wo motta Usio, sunawati *Itiniti-zio* ga hotondo nakattari, mata Basyo ni yottewa *Hanniti-zio* ga nakattari suru koto mo aru ga, ippanno Baai niwa korerano hutatu ga kasanatte kuru. Sorede, ippanni ittyûya no aidani, *Mantyô* ga nido, *Kantyô* ga nido aru. Sono hutatuno *Mantyô* no Takasa ya *Kantyô* no Hikusa wa ippanni onazi de nai; kono Koto wo *Usio no itinitino Hudô* to nadukeru. Itinitino Hudô wa, mata Kisetu ni yotte sizyû kawatte yuku mono de aru.

Taiinreki no Tuki no Hazime to Nakaba, sunawati Taiyô to Tuki to ga oyoso Tikyû to ittyokusenni naru tokiniwa, Tyôseki no Takasa ga ôkiku, kore wo *Oosio* (E., spring tides) to nadukeru. Zyôgen, Kagen no tokiniwa kore ni hansite Tyôseki wa tiisaku, kore wo *Kosio*

(*E.*, neap tides) to iu. Mata itinen no uti dewa, Syunbun to Syûbun no Toki ga Tyôseki no Takasa ga mottomo ôkiku, kore wo *Higanzio* (*E.*, equinoctial tide) to nadukeru.

Tyôseki no mottomo itizirusii Tokoro wa Fundywan no Oku de, Oosio no heikinno Takasa (Kantyô kara Mantyô made no Takasa) ga 15.4 m, Higanzio no Takasa ga 19.6 m mo aru. Igirisu no Bristol-suidô dewa Higanzio ga 16.3 m ni tassuru. Tyôsen no Zinsen atari demo 13.2 m ni naru koto ga aru. Korera wa mina Sekai de nadakai Usio no takai Tokoro de aru ga, ippanniwa 1 m ka 2 m guraino mono de aru. Tôkyô no Kinpen dewa, Sinagawa de 2.2 m, Tateyama de 1.9 m, Ogasawara-zima de 0.9 m to itta yôna mono de aru. Nipponkai no yôna Utiumi dewa Tyôseki wa hizyôni tiisai; tatoeba Turuga de 0.3 m, Niigata de 0.4 m gurai de aru.

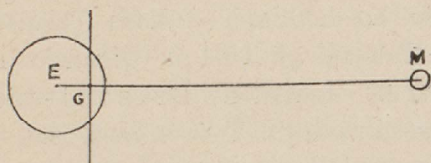
Tuki ga Sigosen wo tôte kara tugino Mantyô made no Zikan wa Basyo ni yotte itizirusiku tigau. Oosio no toki no kono Zikan wo nadukete *Tyôkôritu* (*E.*, establishment) to iu. Tatoeba, Nemuro no hen de 4 zi, Honsyû no Nakaba kara Sikoku e kakete 6 zi gurai, Seto-naikai no Uzina dewa 10 zi, Onomiti no hen de 11 zi 20-pun gurai, Nipponkai no Niigata de 3 zi to itta yôna Guai de aru.

§ 25. Usio wo okosu Tikara.

Tyôseki no ôkoru no wa, Tuki ya Taiyô ga Tikyû ni oyobosu Inryoku ga, Tikyû no ue no Basyo ni yotte itiyô de nai tame de aru. Tentai ga Tikyû no iroirono Bubun ni oyobosu zentaino Tikara no uti kara, kore ga Tikyû no Tyûsin ni oyobosu Tikara wo hikisatta Nokori wo nadukete *Usio wo okosu Tikara* to iu. Kono Tika-

ra ga Tikyûzyô ni donoyôni bunpusarete iru ka to iu Koto wo kangaete miyô.

Ima Mondai wo kantanni suru tameni, Tuki M to Tikyû E (Du 25)



to tada hutatu dake atta Baai wo kangaeru; sosite, hutatuno Tentai wa Zentai no Dyusin G no mawarini onazi Ka-

Du 25.

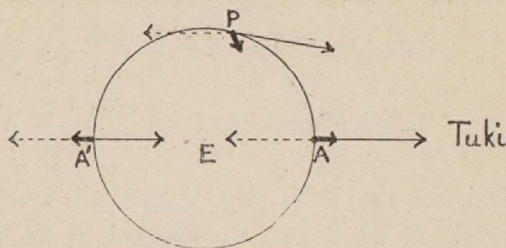
kusokudo de mawatte iru to suru.

Ima, sarani Kotogara wo kantanni suru tameni, Tikyû ga Ziten⁽¹⁾ wo sinai mono to kangaeru. Kuwasiku ieba, Tikyû no Tyûsin kara katteni hitotuno Hankei wo hiita to sureba, kono Hankei wa itu mademo Hôkô wo kaezu, *zibun ni heikôni* ugokû bakari da to kangaeru. Kôiu Dyôken de, Tuki to Tikyû to ga Zentai no Dyûsin G no mawari wo, itteino Kakusokudo w de mawatte iru Baai niwa, Tikyû no subeteno Bubun wa, *sorezore onazi Ookisa no En no ue wo, onazi Kakusokudo w de mawatte iru* koto wa akiraka de aru. Ima, konoyôna Arisama de Tuki to Tikyû ga otagaino aidano Kyori wo kaezuni mawatte iru tokiniwa, hutatuno Tentai no aidano Inryoku ga tyôdo sono Kwaiten no tameni okoru Ensinryoku to turiatte inakereba naranai. Hutatuno Tentai no tagaino Inryoku wa, tyôdo sorezoreno Tentai no Situryô ga sono Tyûsin ni atumatta Baai to onazi de aru kara, tumari Tikyû no Tyûsin no Tokoro ni okeru Tuki no Inryoku ga Ensinryoku ni turiatte iru Wake de aru.

Tikyû no subeteno Ten wa, maeni nobeta tôri, *onazi*

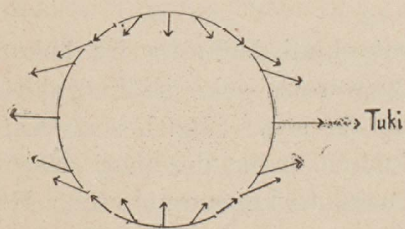
(1) Tikyû no Diku no mawarino Kwaiten.

Hankei no En no ue wo onazi Sokudo de mawatte iru kara, sono Ensinryoku (Du 26 no Tensen) wa doko demo onazi de, sore-soreno Ten ga egaku En no Tyûsin kara sotonô Hô ni muite iru ga, kore ni hansite Inryoku no hô (Du 26 no hosoi Sen) wa



Du 26.

Basyo ni yotte mina tigau; sunawati, Tuki ni mukatta Gawa no Ten A dewa, Tuki no Inryoku ga, Tyûsin E yorimo ôkiku, hantaino Gawa no A' dewa E yorimo tiisai. Sorede, A dewa Inryoku no hô ga Ensinryoku ni masari, A' dewa kore ni otoru. P no yôna Ten dewa Inryoku to Ensinryoku to ga tagaini katamuite iru ga, Tikara no Heikôhôtei wo tukureba hutatuno Tikara no Gôryoku (Du no hutoi Ya) ga wakaruru. Konoyôni site, Tikyûzyô no iroirono Ten ni okeru Gôryoku, sunawati Usio wo okosu Tikara wo motomeruto, oyoso Du 27 no yôna Arisama ni naru.



Du 27.

Ima mosi, ue ni kangaeta yôna Undô ni, Tikyû no Ziten wo kuwaeta naraba dô naru ka to into, sore no tame-ni Tikyû no Hyômen no Dyûryoku ga zentaini sukosi kawari, mata Ido ni yotte no Tigai mo aru ga, sore no tameni ueno Du no Moyô wa, Daitai ni oite, kawaranai koto wa akiraka de aru. Sukunakumo, Tikyû no ue de,

Keidô ni yotte no Tigai wa konotameniwa okoranai.

Usio wo okosu Tikara wo suiheino Hôkô to entyokuno Hôkô to ni wakete miruto, tugino yôni naru:

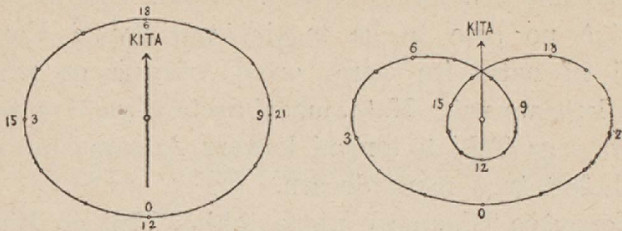
$$\text{Suihei-bunryoku, } H = \frac{3}{2} \frac{mR}{r^3} \sin 2z,$$

$$\text{Entyoku-bunryoku, } V = 2 \frac{mR}{r^3} \left(\frac{3}{2} \cos^2 z - \frac{1}{2} \right);$$

tadasi, m wa Tuki wo Tikyû ni kurabeta Situryô no Wariai, R wa Tikyû no Hankei, r wa Tuki to Tikyû no aidano Kyori, z wa Tuki no Tentyô-kaku (sunawati sono Toti no Maue kara Tuki no katamuite iru Kakudo) de aru. H wa, $z = \frac{\pi}{4}$ matawa $\frac{3\pi}{4}$ no tokini mottomo ôkiku, V wa $z = 0$ matawa π no tokini saidai de aru. V no saidaino Atai wa, Tikyû no heikinno Dyûryoku no $\frac{1}{8\,640\,000}$ guraina mono de aru kara, konniti mottomo seimituna Kikai demo koredakeno wadukana Dyûryoku no Henkwa wo mitukeru koto wa mudukasii. H mo tiisana mono de, Dyûryoku no $\frac{1}{11\,520\,000}$ gurai ni suginai. Sikasi, suiheino Hôkô niwa hokani hataraku Tikara ga nai kara, wadukana Tikara demo, sore no Eikyô ga arawareru koto ni naru no de aru.

Ima, Dyûryoku ga entyokuni hataraite iru hokani) suiheina Tikara H ga kuwawareba, soko no Entyokusen ga sukosi katamuku Wake de aru. Sikasi, sono Kata-muki wa kiwamete wadukana mono de, mosi Nagasa 11.52 km no Sinsi wo turusita to kangaeruto, sono Hazi ga wadukani 1 mm dake hureru no de aru. Konoyôna nagai Sinsi no kawarini, kore to onazi Hataraki wo suru Suihei-sinsi wo tukauto, zissai kono wadukana Entyokusen no Hure wo hakaru koto ga dekiru. Tuki no Hôkô, sunawati z ga kawaru ni turete, Entyokusen no Hazi

wa daitai Du 28 no yôna Kyokusen⁽¹⁾ no ue wo ugoite



Du 28.

Hokui 52° 23' no Tokoro ni okeru Henkwa. Hidari wa, Tuki ga Sekidô ni aru toki; migi wa, Tuki ga Sekidô kara 18° 26' Minami ni aru toki.

yuku koto ga zikkenzyô karamo tasikamerareta⁽²⁾.

Konoyôni Entyokusen no Hôkô ga syûkitekini kawaru koto no daiitino Kekkwa wa, Umi no Hyômen ga sore ni suityokuni narô to site ugoku koto de aru. Kai-men no agari-sagari-suru no wa sore kara okoru dainino Kekkwa ni suginai. Karini Ooumi wo takusanno Kuiki ni sikitte, Midu ga tagaini kayowanai yôni sureba, Tyôseki wa hotondo wakaranaku naru de arô.

Ue dewa, Tuki bakari no Eikyô wo nobeta ga, Taiyô ni tuitemo mattaku dôyôna Koto ga atehamaru. Taiyô no Baai wa, Situryô ga Tuki ni kurabete itizirusiku ôkii kawarini, Kyori ga tôi node, sore no Eikyô wa kekkyoku Tuki no yorimo sukunaku, 2.2 ni taisuru 1 no Wariai de aru. Mosi, Usio wo okosu Tikara ga $1/r^3$ ni hireisinakatta naraba, Tuki to Taiyô no Eikyô wa marude Teido no tigatta mono ni naru no de aru.

Zissaino Usio wo okosu Tikara wa, Tuki to Taiyô to

(1) Sûzi wa, Tuki ga Sigosen wo tôte kara tugini mata kore wo tôru made no Zikan wo 24 ni watta Zikoku, sunawati Tuki no Toki.

(2) Zissaiwa Tikyû zisin mo Usio wo okosu Tikara no tameni sukosi henkeisuru kara, sonotameni Kotogara ga nao hukuzatuni naru.

hutatuno mono no Eikyô ga kasanatta mono de aru kara, nakanaka hukuzatu de aru. Daiiti, Tuki no Syûki to Taiyô no sore to ga tagaini warikirenai Kazu no Wariai ni natte iru kara, onazi Arisama ga kurikaesareru koto wa nai. Mata, maeni ageta H ya V no nakani aru r ya z ga Toki to tomoni kawaru Arisama mo nakanaka hukuzatuna mono de aru.

Konoyôna Tikara wo uketa tokini, Umi no Midu ga donoyôni ugoku ka to iu no ga tugino Mondai de aru.

§ 26. Turiai-setu.

Newton wo hazime, Euler, Bernoulli nado wa, Umi no Midu ga, Tentai no Inryoku wo ukete, turiôte oru Baai no Katati ni natte oru to kangaeta; sunawati, Umi no Hyômen wa, itudemo sono Toki no Entyokusen ni taisite suityokuni naru mono to kangaeta. Kore ga sunawati *Turiai-setu* (*E.*, equilibrium theory) de aru. Konoyôna Umi no Hyômen wa, Tuki aruiwa Taiyô idureka hitotu dake aru to sureba, hitotuno Kwaiten-daentai ni naru Wake de, sore no Diku wa sono Tentai no Hôkô ni mukai, Tentai ni mukatta Hô to, hantaino Hô to ni itumo Mantyô wo okosu koto ni naru. Konoyôna Katei wo Moto ni site, Tyôseki no Takasa wo keisansite miruto, Tuki no tameni okoru mono ga wadukani 55 cm gurai ni naru. Iroirona Hosei wo kuwaete mitemo, konoyôni keisansita Tyôseki no Takasa wa, zissaino mono ni kurabete amari tiisa-sugiru. Nominarazu, zissaino Mantyô wa kanarazusimo Tuki ya Taiyô ni mukatta Tokoro ni okorazu, kaette Tentai ga Tiheisen no Hôkô ni aru tokini okoru Baai ga ôi kara, ueno Turiai-setu wa Zizitu ni tôi mono to iwanakereba naranai.

Hitotuki hodo no Syûki wo motta noroi Usio no Nami de saemo Turiai-setu no simesu tôrino Takasa niwa naranai koto ga wakatte iru.

§ 27. Undô-rikigakutekino Setu.

Laplace wa kore ni hansite Tyôseki no Mondai wo undô-rikigakutekini kangaeta. Madu Mondai wo kantanni suru tameni, Tikyû zentai itiyôna Hukasa no Umi de ôwarete iru to kangaeta. Sosite, Tyôseki no Nami to onaziyôna Nami ga, hoka kara Tikara wo ukezu, ziyûni Tikyû wo mawaru Baai wo kangaete miruto, sono ziyûna Nami ga Tikyû wo hitomawari-suru Zikan wa, Umi no Hukasa ni yotte iroiro tigau koto ga wakaru. Ima, kore to onaziyôna Nami wo okosu Tikara ga 12 zikan no Syûki de hataraku tokini, mosi ziyûna Nami no Syûki ga 12 zikan yorimo nagakereba, ippanno Sindô no Riron kara, Nami no Isô (phase) wa Tikara no Isô to hantaini naru Wake de aru. Mata, mosi Tikara no Syûki ga ziyûna Nami no Syûki to tyôdo onaziku nareba, Tikara wa tiisakutemo, Nami wa hizyôni takaku naru Wake de aru. Kôiu Kangae ni yoreba, Usio no Isô ga Tikara no Isô to hantaini naru koto ya, mata Usio no Takasa ga ôkisugiru koto nado mo husigi dewa nai. Sikasi, zissaino Umi no yôna hukisokuna Katati wo sita Mono ni, kono Kangae wo ôyôsuru koto wa nakanaka mudukasii.

Konohoka, Airy nado wa, Umi no iroirono Bubun wo, Tikyû no ue ni aru Mizo to minasite, Tyôseki no Moyô wo setumeisiyô to kokoromita. Tomokakumo, undô-rikigakutekini Tyôseki no Mondai wo kangaeru no wa mottomo ontô de aru ga, kore ni yotte Tyôseki no

Takasa wo kandyôsite, zissaino Takasa to hikakusuru yôna koto wa dekinai.

Ferrel ya Harris nado wa, ueno yôni, susunde yuku Nami bakari wo kangaetewa zissaino Tyôseki wo setumeisuru koto wa dekinai to iu node, Umi wo iroirona Bubun ni wakete kangae, sono iroirona Bubun ga tyôdo Kosui no Seiches no yôna Sindô wo suru mono to kangaeta. Konoyôna Teizyô-nami to, ippôni susunde yuku Nami to ga kasanatte iru mono to sureba, iroiro huku-zatuna Gensyô wo tugôyoku setumeisuru koto ga dekiru. Ooumi no naka ni aru Sima nado de, Sindô no Husi ni ataru Tokoro wa Tyôseki no Takasa ga tiisaku natte simau Wake de aru ga, zissaini konoyôna Tokoro ga ikutumo aru. Mata hutatuno tagaini suitiyokuna Hôkô ni Teizyô-nami ga atte, sono hutatuno Sindô no Isô ga Syûki no $\frac{1}{4}$ dake tigatte iru Baai niwa, Suimen wa tyôdo Kwaiten no otoroeta Koma no Men no yôna Undô wo suru; sunawati, Suimen wa katamuita mamade entiyokuna Diku no mawarini mawaru no de aru.

Zissaino Tyôseki no Baai nimo kore to niyotta Koto ga aru. Tatoeba, Utiumi no yôna Tokoro de, Engan ni okeru Mantyô no Zikoku wo sirabete miruto, Suimen no mottomo takai Tokoro ga, Utiumi no Mawari wo, 12 zikan no Syûki de, mawatte aruku yôna Baai ga tokorodokoro ni aru. Harris wa konoyôna Basyo wo nadukete *Amphidromic region* to itte iru.

Harris no Setu no Ketten wa, Umi wo kattena Bubun ni wakete kangaeta koto de aru; sonotôri wakenakereba naranai to kagitta Rikutu wa nai no de aru. Sikasi, tomokakumo, susunde yuku Nami nomi de Tyôseki wo setumeisiryô to suru no wa murina Koto de, dôsi-temo Teizyô-nami mo awasete kangaeneba naranai.

§ 28. Tyôwa-bunseki.

A. Riron.

Newton ya Laplace nado no yôni, Usio wo okosu Tikara kara, zissaino Tyôseki no Takasa ya Zikoku nado wo kandyôsuru koto wa, hukuzatuna Tikyû no Umi ni tuitewa totemo Mikomi ga nai. Sikasi, Zituyô no ue kara, iroirono Basyo ni okeru Usio no Takasa ya Zikoku wo arakazime siru to iu koto wa kiwamete taisetuna Koto de aru.

Lord Kelvin wa, kono Hituyô ni ôzuru tameni, *Tyôseki no Tyôwa-bunseki* (E., harmonic analysis of tides) to iu Hôhô wo kangaedasita. Usio wo okosu Tikara ga, Tuki ya Taiyô no Kyori to sono Tentyô-kaku to ni yoru koto wa maeni nobeta tôri de aru ga, kono Kyori to Kakudo to ga, Toki to tomoni kawaru Arisama wa nakanaka hukuzatu de aru. Kelvin wa konoyôni hukuzatuna (Tikyû ni taisite no) Undô wo suru Tuki to Taiyô no kawarini, karini 21 hodono, iroirona Syûki de, kisokutadasii Undô wo suru Tentai wo sôzôsita; sosite, kono takusanna sôzôtekino Tentai ga, dôzini Tikyû ni Usio wo okosu tokiniwa, sore no Kekkwa wa tyôdo zissaino Tuki to Taiyô to ga Tikara wo oyobosu no to dôyôni naru to iu koto wo simesita. Iikaereba, *zissaino Usio wo okosu Tikara wo, 21 tôrino Syûki wo motta kantanna Bubun ni wakeru koto ga dekiru* to iu no de aru.

Sorede, Umi no Midu niwa, 21 tôrino Tikara ni yotte okosareta Nami ga dôzini kasanatte arawareru Wake de aru ga, sorerano Nami no Takasa ya Isô nado wo rironzyô kara kandyôsuru koto wa mudukasii kara, kore wo zissaino Kwansoku no Kekkwa kara kimeru.

Korerano sôzôtekino Tentai no Undô wa mina kantan de itiyô de aru kara, arû kimatta Basyo ni tuitewa, sorezoreno Tentai ga okosu Usio no Takasa wa kimatte ite, sore no Isô wa itiyôni susunde yuku. Soreyue arû kimatta Basyo ni tuite itido kono takusanno Tentai no onôno ni sôtôsuru Usio no Takasa to Isô wo sadamete simaeba, sorekara notiwa itudemo kattena Toki no Usio no Takasa ya Zikoku wo keisansite siru koto ga dekiru no de aru.

Matomete ieba, *Tyôseki wo iroirono kantanna Bubun ni wakete, sorerano Bubun no Syûki wo rironzyô kara sadame, sore no Takasa to Isô to wo Kwansoku kara sadameru to iu no de aru.* Korerano 21 hodono Tentai kara okoru Usio no utide, omona mono wo agete miruto, tugino tôri de aru :

Namae ⁽¹⁾	Hugô	Syûki (zikan)
1. Tuki kara okoru Usio :		
a) Hannitino Usio (semidiurnal)		
Principal lunar tide	M_2	12.42
Major elliptic tide	N	12.66
b) Itinitino Usio (diurnal)		
Lunar tide	O	25.82
Luni-solar tide	K_1	23.93
2. Taiyô kara okoru Usio :		
a) Hannitino Usio (semidiurnal)		
Principal solar tide	S_2	12.00
b) Itinitino Usio (diurnal)		
Solar tide	P	24.07
Luni-solar tide (ue ni aru to onazi mono)	K_1	23.93

(1) Tokubetuna Usio no Namae wa Eigo de dasu.

Konohokani, Tuki kara okoru hitotukino Usio (monthly tide, *Mm*) ya, hantukino Usio (fortnightly tide, *Mf*) ya, mata Taiyô kara okoru hantosino Usio (semi-annual tide, *Ssa*) nado no yôna hizyôni nagai Syûki no mono mo aru ga, sorera no Takasa wa taitei goku wadukana mono de aru.

B. Keisan no Hôhô.

Sate, zissai Kentyôgi de eta hukuzatuna Usio no Kyokusen kara, kore wo kumitatete iru iroirono Bubun no Takasa ya Isô wo dôsite motomeru ka to iu koto wo kantanni noberu.

Iroirono Bubun no Syûki ga, mae kara wakatte iru kara Tugô ga yoi. Ima, arû kimatta Hyôzyun-ten kara, Zikan t ni okeru Suimen made no Takasa wo h to sureba, Syûki $\tau_1, \tau_2, \tau_3, \dots, \tau_n$ no Nami no tameni, h wa tugino Siki ni arawasu yôna Henkwa wo suru :

$$h = h_0 + A_1 \cos \left(2\pi \frac{t}{\tau_1} - \kappa_1 \right) + A_2 \cos \left(2\pi \frac{t}{\tau_2} - \kappa_2 \right) + \dots \\ \dots \dots \dots + A_n \cos \left(2\pi \frac{t}{\tau_n} - \kappa_n \right) \quad (1).$$

Tadasi, h_0, A, κ nado wa iduremo, sono Basyo ni kimatta Zyôsû de aru. h_0 wa Hyôzyun-ten kara Heikin-suimen made no Takasa de, Rikuti-sokuryô nado niwa hituyôna mono de aru. $A_1, A_2, \dots, \kappa_1, \kappa_2, \dots$ nado wa *Tyôseki no Tyôwa-zyôsû* (*E.*, harmonic constants of tides) to tonaeru mono de aru.

Madu, h_0 wo motomeru niwa dô sureba yoi ka? Kore niwa, nagai Tosituki no aida ni watatte, maizikan-

(¹) Kuwasiku zissaino Usio wo arawasu niwa, mada konohokani $\frac{1}{2}\tau_1, \frac{1}{3}\tau_1, \dots, \frac{1}{2}\tau_2, \frac{1}{3}\tau_2, \dots$ no yôna Syûki wo motta Nami wo kuwaeneba naranai.

no h wo hakari, sore no Heikin wo toreba yoi.

Ima, karini Taiyô no itiniti (24 zi) no Syûki wo motta Nami to, Tuki no itiniti (24 zi 50-pun 28.3 byô⁽¹⁾) no Nami to tada hutatu dake ga kasanatte kuru Baai wo kangaete miru; sosite, 365 niti to 9 zikan no aida, mai-zikanno h wo hakari, kore wo kuwaeta Wa wo Zikan no Kazu 8769 de watta Heikin h_m wo motomeru:

$$h_m = \frac{1}{8769} \Sigma h = h_0 + \frac{1}{8769} \sum_{k=1}^{8769} A_1 \cos \left(2\pi k \frac{1}{24.84} - \kappa_1 \right) + \frac{1}{8769} \sum_{k=1}^{8769} A_2 \cos \left(2\pi k \frac{1}{24} - \kappa_2 \right).$$

Tadasi, k wa 1 kara 8769 made no Seisû de aru.

365 niti to 9 zikan wa, Tuki no Hi de kazoete tyôdo 353 niti ni naru kara, koredakeno aidaniwa Tuki no Nami ga 353 aru. Koredakeno nagai aidani 8769 hodo-mo, onazi Aida wo oita Ten wo totte miruto, sorerano Ten ni ataru Tuki no Nami no Takasa niwa, + no mo areba - no mo ari, kore wo mina yosete kuwaeruto, sono Wa wa 0 ni natte simau.

Nao kuwasiku ieba,

$$\frac{1}{8769} \Sigma h = h_0 + \frac{1}{8769} \Sigma A_1 \cos \left(2\pi k \frac{1}{24.84} - \kappa_1 \right) + \frac{1}{8769} \Sigma A_2 \cos \left(2\pi k \frac{1}{24.0} - \kappa_2 \right)$$

no utide, Siki no Migigawa no hazimeno Σ wa 0 ni natte simau⁽²⁾. Tugini, Taiyô kara okoru Nami no Ta-

(1) Tuki ga Sigosen wo tôte kara tugini mata onazi Sigosen wo tôru made no heikinno Zikan.

(2) Ippanni $\sum_{k=1}^{k=n} \cos 2\pi k \frac{m}{n}$ matawa $\sum_{k=1}^{k=n} \sin 2\pi k \frac{m}{n}$ wa, m to n ga Seisû no Baai niwa, 0 to naru kara de aru. Kono Baai niwa $\frac{m}{n} = \frac{1}{24.84} = \frac{353}{8769}$ de aru.

kasa wo itizikan gotoni hakatta mono wo, itiniti no aida ni tuite kuwae-awaseruto, + to - to ga onazi dake aru kara, sono Wa wa tyôdô 0 ni naru. Sorede 365 niti to 9 zikan no Wa wo toreba hazimeno 365 niti no Wa wa 0 ni natte, nokoru no wa tada 9 zikan no Wa de aru. Kore wa 0 niwa naranai ga, sikasi kore wo 8769 de watte simaeba tiisana Kazu ni naru no wa akiraka de aru. Sorede, ueno Siki no nibanmeno Σ mo hotondo 0 ni tikaku naru kara, kekkyoku $\frac{1}{8769} \Sigma h$ ga hotondo h_0 ni hitosiku naru no de aru.

Zissaino Baai niwa iroirono Syûki no Usio ga takusan kasanatte iru kara, subeteno Nami wo kesite simatte h_0 wo motomeru niwa, sukunakutomo 18 nen hodono aida no Heikin wo toraneba naranai.

Tugini, A ya κ nado no Zyôsû wo motomeru Hôhō no Daitai wo setumeisiyô. Tatoeba, Tuki no Hanniti no Syûki wo motta Usio M_2 no Zyôsû wo motomeru. Madu Tuki no Hanniti, 12.42 zikan wo 24 ni watte, sono hitotuno Bubun wo "Tentai M_2 no Itizikan" to nadukeru. Ima, Kentyôgi no Kiroku ni tuite, kono Tentai M_2 no Itizikan gotoni, Suimen no Takasa $h-h_0$ wo hakaru. Sosite, M_2 no Zikan de kazoeta Dai 1 zi, Dai 2 zi, Dai 24 zi ni ataru $h-h_0$ no mainitino Atai wo betubetuni wakete, sozore yose-atumeru. Tatoeba, M_2 no Dai 1 zi ni okeru Atai wo nagai aida ni tuite yoseta to sureba, korerano Zikoku ni okeru hokano Tentai no Iti wa iroiro-samazama de atte, kore ni yotte okoru Usio no Takasa wa + mo areba - mo atte, nagai aida no Heikin wo toreba, korerano hokano Tentai no Eikyô wa kiete simatte, M_2 kara okoru $h-h_0$ no Atai nomi ga nokoru. Dôyôni site, M_2 no iroirono hokano Zikoku ni okeru Atai wo moto-

mete simaeba, M_2 no Sinpuku \bar{A} mo Isô κ mo wakaru no de aru⁽¹⁾.

Zissai niwa, iroirono Tentai no Syûki no $\frac{1}{24}$ no Zikan gotoni h wo hakaru to iu koto wa nakanaka mendô de aru kara, Taiyô-zi no itizikan-gotono h wo hakatta Hyô wo tukutte oite, sonouti kara motomeru Tentai no Dai 1 zi, Dai 2 zi, . . . ni mottomo tikai Zikoku no Atai wo totte kore ni kaeru. Kôsitemo, nagai aida no Heikin wo toru Baai niwa, taisita Ayamari wo syôzinai.

Konoyôni, Hyô no naka kara iroirona Tentai no Zikoku ni tikai h no Atai wo yori-idasu niwa, iroiro benrina Hôhô ga dekite iru. Tatoeba, tekîtôni takusanna Ana wo kirinuita Kami wo Hyô no ue ni nosete, sono Ana kara h no Kazu wo hiroi-dasu yôni sita no mo ari, mata tômeina Kami ni nanameni Sen wo hiita mono wo tukau koto mo aru.

C. Keisan no Kekkwa.

Iroirono Basyo ni tuite, Tyôseki no Tyôwa-zyôsû wo motomete miruto, itizirusii Tigai ga aru. Arû Tokoro dewa itinitino Usio ga hotondo nakattari, mata arû Basyo dewa hannitino Usio ga hizyôni tiisai. Itinitino Usio to hannitino Usio to, dotira ga katte iru ka to iu koto wo miru tameni, tûrei O no Takasa to K_1 no Takasa wo kuwaeta mono wo, M_2 to S_2 to kuwaeta mono to kura-beru. Tatoeba, Taiheiyô no Rei wo agege miruto, tugino Hyô ni simesu yôna mono de aru :

(1) Zissai niwa, M_2 no $\frac{1}{2}, \frac{1}{3}, \dots$ no Syûki wo motta Nami mo dôzini nokotte arawareru kara, mata kore wo bunkaisite sozoreno Keisû wo kimeru. Sikasi, korerano Usio wa ippanniwa tiisai mono de aru.

Basyo	$\frac{O + K_1}{M_2 + S_2}$
Wellington (New Zealand).....	0.11
Sidney	0.37
Nagasaki	0.35
Simoda	0.76
Yokohama.....	1.09
Maiduru.....	1.27
Unalga Bay (Aleutian Islands).....	2.40

Mata, κ no Atai mo, Basyo ni yotte iroiro tigatte iru.

Mottomo itizirusii Hannniti-zio S_2 to M_2 no Isô ni tuite, $0.04(\kappa_{S_2} - \kappa_{M_2})^{(1)}$ no Atai wo motome, kore wo *Usio no Yowai* to nadukeru. Kore wa tyôdo Mangetu ka Singetu no Toki kara, tugino Oosio made no Hikazu wo simesu mono de, kore mo Basyo ni yotte iroiro tigatta Zyôsû de aru. Tatoeba, Yokohama ga 1.3 niti, Simoda ga 1.0 niti, San Francisco ga 0.5 niti de aru. Basyo ni yottewa huno Atai ni naru koto mo aru.

Yohô. Ima, arû Basyo ni tuite, Tyôwa-zyôsû wo mina sadamete simaeba, sorezoreno Usio wo kandyôsi, sore wo kumi-awasete, kattena Toki no zissaino Usio wo arakazime siru koto ga dekiru; sunawati *Tyôseki no Yohô* (*E.*, tide prediction) ga dekiru. Iroirono Usio no Nami wo awaseru niwa, Keisan de suru koto mo ari, mata Kikai wo motiiru koto mo aru. Konoyôna Yohô ga doreguraino Teido made yoku ataru ka to iu Rei wo agete miruto, Igirisu no Portsmouth ni okeru Mantyô no Zikoku no Yohô to Zissai to no Tigai ga 5 hun wo koenai Baai ga

(1) κ wo Kakudo de arawasuto, Usio no Yowai wa Hikazu de ataerareru.

oyoso 50 % de, 16 hun kara 20-pun no Tigai no aru Baai wa 3.4 % guraino Wariai de aru. Mata, Mantyô no Takasa no Yohô no Ayamari wa, 6 inch yori sukunai Baai ga 57 %, 13-18 inch no Baai ga wadukani 7.5 % gurai de aru.

§ 29. Kisyô ni Kwankei no aru Usio. Sonotano Usio.

Tyôseki no Takasa wa, Kaze ya Kiatu no Henkwa no tameni kanari itizirusii Eikyô wo ukeru. Kisyôgaku-zyôno Gensyô niwa itiniti no Syûki wo motta mono ga ôi kara, sore no Eikyô wa, 24 zikan ya 12 zikan no Syûki wo motta Tyôseki ni kasanatte arawareru.

Mata, Tentai kara okoru Syûki to tigatta Syûki no Usio ga arawareru koto ga aru. Kore wa, hutatuno tigatta Nami ga kasanaru tokini dekiru mono de, tyôdo Onkyôgaku de iu *Kumiai-on* (*E.*, combination tone) to onazyôna mono de aru. Kore wa ippanniwa tiisana mono de aru ga, sore no Syûki ga Wan nado no Hokusindô no Syûki to onazi Baai niwa, kanari itizirusiku naru koto mo aru.

Ookina Kosui, tatoeba Amerika no Lake Superior de kwansokusita Kekkwa ni yoruto, kono Kosui no Suimen wa, § 25 ni nobeta Entyokusen no Henkwa ni ôzite, sore ni suityokuni naru yôni ugoite iru koto ga yoku wakarû. Mata Lake Michigan demo Tyôseki ga kwansoku-sareru ga, sono hannitino Usio no Takasa wa 4 sun guraino mono de aru.

Kaigan ni tikai Rikuti no Ido no Midu wa, Kiatu no Henkwa no tameni agari-sagari-suru nominarazu, mata sono Tihô no Tyôseki ni turete, henkwasuru. Tatoeba,

Tôkyô-Daigaku no naka ni aru hukai Ido dewa, 2 em gurai, mata Suruga no Yosiwara no Kaigan kara 3.3 km hanareta aru Ido dewa 10 em guraino Agari-sagari ga aru.

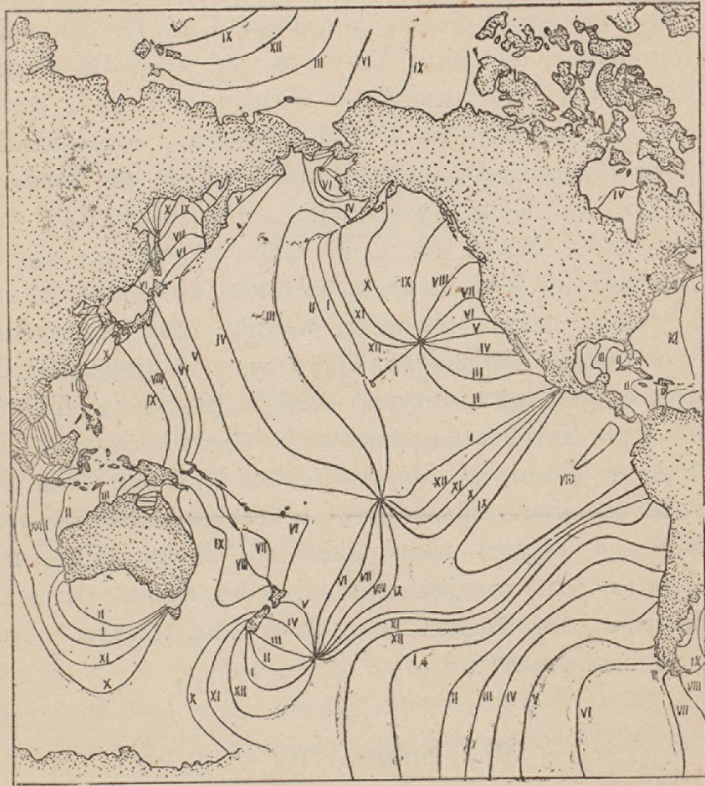
Usio wo okosu Tikara wa, tada Umi no Midu ni hataraku bakari de naku, Tikyû no subeteno Bubun ni hataraku. Tikyû wa kwanzenna Gôtai de nai kara, kono Tikara no tameni ikuraka Katati wo kaeru. Sonotameni, Tikyû no Hyômen de kwansokusareru Usio no Takasa wa, Tikyû ga Katati wo kaenai to sôzôsita Baai ni kurabete tiisai Wake de aru. Goku Syûki no nagai Usio ni tuitewa, maeni nobeta seisi-rikigakutekino Riron wo ôyôsitemo taisita Ayamari wa nai kara, konoyôna Usio no zissaino Takasa wo, Tikyû wo kwanzenna Gôtai to sôzôsita Baai no rironzyôno Atai to hikakusite, Tikyû no Gôsei no Keisû wo motomeru koto ga dekiru.

Usio no Nami no tameni ugoku Umi no Midu to Tikyû to no aidano Masatu wa wadukana mono de aru ga, kore ga hizyôni nagai aida hatarakeba Tikyû no Ziten no Sokudo wo itizirusiku herasu Wake de aru. Sorede, Itiniti no Nagasa wa sukosi dutu nagaku naru mono to kangaerareru.

§ 30. Siodoki no Du.

Tikyûzyô no iroirono Basyo ni okeru Mantyô no Zikoku wo Greenwich no Toki de arawasi, kono Zikoku no onazii Basyo wo Tidu no ue de musubi-awaseru yôna Sen wo hikeba, Usio no Nami ga susunde yuku Moyô ga hitomeni wakaru. Konoyôna Sen wo *Siodoki-sen* (*E.*, cotidal lines) to naduke, sore wo kaki-ireta Tidu wo *Siodoki no Du* (*E.*, cotidal charts) to iu. Oonmi no naka dewa Tyôseki wo kwansokusuru koto ga mudukasii kara

tada Engan no Kwansoku wo Dodai to site, Riron no Tasuke wo karite Sen wo hiku no de aru kara, ippanniwa



Du 29.

Taiheyô ni okeru Hanniti-zio no Siodoki-sen.

Sen no wakino Rôma-sûzi wa Mantyô no Zikoku wo Greenwich no Toki (Tuki no) de simesu. Sûzi wa itumo Mantyô no susunde yuku hôno Gawa ni kaite aru. Siodoki-sen no atamaru Ten wa *Amphidromic point* to itte, Sio no Takasa no 0 ni naru Tokoro, sore no mawari wa *amphidromic Region* de aru.

amari tasikana mono dewa nai. Tada, Rikuti ni tikai Bubun wa, Sinyô ga dekiru kara, Zituyô niwa naru.

Koremade iroirono Syomotu ni aru Siodoki no Du wa, Usio no Nami ga susunde yuku Nami bakari de aru to kangaete tukutta mono de aru ga, Harris wa, zibun no Setu ni motoduite, Teizyô-nami ga aru mono to kangaete, koremade towa tigatta Du wo tukutte iru (Du 29). Harris no Setu ni tuitewa Iron mo aru ga, kono Hito no Du wa Zissai to yoku atte iru Baai ga ôi.

§ 31. Tyôryû.

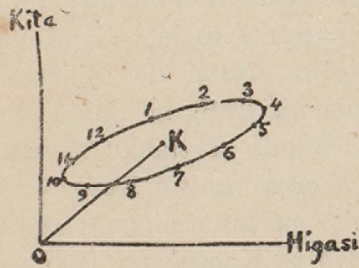
Tyôseki no tameni Midu ga suiheino Hôkô ni nagareru Gensyô wo *Tyôryû* (*E.*, tidal current) to iu. Nami ga Oumi wo susunde yuku tokiniwa, Nami no Mine no Tokoro no Midu wa maeni susumi, Tani no Midu wa sirizoite iru Wake de aru ga, Rikuti ni tikaku naruto, Moyô ga tigau. Oumi dewa, Mantyô aruiwa Kantyô no noti 3 zikan de, Nagare no Hôkô ga hantaini naru Hazu de aru ga, Kaigan dewa Mantyô to Kantyô no Toki ga tyôdo Tyôryû no Kawarime ni naru. Kaigan kara doredake hanareta Tokoro de, Oumi to onazini naru ka to iu koto ni tuitewa, amari tasikana Koto wa wakaranai ga, aru Kwansoku no Kekkwa dewa, waduka 3 majru no Oki de, sudeni konoyôni naru sô de aru.

Hiroi Umi no naka dewa Tyôryû no Sokudo⁽¹⁾ wa tiisana mono de aru ga, Kaigan no asai Tokoro ya, semai Tokoro dewa, itizirusiku naru kara, Hunanori wa tuneni kore ni Ki wo tuku. Baai ni yottewa, sore no Sokudo ga 1 zikan 11 kairi ni tassuru koto ga aru. Konoyôna Baai niwa tûrei ôkina Udumaki ga dekiru. Noruwê no Lofoten no Sima no Tikaku ni aru Udumaki wa Seka

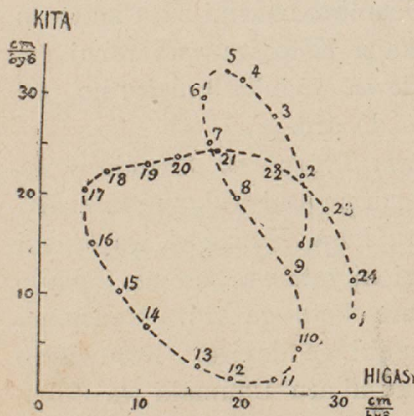
(1) Sokudo wo hakaru Hôhô wa § 33 ni aru.

ni nadakai. Wagakuni dewa Naruto no Udu ga yûmei de aru ga, sono Udu no, Me ni mieru Bubun no Tyokkei wa 7-8 ken guraino mono de aru.

Arû kimatta Basyo ni tuite, Tyôryû ga Toki to tomoni kawaru Arisama wo simesu tameni, tokubetuna Du wo motiiru koto ga aru. Du no uti no kimatta Ten wo Moto to site, iroirono Zikoku ni okeru Tyôryû no Hôkô to Sokudo to wo, kono Ten kara hiita Ya no Hôkô to Nagasa de arawasu; sosite korerano Ya no Hazi wo Zikoku no Zyun ni turaneta Sen wo hiku. Konoyôni site dekita Kyokusen no Katati kara iroirono



Du 30.



Du 31.

Koto ga wakaru. Tatoeba, kore ga Ya no Moto wo Tyûsin to sita Daen ni naru Baai niwa, onazi Syûki no Nami ga tigatta Hôkô ni kasanatte iru koto ga wakaru; mata, Du 30 no yôna Baai niwa, konoyôna Nami no hokani OK de arawasareru

yôna Nagare ga, itumo Tyôryû no hokani kasanatte iru koto ga wakaru. Zissaino Kwansoku ni yotte tukutta Du wa, tatoeba Du 31 no yôni, hukuzatuna mono de aru.

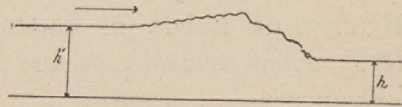
Kawa no Kuti nado dewa Tyôryû wa hukuzatuni naru. Hyômen no Midu to Soko no hô no Midu to ga hantaini na-

gareru yôna koto mo aru. Sosite, Kawaguti no Doro ya Suna wa Tyôryû no tameni hakobarete Asase ya Hukami wo tukuru.

Usio no Nami ga Kawa wo nobotte yuku tokiniwa, Nami no Katati ga dandanni kawaru. Usio no ageru Zikan wa, Zyôryû ni yuku hodo mizikaku naru. Amazon-gawa dewa 500 mile no Zyôryû made Tyôseki no Eikyô ga aru sô de aru.

§ 32. Sio-tunami.

Asai Irie ya Kawa nado ni Usio no Nami ga susunde yuku tokini, Nami no maeno hôno Katamuki ga kyûni nari, Du 32 no yôna Katati ni natte susunde yuku koto ga aru. Kore wo *Sio-tunami* (E., tidal bore) to nadukeru.



Du 32.

Sio-tunami no susunde kuru no wo Oka kara mite iruto, tyôdo

Midu no Dote ga susunde kuru yôni mieru sô de aru. Kono Nami no mae to usiro no Takasa no Tigai $h'-h$ ga 8 m kara 10 m ni naru koto ga aru node, Hune ni tottewa osorubeki Gensyô de aru.

Sio-tunami no Arisama no susumu Sokudo wa

$$v = \sqrt{\frac{1}{2} g(h+h') \frac{h'}{h}}$$

de aru.

Sina no Tien-Tang-Kiang (錢塘江) wa, itizirusii Sio-tunami no okoru koto ga aru no de nadakai. Sono-hoka Seine-gawa ya Amazon-gawa nado no Kawaguti nimo tokidoki Sio-tunami ga okoru; kotoni Ama-

zon-gawa dewa Kawaguti kara sûzyû-ri no Zyôryû made noboru koto ga aru⁽¹⁾.

KAIRYÛ.

§ 33. Kairyû.

Tyôseki no tameni okoru iwayuru Tyôryû dewa, Midu no Bubun wa kimatta Basyo wo atira-kotira ni ugoku bakari de atte, Midu ga tôku hedatatta Basyo ni nagarete yuku yôna koto wa nai. Konoyôna syûkitekina Oohuku-undô no hokani, Umi no Midu wa mata tyôdo Kawa no Nagare no yôni kimatta Hôkô ni hikituduite nagareru Baai ga aru. Konoyôna Nagare wa omoni Hyômen no Bubun ni kagirarete iru. Kore wo *Kairyû* (*E.*, current, matawa ocean current) to itte, Tyôryû to kubetusuru.

Kairyû no Kenkyû wa Ooumi wo kôkaisuru Hitobito

(¹) Bôhû no Toki ni okeru *Tunami* (Kaisyô) ni tuitewa, mada zyûbun tasikana Kenkyû ga dekite inai ga, watasi no Kangae dewa, kore wa Bôhû no tameni hukai Ooumi de okotta goku nagai Nami ga Kaigan ni tikaduku ni sitagatte Sio-tunami no yôna Katati ni naru mono de arô. Sono *Tunami* ni naru Nami wa, Baai ni yottewa Usio no Hukusindô no yôna Teizyônami de aru koto mo ari, mata Oki kara susunde kuru koto mo arô. Mata Bôhû no Tyûsin ga Kaigan ni tikaduku tokiwa, Kiatu no hikui tameni Suimen ga agari, kore ga tyôdo Mantyô to kasanaruto, Suimen wa itizirusiku takaku naru; sonoueni Sio-tunami no yôna mono ga kureba hizyôna *Tunami* ga okoru Wake da to omou.

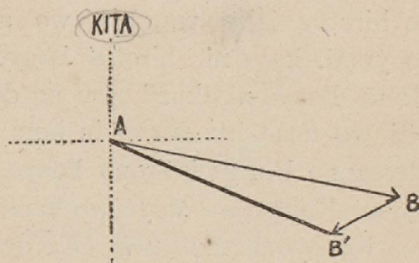
Doitu no Baltic-kai no Kaigan de, Tenki no yoi Hi ni okoru, *Seebâr* (zêbêa to yomu) to nadukeru mono mo *Tunami* no Issyu de, Kiatu no kyûna Kawari nado no tameni okotta Naganami ga, asai Kaigan ni tikaduku tokini okoru mono de aru.

ni hituyô dè aru nominarazu, Gyogyôsyâ nimo hizyôni taisetuna mono de aru.

§ 34. Kairyû wo hakaru Hôhô.
Kairyû no Hayasa nado.

Oumi wo kôkaisuru Hune dewa, Tentai no Kwansoku wo site, mainiti Syôgo ni okeru Hune no Iti wo sadameru. Mata ippô dewa Hune no totta Sinro to, Hune no Midu ni taisuru Sokudo to kara Hune no susunda Hôkô to Kyori to wo sadameru.

Ima Du 33 no *A* kara, *AB* no Hôkô ni Sinro wo sadamete susumi, tuginô Hi no Syôgo madeni, Midu ni taisite *AB* no Kyori dake susunda to suru. Mosi, Kairyû ga nakereba Hune wa zissai *B* no Ten ni kuru Wake de aru ga, mosi Kairyû



Du 33.

ga atte, sonotameni Umi no Midu ga, Hune wo ukabeta mamade, kono itiniti no aidani *BB'* no Hôkô ni *BB'* no Kyori dake nagareta to sureba, Hune no zissaino Iti wa *B* de nakute, *B'* ni naru Wake de aru. Sorede, Tentai no Kwansoku ni yotte *B'* no Iti wo sadamereba, sono ittyûya no aidani okeru heikinno Kairyû no Hôkô to Sokudo wo siru koto ga dekiru Wake de aru. Mottomo, Sinro to Sokudo kara *B* wo sadame, mata Tentai-kwansoku de *B'* wo kimeru to ittemo, sono Kwansoku wa dokomademo seimituna mono dewa nai kara, ôkuno

Baai ni 5-6 kairi no Ayamari ga aru mono to minake-reba naranai. Sorede, *BB'* no Kyori ga 5-6 kairi gurai to natta Baai niwa, zissai, Kairyû no tameni soretake nagasareta no ka, aruiwa Kwansoku no Ayamari no tameni soretakeno Sa ga okotta no ka, handansuru koto ga dekinai.

Kairyû wo hakaru tameni Bin wo nagasu koto mo aru. Garasuno Bin no naka ni iroirono Kuni no Kotoba de sirusita Kakituke wo irete, Kuti wo kataku hûziru; sosite, Bin no Sotogawa wo, Umi no ue de Me ni tuki-yasui yôni, akaku nuri, Iti no wakatta Basyo de nagekomu. Kore ga ikuka mo Umi ni tadayotte iru utini, aruiwa Hune ni, aruiwa Hamabe ni nagare-yoruto, sore wo hirotta Hito wa, Bin wo akete naka no Kakituke wo yomi, kore ni, hirotta Basyo ya Toki wo kakiirete, siteino Basyo ni okurikaesu no de aru. Bin ga donoyôna Miti wo tôte itta ka to iu koto wa wakaranai ga, sikasi takusanno Bin ga iroirono Basyo ni tukeba, ikuraka sonohen no Kairyû no Moyô wo handansuru koto ga dekiru⁽¹⁾.

Konoyôna *Huryûbin* (*E.*, drift bottles) wa itibun Midu kara ukidasite iru kara, Kaze no tameni huki-nagasarete, hontôno Kairyû no Hôkô ni nagarenai koto ga ôi. Sikasi, Bin no sita ni, kanari ôkina Kago ya, Zukku wo hatta Waku no yôna Mono wo turisagete nagaseba, Bin ni ataru Kaze no Tikara ni kurabete Kago ya Waku ni ataru Kairyû no Tikara no hô ga harukani ôkiku naru node, amari matigatta Kekwa wo eru Osore ga naku naru.

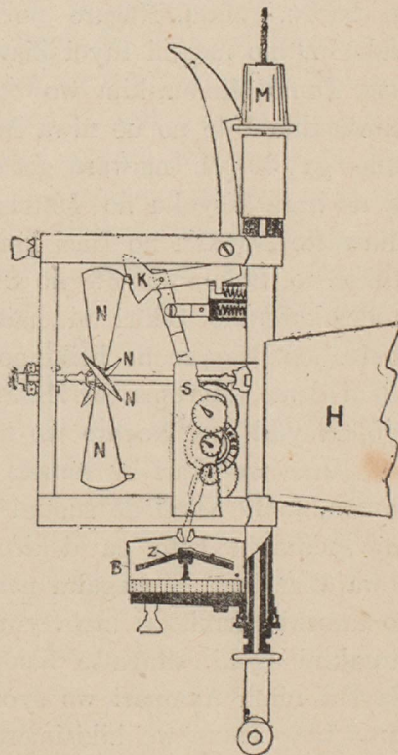
Huryûbin to onazyôna Wake de, sidumi-kakatta

(1) Igirisu dewa, Umi no Soko no Nagare wo miru tameni, Hyômen ni ukabazu, yatto Soko ni sidumu yôna Bin wo takusanni nagasi, kore ga hôbô no Ryôsi no Ami ni kakatte agatta Toki to Basyo to kara Soko no Nagare wo sadameta koto ga aru.

mamade nagarete iru Nanpasen wo mikaketa to iu iroirono Hune no Hôkoku wo atumete, Kairyû wo siraberu Zairyô ni suru koto mo aru. Nansen wa, yûmeina Fram (Hune no Na) no Ensei no tokini, Hune ga Kôri ni todi-komerareta mamade nagasareta Moyô kara, Hokuhyôyô no Kairyû wo sokuteisita. Konoyôna Baai nimo, Kaze no Eikyô ga kanari ôkii koto wo wasuretewa naranai.

Konoyôna Hôhô dewa, Hyômen no Nagare ga wakarubakari de aru. Iroirono Hukasa ni okeru Nagare no Sokudo wo hakaru niwa, tokubetuna Kikai ga hituyô de aru.

Ima mottomo hutûni motiirarete iru no wa, Du 34 ni simesu Ekman no *Ryûsokukei* (current meter) de aru⁽¹⁾. Kazami no Yabane no yôna mono *H* ga tuite ite, Kikai no ippôno Hazi ga tuneni Nagare wo syômenni ukeru yôni site aru. Kono, syômenni Nagare wo ukeru Tokoro ni Nedibane *N* ga atte, Nagare wo ukeru mawaru yôni natte iru. Hazime Umi ni



Du 34.

(1) Kore wa motiron Tyôryû wo hakaru tamenimo motiirareru.

turi-orosita tokiniwa, kono Kuruma wa Kakegane *K* ni hikkakatte iru ga, ue kara, Kikai wo turusita, Harigane ni sôte Omori (Messenger) *M* wo otosuto, kore ga Kikai ni ataru Hazumi ni, Kakegane *K* ga hadurete, Nedibane ga mawaridasu. Kuruma no mawaru Kazu wa Higuruma no Sikake *S* de wakaruru. Tekitôno Zikan no notini, dainino Messenger wo otosuto, sore ga Teko wo ugokasite, Nedibane wo tomeru kara, sono Zikan no aidani Nedibane no mawatta Kazu wo *S* no Hari de yomu koto ga dekuru. Mata, Nagare no Hôkô wo siru tameniwa, Hako *B* no nakani tuyoi Zisyaku *Z* ga Hari de sasaete atte, itumo Minami-kita wo muite iru. Kono Zisyaku no katakatano Ude no ue niwa Mizo ga tukete aru. Nedibane ga 30-pen mawaru gotoni, tiisana namarino Tama ga ue kara Zisyaku no Mannaka ni otite kite, Mizo wo tutawatte Zisyaku no Hazi kara Hako no Sôko ni otiru. Hako no Soko wa 36 no Sikiri ni wakarete iru node, atode korerano Sikiri ni haitte iru Tama no Kazu wo sirabereba, Nagare no heikinno Hôkô ga wakaruru. Kono Kikai demo, Kuruma no Masatu ga aru tameni, 3 mai-byô-em yori osoi Nagare wo hakaru koto wa mudukasii.

Hune wo Ikari de tomete oku koto no dekuru Baai naraba, kono Kikai de suguni hukai Tokoro no Nagare wo sadameru koto ga dekuru. Mottomo, hukai Tokoro dewa Ikariduna ga nagaku naru node, kore ga Nagare no tameni harikittari mata yurundari site, Hune ga taezu atosakini ugoki, sitagatte Kikai de hakatta Nagare no Hayasa nimo Ayamari wo syôzuru kara, Ikari wo iku-tumo irete Hune wo hikisimeru yôni sinakereba naranai. Mata, Hune wo tomete oku koto no dekinai Baai demo, ueno Hôhô de Hyômen to Soko to no Nagare no *Sa* wo siru koto ga dekuru.

Asai Basyo de, Nagare no daitaino Moyô wo siraberu niwa, Hune wo Ikari de tomete oite, tekitôna Uki wo nagasi, sore ga kimatta Kyori, tatoeba Hune no Nagasa dake nagareru Zikan wo hakareba yoi. Kono Baai nimo, Ikariduna ga hattari yurundari sitewa ikenai. Mata Uki ga Kaze ni hûkinagasareru yô demo ikenai.

Kurosio ya, Wanryû (Gulf Stream) nado no yôna atatakai Kairyû dewa, Hyômen no Ondo ga, Nagare no soto ni kurabete itizirusiku takai. Mata, tumetai Nagare demo Nagare no naka to soto to de Ondo ga yohodo tigau. Konoyôna Basyo de Umi no Hyômen no Tôonsen wo tukureba, Kairyû no aru Tokoro wa Tôonsen ga itizirusiku magari Wake de aru. Zissai, konoyôni site imamade sirarete inakatta Nagare wo mituketa Rei mo sukunaku nai. Mosi mata, iroirono Hukasa ni okeru Ondo no Bunpu wo kuwasiku sirabete mireba, Nagare no Hukasa mo wakarû. Sonoueni Enbun mo wakareba naosara tasikana Koto ga wakarû. Du 40 ni simesu Kairyû wa konoyôni site wakatta mono de aru. Kono Hôhô dewa tyokusetuni Kairyû no Hayasa wo siru koto wa dekinai ga, noti ni (p. 102) noberu Riron kara ôyosono Kentô wo tuku koto wa dekiru.

Mottomo hayai Kairyû no Hayasa wa oyoso doreguraino mono ka to iuto, Wanryû no utide mottomo hayai Florida-kairyû wa ittyûya ni 120 kairi, sunawati 2.58 maibyô-mêtoru gurai, Kurosio wa, mottomo hayai Tokoro de, ittyûya 160 kairi gurai de aru.

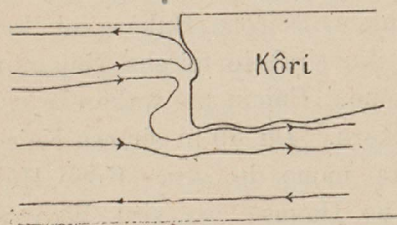
Ippanni, Nagare no Hayasa wa, Hyômen yorimo sukosi hukai Tokoro ga itiban ôkii. Kore wa, Kawa no Baai to onaziku, Kûki to Suimen to no Masatu no tame de aru.

§ 35. Kairyû no Gen'in to kore ni eikyôsuru Sayô.

A. Kairyû no dekiru Moto.

Kairyû wo okosu Gendôryoku wa iroiro aru.

(a) *Hidyû no Tigai kara okoru Baai.* Hokkyoku ni tikai Tokoro de, Kôri ga taezu tokete iru Basyo dewa, Kôri no toketa Midu wa, Ondo wa hikui ga, Enbun ga goku sukunai kara, itiban karukute Hyômen ni nagaredasu. Sore no sita niwa minamino Hô no atatakai Umi no, Enbun no ôi Midu ga kite iru. Itibanno Soko niwa, zutto kitano Hô de Kôri ga dekiru tokini, ato e nokotta, Enbun no ôi tumetai Midu ga kite iru node, Du 35 ni



Du 35.

simesu yôna Nagare ga okoru. Mata, Kôkkai (Red Sea) nado dewa, Zyôhatu no sakanna tameni Enbun ga goku nari, sitagatte Midu ga omoku naru kara, Umi no Soko ni sôte Indoyô

no Hôkô e nagare-dasi, sonokawarini Indoyô no Midu wa Hyômen wo nagare-komu. Ue to sita to no hantaino Nagare no Sakai wa, 100 m kara 180 m guraino Hukasa ni aru to iu koto de aru. Mata, Kôkkai (Black Sea) no Midu wa, Hyômen no Enbun ga Tityûkai no hanbun gurai sika nai node, Hyômen kara Marmora-kai e nagare-dasi, Soko dewa hantaini Enbun no koi Midu ga nagare-komu. Kono Hyômen no Nagare no Hukasa wa, wadukani 9 m kara 22 m gurai de aru.

(b) *Kiatu no Sa de okoru Baai.* Baltic-kai no Kiatu ga Sotoumi ni kurabete kyûni kawaru tokiniwa,

Suwêden to Denmaruku to no aidano Kaikyô ni Nagare ga okoru. Kono Nagare no Sokudo wa, oyoso Kiatu no Sa ni hireisuru koto ga wakatta.

(c) *Kaze no tameni okoru Baai.* Kairyû wo okosu itiban omona Gen'in wa Kaze de aru. Kaze ga huku tokiniwa, Hyômen no Midu wa, Kûki to no Masatu no tameni dandan Undô-no-seiryoku wo ete, kore wo sita-no Midu ni tutaeru. Kaze ga itteino Tuyosa de huki-tudukuto, kanari hukai Tokoro made Undô ga okotte, Miduga ippôni nagareru.

Umi no Katagawa ga Rikuti de kagirarete iru yôna Tokoro de, Kaze no tameni Kaigan ni nagare-yoru Midu wa, Soko wo hantaini nagarete, Suimen no Heikin wo tamotte iru. Mata, Kaze ga Kaigan ni tikai Midu wo huki-nokeru Baai niwa, Soko no Midu wa hantaini Rikuti no Hô ni nagarete kore wo oginau. Kono notino Baai niwa, Soko no tumetai Midu ga agatte kuru node, Kaigan no Hyômen no Midu ga tumetaku naru. Ippanni, Hyômen no Nagare no Kekkwa tosite, kansetuni okoru hantaino Nagare wo, Eigo de *compensation current* (umeawaseno Nagare) to nadukeru.

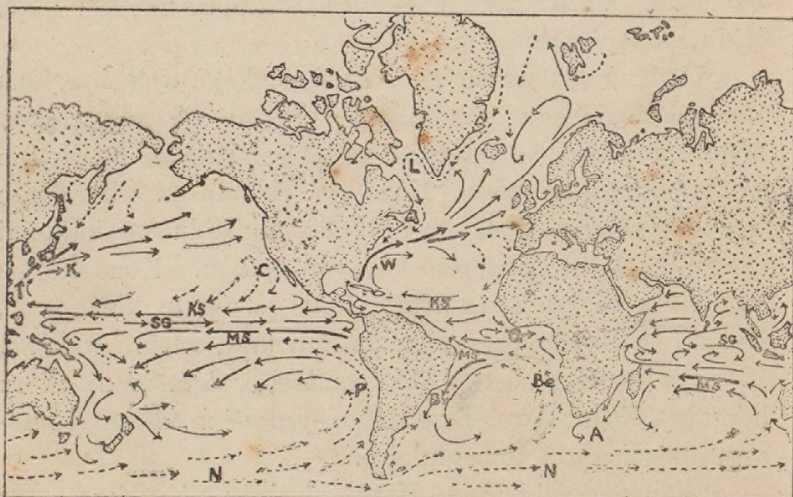
Wan nado de, iroiro Hidyû no tigau Sô ga kasanatte iru Baai ni, tuyoi Kaze ga hukeba, Du 36 (Danmen-du) no yôna Nagare ga okoru. Sosite ue-nohôno Sô no aidano Sakai no Men wa Kazasimo ni mukatte kata-muki, Baai ni yot-



Du 36.

tewa, Hyômen ni atta usui Sô ga Kazasimo no Kaigan ni huki-yoserarete, kûsabigatani natte, ueno Du no yôna Undô wo site iru. Hyômen no Nagare wa, Ryôhô kara S no Tokoro ni mukatte iru kara, Gomi ya Akuta ga S ni atumatte, Kaigan ni heikôsita Sen wo tukuru. Kono-yôna Baai ni, konô Akuta no Sen no Ryôgawa dewa, Hidyû ya Ondo ga itizirusiku tiganu koto ga ôi.

Kore: a wa mina tiisai Kuiki no Nagare de aru ga,



Du 37.

Kita-hankyû no Huyu ni okeru Kairyû (Schott ni yoru). Kuroi Ya wa atatakai Kairyû sunawati *Danryû*, Tensen no Ya wa wariaini tumetai Kairyû sunawati *Kanryû* wo simesu.

KS, Kitano Sekidô-kairyû.

MS, Minamino Sekidô-kairyû.

SG, Sekidô-gyakuryû.

K, Kurosio.

W, Wanryû.

C, California-kairyû.

N, Nanpyôyô no Nisikaze-kairyû.

A, Agulhas-kairyû.

Be, Benguela-kairyû.

Br, Buraziru-kairyû.

G, Guinea-kairyû.

L, Labrador-kairyû.

P, Peru-kairyû.

Ooumi no Hyômen ni aru ôkina Nagare mo omoni Kaze no tameni okoru mono to kangaerareru., Sekidô no Ryôgawa wo nendyû hotondo Yasumi nasini huite iru Bô-ekihû no tameni, Sekidô no Ryôgawa no Umi no Midu wa nisino Hô ni nagareru, kore wo *Sekidô-kairyû* (E., equatorial current) to nadukeru. Kono Nagare ga Tairiku ni yuki-ataruto, itibun wa Sekidô no Kinpen no Muhûtai⁽¹⁾ ni sôte gyakuni nagare, iwayuru *Sekidô-gyakuryu* to naru ga, omona Bubun wa Tairiku ni sôte Ido no takai Hô ni mukau. Wanryû ya Kurosio wa kore no Rei de aru. Mata, Ooumi no higasino Hazi dewa, Sekidô-kairyû wo oginau tameni, Ido no Takai Hô kara Sekidô ni mukatte Nagare ga okoru; California-kairyû wa sore no Rei de aru. Bôekihû nominarazu, Nanpyôyô no yôni, nendyû tuyoi Nisikaze ga huite iru Tokoro dewa kore ni tomonau Nagare ga aru.

B. Hokano Sayô.

(a) *Tikyû no Ziten*. Mosi Tikyû ga Ziten wo sinai mono de areba, iroirono Gen'in kara okoru Kairyû wa sore wo okosu Tikara no Hôkô ni nagareru Wake de aru. Sikasi, mawatte iru Tikyû no ue dewa, subeteno ugoku Mono no, Tikyû ni taisuru Undô no Moyô wa, (Ziten ga nai to site, sonokawarini) Undô no Hôkô to suityokuni arû Tikara wo uketa toki to onazini naru. Sono Tikara wa Undô no Sokudo ni hireisi, mata sono Basyo no Ido ni yotte tigau; Siki de arawaseba,

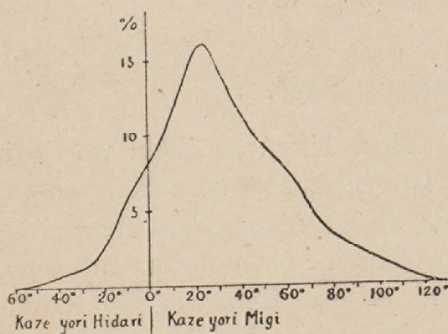
$$2w \sin \varphi$$

de aru; tadasi, w wa Tikyû no Ziten no Kakusokudo,

(1) Kaze no nai Kuiki.

v wa Tikyû no ue de mita Undô no Sokudo, φ wa Ido de aru. Kono Tikara no Hôkô wa, Kita-hankyû dewa Undô no Hôkô ni mukatte *migini*, Minami-hankyû dewa *hidarini* mukatte iru. Ueno Siki de wakaru tôri, kono Tikara wa Sekidô ($\varphi=0$) dewa 0 de, Ido no takaku naru hodo ôkiku naru.

Kaze ga Kairyû wo okosu Baai demo, mosi Tikyû no Ziten no Eikyô ga nakereba, Rikuti no Samatage no nai hiroi Umi no Hyômen no Nagare wa, Kaze to onazi Muki ni nagareru Wake de aru ga, zissaiwa kono Eikyô no tameni yokoni hureru Wake de aru. Ookuno Baai niwa, Rikuti ya, hokano Nagare no Eikyô ga issyoni kuwawaru tameni hukuzatuni naru ga, Kwansoku no Kekkwa ni yoruto, yahari Kita-hankyû dewa Nagare-ga Kaze yori *migini* mukau Baai ga ôi. Du 38 wa Baltic-



Du 38.

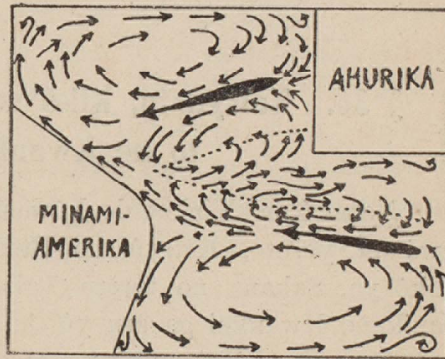
kai no Adlergrund to iu Tokoro no Tôdai-bune de kwansokusita Kekkwa de aru. Yokono Diku no Hô ni Kaze to Nagare to no aidano Kakudo wo tori, tateno Diku niwa, sorezoreno Kakudo ni sôtôsuru Kwansoku no Kwaisû wo, Kwansoku no zentaino Kazu ni kurabeta Wariai wo totta mono de aru. Kono Du de mitemo, hidarini hureru Baai wa sukunaku, *migini* 25° gurai hureru Baai ga mottomo ôi koto ga wakaru. Indoyô (Minami-hankyû) de kwansokusita Kekkwa ni yoruto, heikin 45.5° gurai hidarini hureru to iu koto de aru.

kai no Adlergrund to iu Tokoro no Tôdai-bune de kwansokusita Kekkwa de aru. Yokono Diku no Hô ni Kaze to Nagare to no aidano Kakudo wo tori, tateno Diku niwa, sorezoreno Kakudo ni sôtôsuru Kwansoku no Kwaisû wo, Kwansoku

(b) *Rikuti no Eikyô*. Ooumi wa Rikuti no tameni kagirarete iru kara, iroirono Gen'in kara okoru Nagare wa kore no tameni magerareru.

Kaze ya Rikuti no Eikyô wo setumeisuru tameni tugino yôna Zikken wo sita Hito ga aru. Oke ni Midu wo irete, kore ni Rikuti ni sôtôsuru Katati no Mono wo ire, Midu no Hyômen niwa karei Kona, tatoeba Nokokudu no yôna Mono wo ukasite oku; sosite, semai Kuda no Hazi kara hukidasu Kûki no Nagare wo nanameni Sui-men ni hukitukeru. Suruto, kono Kaze no tameni okoru Nagare no Moyô wa Kona no ugoku Moyô de yoku

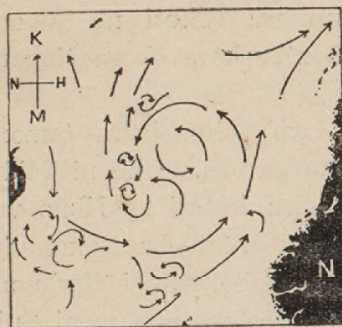
wakaru. Du 39 wa, Taiseiyô no, Sekidô ni tikai Bubun ni okeru Nagare no Arisama wo miseta mono de aru. Kuroku hutoi Ya wa hukitukeru Kaze wo simesi, tiisai Ya wa Nagare wo simesu.



Du 39.

Kuroi Ya wa zissai-no Baai no Bôekihû ni sôtôsuru mono de, konotameni okoru Sekidô-kairyû ya Sekidô-gyakuryû no Moyô ga ikuraka wakaru.

(c) *Sonohokano Koto*. Arihureta Tidu ya Kaidu ni tûrei arawarete iru Kairyû wa, tyôdo Kawa no Nagare no yôni Midu ga kisokutadasii Miti ni sôte nagarete yuku rasiku kaite aru ga, zissaino Kairyû wa sonoyôna Seisitu no mono dewa nai. Tikagoro Noruwê no Kinzyo de kuwasiku Umi no Ondo ya Hidyû no Bunpu wo hakatte kenkyûsita Kekkwa ni yoruto, Kairyû niwa



Du 40.

Du 40⁽¹⁾ ni simesu yôna, yuruyakana Udu no yôna Undô ga takusan tomonatte iru.

Kairyû no Hayasa ya Hôkô wa Kisetu ni yotte iroiro kawaru mono de aru. Kikôhû no itizirusii Tokoro dewa, kotoni sore no Eikyô ga ôkii. Kurosio nado mo, sonotameni Natu to Huyu to

de Nagare no Iti ya Hayasa ga kanarini tigau.

§ 36. Kairyû to, Kikô sonohokano Koto to no Kwankei.

Noruwê no Kinkai de kuwasii Sirabe wo sita Kekwa ni yoruto, Kairyû no Henkwa to kono Kuni no Kikô ya, Sakana no toreru Taka nado to no aidaniwa nanikano Kwankei ga aru yô de aru.

Noruwê no Kaigan no Sognefjord⁽²⁾ to Lofoten to kara, hobo Kaigan ni suityokuna Sen wo nihon hiite, kono Sen wo hukumu yôna Umi no Setudanmen wo hutatu tukuri, sono Setudanmen no iroirono Ten no Ondo wo zissaini hakatte mite, kono Danmen no Tôonsen wo hiku koto ga dekita. Nao konohokani, zutto kitano Hô no Barent-kai nimo dôyôna Danmen wo tukutta. Sosite, korerano mittuno Danmen no mainenno Heikinondo wo totte miruto, itiban minamino Sognefjord

(1) Noruwê N to Iceland I to no aidano Kairyû wo simesu.

(2) Sogune-fyôru to yomu.

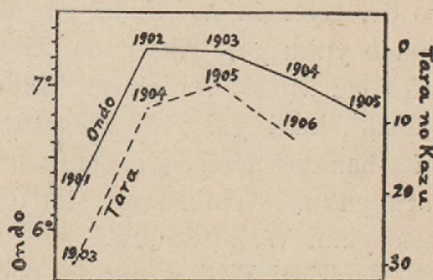
to onazyôna Arisama ga, Lofoten dewa itinen ato de araware, Barent-kai dewa Lofoten yori mata itinen okurete iru yôna Arisama de aru. Tyôdo minami kara kuru atatakai Midu no Netu ga, wadukana Sokudo de dandan Kita e okurarete yuku yôna Moyô de aru.

Ima Sognefjord no Danmen no heikinno Ondo wo keisansite, kore ga tosi-dosini tigau Moyô wo Noruwê no *Heikin-kion* no Henkwa to kurabete miruto, kono hutatu no kawaru Moyô ga yoku nite iru.

Mata, mainen 5 gwatu ni okeru Sognefjord no Danmen no Heikin-ondo⁽¹⁾ wo sirabe, mata ippô dewa Noruwê no Oki de Torôru-ami ni toreta 2-3-saino *Tara no Kazu* wo, itizikan no Heikin ni naosi, kore ga Tosi ni yotte kawaru Arisama wo sirabete miruto, omosiroi Koto ga aru. Sunawati, Sognefjord no Ondo no takakatta Tosi kara 2-nenme no Tara no Toredaka wa sukunaku, hantaini Ondo no hikukatta Tosi kara 2-nenme niwa Tara no Toredaka ga ôkatta (Du 41). Mosi itu demo

konoyôna Kwankei ga aru mono to sureba, Gyogyôsyâ ni tottewa hizyôni tai-setuna Koto de aru ga, wadukani sûnen no aida no Kekwa de aru kara, tasikana Koto wa mada wakaranai.

Sikasi, konoyôna Sirabe wo tudukete iru utiniwa, dandan yûekina omosiroi Zizitu ga wakatte kuru de arô.



Du 41.

⁽¹⁾ Taiseiyô kara kitano Hô ni nagare-komu Midu no Bubun ni tuite no Heikin.

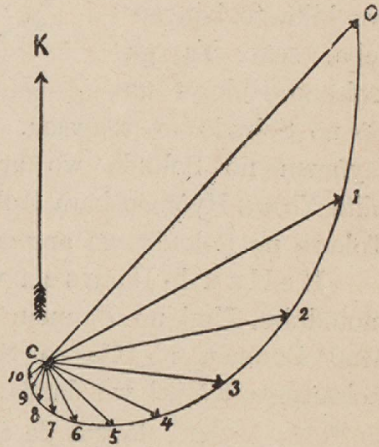
§ 37. Kairyû no Riron.

W. Ekman to iu Hito wa tugino yôna Riron wo dasita⁽¹⁾. Madu Umi ga kagirinaku hiroi to kangae, mata Umi ga hizyôni hukai to suru. Hyômen no Midu ga madu Kaze no tameni ugoki-hazimeruto, kono Midu no Sô wa Kaze no Masatu no hokani hutatuno Tikara wo ukeru. Hitotu wa Tikyû no Ziten no tameni okoru mono de, kore wa Undô no Hôkô to suityokuni, Kita-hankyû nareba migini, Minami-hankyû nareba hidarini hataraku. Mô hitotuno Tikara wa, Hyômen no Midu ga sitano Midu ni taisite ugoku tameni, sono Sakai no Tokoro de, Undô to hantaino Muki ni hataraku Masatu no Tikara de aru. Kore to onazi Tikara ga mata kono sitano Sô ni hataraitte, kore wo Hyômen no Sô to onazi Hôkô ni ugokasi-hazimeru. Sitano Sô mo, dôyôni Tikyû no Ziten no tameni yokoni hure, mata sarani sonositano Sô kara Masatu no Tikara wo ukeru. Konoyôna Zyunzyo de, Hyômen no Undô ga dandan Soko no Hô ni oyonde yuku ga, Tikyû no Ziten no tameni Undô no Hôkô ga, Undô wo okosu Tikara kara yokoni hureru tameni, sitani yuku ni sitagatte, Nagare no Hôkô wa, (Kita-hankyû nareba) masumasu migi e migi e to mawatte yuku. Nominarazu, sita e yuku hodo Hayasa mo hette yuku Wake de aru.

Kagirinai Umi no ue de, onazi Tuyosa no Kaze ga nagai aida hukituduita notiniwa, Undô no Moyô ga ki-

(1) Kono Riron niwa iroiro hukwanzenna Ten ga aru koto ga wakatte kite, tikagoro dewa Riron to site no Neuti wa sukunaku natta. Sore nimo kakawarazu, koko de, tokubetuni, kono Setu wo noberu no wa, Tikyû no Ziten no tameni Kairyû ga eikyôsareru daitaino Arisama wo simesu mono to site, tasyôno Neuti ga aru kara de aru.

matte simau; sunawati, onônono Sô ga, ueno Sô to sitano Sô to kara ukeru Masatu no Tikara to, Tikyû no Ziten kara okoru Tikara to ga tyôdo turiau yôna Sokudo ni natte simau. Ekman wa, arû Katei wo site, konoyôna Baai ni okeru iroirona Sô no Nagare no Sokudo wo keisansita. Du 42 wa sore no Kekkwa de aru; K wa Kaze no Hôkô, C Ten kara hiita Ya 0, 1, 2, 3, nado wa, arû Tan'i de hakatta Hukasa 0, 1, 2, . . . no Sô ni okeru Sokudo wo arawasu. Ya 0 wa Hyômen no Sokudo de aru. Arû Hukasa dewa, Nagare no Hôkô wa Kaze no Hôkô to suityokuni nari, motto hukaku naruto, Kaze to hantaino Muki ni nagareru Tokoro mo aru ga, sonoyôna hukai Tokoro dewa Nagare

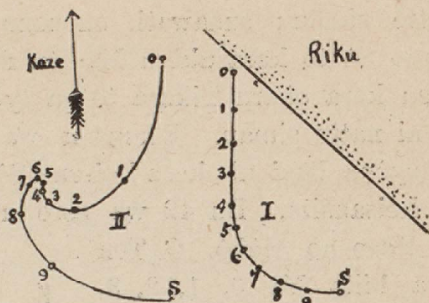


Du 42.

no Hayasa wa mô itizirusiku hette iru. Kore wa Umi ga hizyôni hukai Baai no koto de aru ga, asai Umi dewa, Soko no Nagare no Hôkô to Hyômen no Hôkô to no Tigai ga sukunaku naru.

Ekman wa mata, Umi no Hyômen ga arû Gen'in no tameni katamuita Baai ni okoru Nagare ni tuitemo dôyôna Keisan wo sita. Mata, Umi ga Rikuti ni sessite iru Tokoro dewa, Kaze ga Midu wo Kaigan ni huki-yose, matawa Kaigan kara huki-nokeru tameni Hyômen ga katamukô to suru kara, sitano Hô de hantaino Nagare ga okoru. Kono Baai ni kwansuru Ekman no Riron no Kekkwa wa, Du 43 ni simesu yôna mono de aru.

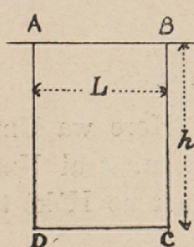
I wa Umi no asai Baai, *II* wa hukai Baai ni ataru. *S* Ten kara Kyokusen no 0, 1, 2, 3, . . . nado no Ten ni Ya wo hiita to kangae-reba, sono Ya ga iroirono Hukasa no



Du 43.

*S*ô no Sokudo wo arawasu. *S* kara 0 e hiita Ya wa Hyômen no Sokudo wo arawasi, *S* kara 1, 2, 3, . . . e hiita Ya wa Hyômen kara Hukasa no $\frac{1}{10}$, $\frac{2}{10}$, $\frac{3}{10}$, . . . no Tokoro no Sokudo wo arawasite iru.

Helland-Hansen wa Bjerknæs no Riron ni motoduite, Umi no Danmen no Ondo ya Enbun kara, sono Danmen no Ue to Sita no Nagare no Tigai wo keisansuru Kôsiki wo dasita. Du no *A* to *B* to hutatuno



Du 44.

Basyo de Ondo oyobi Enbun no uesita-no Bunpu wo hakareba, sore kara *AB* ni suityokuna Suihei-nagare no Bunsokudo v_0 to *CD* ni suityokuna Bunsokudo v_1 to no Sa wo siru koto ga dekiru. Sono Siki wa

$$v_0 - v_1 = \frac{A - R}{2w \sin \varphi L \cdot 10^5} \text{ cm/byô,}$$

tadasi, *L* wa *AB* no Kyori wo Kiromêtoru de arawasi, φ wa sono Basyo no heikinno Ido, *w* wa Tikyû-ziten no Kakusokudo de aru. Mata *AD* no Hukasa wo *h* mêturu to si, *AD* no aida no heikinno Hiyôryô (sono Basyo deno Hidyû no Gyakusû) wo V_a (Syôsûten ika 5-banmeno Keta wo Tan'i to suru), *BC* no wo V_b to sureba, *A* wa $h(V_a - V_b)$ de oyoso ataerareru. *R* wa Midu no Masatu ni

kwansuru mono de, kore wo keisansuru koto wa mudu-
kashii ga, tûrei A ni kurabete tiisai mono de aru kara,
kore wo karini habuitemo daitaino Koto ga wakaru.
Mottomo, ueno Siki wa Nagare no Arisama ga wadukano
Zikan no aidani kawaru yôna Baai niwa motiirarenai.

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HUROKU.

Kwansoku wo suru Hito no Kokoroe.

Arayuru Sizen-kwagaku no Dodai to naru mono wa
Kikai wo *Sizen no Kwansatu* de aru. Gakumon no
seitôni tukau susumu ni turete Kwansatu wa sidaini ku-
Hituyô wasiku natte kuru. Tatoeba, Umi no Midu
ga atatakai toka tumetai toka iu bakari de naku, Ondo
ga Sessi no nando ka to iu Koto wo sadamenakereba
naranai; Baai ni yottewa 1° no hyakubun-no-iti mademo
tasikani siraneba naranai koto mo aru. Mata, Sio ga
karai to iu bakari dewa tarinai, Enbun ga senbun-no-
ikura ka to iu Koto wo sadameneba naranai. Konoyôna
sûryôtekino Kwansoku wo suru niwa, Ningen no Gokwan
no Tikara bakari dewa tarinai node, Kikai no Tasuke
wo karinakereba naranai. Sikasi, Kikai to iu mono wa
motomoto Ningen no Gokwan no Tikara wo oginau
tamenô mono de atte, sore zisin niwa Tamassii no nai
mono de aru kara, kore wo tukau Hito ga yokuyoku
kokoroete inaito, Kikai wo seitôni tukaikonasu koto ga
dekinai bakari de naku, kaette Kikai ni damasarete,
Kikai wo tukawanai yorimo warui Kekkwa wo eru koto
mo kessite medurasikuwa nai.

Kikai ga seimitu de hukuzatuni naru hodo, masu-
masu sore no Tukaikata mo mudukasiku nari, iroirono
komakai Tyûi ga hituyôni naru. Ippanni, hukuzatuna
Kikai wo waruku tukau yoriwa, kantanna mono wo
zyôzuni tukatta hô ga madasimo Sin'yô ga dekiru no de
aru. Yoi Kikai wo seitôni tukaeba yoi koto wa moto-

yori de aru ga, tada, yoi Kikai wo tukai sae sureba, suguni yoi Kekkwa wo erareru yôni omou no wa Aya-mari de aru.

Umi no Kenkyû wo suru nimo samazamana Dôgu ya Kikai wo tukau. Korerano Kikai de **Tadasii** hakatta Kekkwa ga, atode taisetuna Ooyô ya **Kwansoku no** Riron no Dodai to naru itiban daizina Tane **Neuti** de aru. Arû Imi kara ieba, *tadasii Kwansoku no Kekkwa wa Kakegae no nai Takaramono de aru.* Ningen no Tikara de katteni suru koto no dekinai Sizen no Gensyô niwa, itido Ori wo usinaeba, nido to Torikaesi no tukanai monô ga ikuramo aru. Keredomo, Kwansoku no Kekkwa ga attemo, sore ga taihenni matigatta mono de attara dô de arô ka? Konoyôna Kekkwa wa kaette nai hô ga masi de aru. Mata, hakatta Kekkwa wa Sin'yô ga dekitemo, hakatta Toki no daizina Dyôken (tatoeba, Kaisui no Hidyû wo hakatta tokino Ondo nado) ga kakitomete nai tameni, sekkakuno Kekkwa ga, nanno Yaku nimo tatanai Hogo doyôno mono ni naru koto mo aru. Sonokawari, **tadasii** yukitodoita Kwansoku no Kekkwa wa itumademo Neuti no kawaranai Takaramono de aru. Korera wo Tane ni site tateta iroirona Riron ya Gakusetu ga matigatte itari, mata hukwanzen de attari site, sore ga ato kara dandanni **tadasii** hô ni susunde yuku yôna Baai demo, Kwansoku no Kekkwa wa itumademo ugokanai Syôko ni narubeki mono de aru.

Konoyôna taisetuna Syôko ni naru Kekkwa wo eru tameniwa, iroirona komakai Tokoro made Ki wo tukete, Kikai wo tukai-konasu koto ga nani yorimo taisetû de aru.

Kokode hitotubitotuno Kikai ni tuite komakai Koko-roe wo nobetukusu Wake niwa yukanai ga, madu ippanni

Kikai wo tukau tokino Kokoroe to naru yôna Kotogara wo nobete, atode goku arihureta hutatu-mituno mono ni kwansuru taisetuna Tyûi wo nobeyô to omou.

Ippanno Tyûi.

Donna Kwansoku wo suru no demo, madu daiitini **Sokutei no Mokuteki** taisetuna Koto wa, zibun ga korekara nani wo hakaru ka to iu Koto, *ima nani wo hakatte iru ka to iu Koto wo akirakani Kokoro ni tomete iru koto* de aru. Kore wa makotoni wakarikitta Koto no yô de aru ga, zituwa zongwai mudukasii Koto de aru. Tatoesha, Kûki no Ondo wo hakaru no demo, Kandankei no Tama wo Te de tukande itari, aruiwa Kao wo amari tikadukete, atatakai Iki no kakaru no wo sirazuni itari sita no dewa, hontôno Kûki no Ondo ga wakaru Hazu wa nai. Kaisui no Hidyû wo kimeru no demo hakarô to omou Midu wo ireru Utuwa ni, hazime kara sukosi Mamidu ga haitte itari sitewa makotono Hidyû wa hakarenai; mata Hidyû wa hakattemo, sono Toki no Ondo wo yomu koto wo wasurete wa naranai.

Tugini taisetuna Koto wa, *dekiru dake yoi Kekkwa* **Kokoro-gake** *wo ete yarô to iu sikkarisita Kokorogake* de aru. Tada kikaitekini Sasidugaki no tôri hakareba sorede yoi to iu yôna tenurui Kangae dewa, iroirona omowanai Tenukari ga okori-yasuku, daiiti zibun de sukosino Omosiromi mo nai. Kore towa hantaini, kitto yoi Kekkwa wo ete yarô to iu Ikigomi ga areba, dôsite-mo Tyûi ga yukitodoki, nanika Kosyô demo areba suguni Ki ga tuki, mata Kwansoku no aidani omosiroi Zizitu wo mitukeru Nozomi mo ôi; Hone wo oru dakeni, eta Kekkwa zisin ni taisitemo Omosiromi wo kanzuru koto.

ga itibai hukaku naru Wake de aru.

Hakarô to omou mono ni tyokusetu Kwankei no aru
Tyûi no yôna Kotogara wa, Teoti no nai yôni, dôzini
Bunpai kwansokusite kakitomete oku koto wa motiron
 hituyô de aru ga, mata tyotto kangaetewa taisite Kwan-
 kei no nai yôni omôwareru Koto demo, Yoyû ga areba,
 kaite oita hô ga yoi; notini sore ga omoigakenai Yaku
 ni tatu koto mo aru. Ittai, hakarô to omou mono ni
 tokubetuna Tyûi wo mukeru koto wa nani yorimo hitu-
 yôna Koto dewa aru ga, sikasi amari sore bakari ni
 Kokoro wo ubawarete, mawarino Koto wo wasuretewa
 ikenai. Kono "*Tyûi no Bunpai*" to iu Koto wa mudu-
 kasii Koto de aru ga, nareru ni sitagatte oboeru hokawa
 nai. Iroirona omowanai Sikuziri wa, amari hitotuno
 Tokoro ni Ki wo ubawarete iru tokini okori-yasui mono
 de aru.

Kikai wo tukatte Kwansoku wo suru tokini, *Kokoro*
no Otituki ga hituyôna to onaziyôni, *Karada no*
Otituki *Otituki* mo hituyô de aru. Kyûkutuna Karada
 no Okikata wo site itewa, sirazusirazu sono hô ni Tyûi
 wo ubawarete ikenai. Hazime ni tyanto Guai no yoi yôni
 Kikai ya Kosikake no Iti nado wo sadame, rakuna
 Migamae wo site kara Kwansoku ni torikakaru ga yoi.

Tukau *Kikai no Hatarakikata* wo yokuyoku nomi-
Hatarakikata konde kakaraneba naranai koto wa motiron
no Ryôkai de aru. Kikai no hitotu-bitotuno Bubun
 no Yakume ya Imi wo yoku sitte oreba, Kosyô no
 okotta toki nado demo, suguni doko ga warui ka to iu
 Koto ga wakari, sitagatte hayaku warui Tokoro wo naosu
 koto mo dekiru. Wake ga wakarazuni tukatte iruto,
 ôkina Sikuziri wo suru bakari de naku, nandemonai
 Kosyô no tameni Kwansoku wo tyûsisitari, wazawaza

Kikaiya no Te wo karinakereba naranai yôna Koto ni naru.

Sate, korekara Kikai wo tukau to iu Toki niwa, **Kikai no** maemotte yoku sono subeteno Bubun wo ginmi-
Ginmi site, Kosyô no aru-nai wo tasikameru koto ga taisetû de aru. Kosyô no aru no wo sirazuni ite, nakagoro kara yatto Ki ga tuite, mata Hazime kara sukkari yarinaosaneba naranai yôna Koto ni naru. Osimai made Ki ga tukazuni itara naosara nangina Koto ni naru. Tatoi, mainiti tukainarete iru kantanna Kikai, tatoeba Kandankei no yôna mono demo, iza to iu Toki niwa hitotôri yoku sirabete, sore no Bangô ga tigattewa inai ka, dokoka Suigin no kirete iru Tokoro wa nai ka to iu yôna Koto wo mite oku no ga taisetû de aru. Komiitta Kikai dewa naosara de aru. Tatoeba, *Saisuiki* (p. 13) ya *Ryûsokukei* (p. 89) nado no yôna mono dewa, hitotôri subeteno Bubun ni Me wo tôsite, ugoku Tokoro wa ugokasite mite, katasugitari mata yurusugitari suru no wa Kagen wo suru; mata, koteisite irubeki Bubun ga yurundewa inai ka to iu Koto wo ginmisite, subeteno Guai wo tamesi-kokoromiru. Taezu Tikara wo ukeru Bubun wa oretari, kiretari, yugandari suru Sinpai wa nai ka to iu Koto wo tasikamete, sorekara Kwansoku ni torikakaru no de aru. Kwansoku no owatta atode, mô ippen onazi-yôni sirabete mite, nanimo Betudyô ga nakereba, madu Kwansoku no Totyû dewa Kikai ga manzokuna Hataraki wo site ita to iu Ansin wo eru koto ga dekiru no de aru.

Donoyôna Kikai demo, *Kisa* (*E.* instrumental correction) to iu mono no aru no ga tûrei de aru; **Kisa** sunawati, sono Kikai de tyokusetuni yomitotta Atai ni ikurakano *Naosi* (*E.* correction) wo kuwaete, hazimete hontôno Atai wo eru no de aru. Monosasi

demo, Tenbin no Hundô demo, mata Kandankei demo, subete seimituna Mokuteki ni tukau Mono wa, mina itido Sin'yô no aru Kenteizyo de yoku sirabete Kisa wo siru-sita no de nakutewa ikenai. Mata, Kisa wa itido sadamete oitemo, tukatte iru utini dandan kawatte kuru no ga tûrei de aru kara, tokidoki Kentei wo sinaosi, kotoni daizina Kwansoku wo sita atodewa, mô itido sirabete, Kisa ga kawari wa sinakatta ka to iu Koto wo tasikameru ga yoi. Kandankei nado de, 10 nen mo maeni sadameta Kisa wo sonomama tukatte itewa, Kekkwa wa kiwamete ayasii mono de aru.

Ositomedokai (*E. stop-watch*) ya *Rokubungi* (*E. sextant*) no yôna Kikai de, Yomitori ga 0 wo simesubeki tokini, hatasite 0 ni natte iru ka dôka to iu Koto wo tasikame, mosi natte inakereba, Kikai wo naosu ka, aruiwa sono Toki no Yomitori wo mite oite, hakatta mono kara hikisaru koto wo wasuretewa naranai.

Kikai no Domori wo yomu tokini *Sisa* (*E. parallax*)
Sisa to iu Koto ga aru; tatoeba, Kandankei wo yomu tokini, Me to Suigin no Atama to wo musubu Tyokusen ga Suigin no Hasira ni tyokkakuni natte inaito Yomitori ga ôkisugi, aruiwa tiisasugiru. Kore to onazi-yôna Ayamari wa iroirono Kikai nimo okoru kara, yoku tyûisite inakereba naranai. Kikai ni yottewa, kore wo naku suru tameni, tokubetuna Sikake no tuite iru no mo aru ga, atarimaeno Baai niwa sukosi Ki wo tukete keikoksureba taisita Ayamari wa okoranai.

Seimituna Domori wo *Soezasi* (*E. vernier*) de yomu tokiniwa, Hikari no Atariguai ni yotte tigatta
Hikari no Atariguai Yomitori wo eru koto ga aru kara, Ki wo tukeru ga yoi. Mata, Domori wo yomu noni, Hikari no Guai de taihenni yominikui koto to yomiyasui koto to ga

aru. Yominikui tokiniwa sizen Yomitigai nado mo ôku naru kara, narubeku, yomiyasui yôna Hikari no Muki wo eranda ga yoi. Hikarisugitari, mata kurasugitari site yominikui tokiniwa, tyotto siroi Kami demo kazasite kagensuruto, sore dake de taihenni yomiyasuku naru Baai ga ôi.

Taiteino Kikai wa tyokusetu Nikkô ni ateru koto Nikkô no wo narubeku sakeru ga yoi. Kandankei nado Eikyô wa motiron de aru ga, tatoeba Tenbin no yôna mono demo, Hi ga ataruto iroirona Ayamari ga okoru.

Tyômen no Tukekata.

Kwansokusita Kekkwa wo Tyômen ni kakitukeru tokini tyûisubeki Kotogara ga iroiro aru. Kakikata no warui tameni, sekkakuno yoi Kekkwa no Neuti ga sagari, matawa mudani naru koto ga aru.

Kimatta Kwansoku bakari wo kakikomu Tyômen Kakikomi- naraba, Hazime kara yoku sekkeisite, sore-
kata zoreno Atai wo kakikomu Basyo wo kimete oku ga yoi koto wa iu mademo nai. Sô de nai Baai demo, madu doredakeno Kadyô wo kakitomeru ka to iu Koto wo yoku kangaete, sorezoreno Basyo wo sadamete kakaru ga yoi. Sô sinaito, Tyômen no Omote ga konzatusite, atode Miwake ga tukinikuku nari, sitagatte Kandyô no Matigai nado mo okoriyasuku naru. Idure ni sitemo, narudake kireini zyunzyo-tadasiku kaite, hokano Hito ga mitemo wakariyasui yôni site oku koto ga taisetu de aru. Mata, atode keisansitari, iroiro kakikuwaetari suru tameni Sirakami no Bubun wo tappuri nokosite okuto Tugô ga yoi.

Ikanaru Baai demo, daiitini hituyôna Kadyô wa, **Kakubeki** *Kwansoku no Basyo, Hiduke to Zikoku* de aru. **Kotogara** Tuki to Hi to Zikoku to wa kaite attemo, *Tosi* ga kaite nai tameni, atode siraberu tokini komaru yôna koto mo aru. Tuginiwa Kwansokusya no *Namae*, mata kakitomeru Hito ga betu de areba sono Namae wo sirusi, Sekinin wo akirakani site okaneba naranai. Baai ni yottewa, kono Namae ga Kekwa no Sin'yô no Do wo sadameru Meyasu ni naru mono de aru. Sorekara, tugini taisetuna Koto wa, tukatta *Kikai no Bangô* de aru. Sonotokiniwa sukosimo magirawasii Koto ga nakutemo, atode sirabe-naosu yôna tokini, dono Kikai de atka to iu Koto ga wakaranakute komaru Baai ga okoru. Sonohoka, tyokusetuniwa amari hituyô de nakutemo, atode nanika no *Sankô* ni nari-sôna Kotogara, tatoeba Tenki no Moyô toka, Mawari no Tikei toka, mata sonotokini gûzen ariawaseta Dekigoto nado demo sirusite okuto, notini omowanai Tayori ni naru Tamesi ga sukanaku nai. Tomokakumo, mazimena, syôdikina Kwansokusya ni naru niwa, tada Kwansoku no Kekwa wo todomeru bakari de naku, Kwansoku wo sita Toki no Dyôken ya, Sonoba no Arisama wo tyûzituni kakiarawasu no ga kanzin de aru. Iroirona Sikuziri ya Kosyô (tatoeba, Kion wo hakatta atode, Soba ni Zyôki no hukidasite iru no ni Ki ga tuita toka, aruiwa Hidyû wo hakatta Midu ni sukosi Nigori ga atta toka, Hyômen ni Abura ga uite ita toka iu yôna Koto) wa syôdikini kanarazu kakitukete okaneba naranai.

Tyômen wa subete migigawano Pêzi ni kwansokusita Atai wo sirusi, sore ni taisita **Kwansokusita Atai** *sita Atai wo sirusi, sore ni taisita*
to Keisan to no *hidarino Pêzi wa siroku nokosite oite,*
Kakiwake *atode Keisan nado wo suru tokini*

tukau ga yoi.

Sonoba de Kwansoku no Kekkwa wo kakitukeru niwa Enpitu ga yoi. Pen to Inki wa, isogasii Baai ni Ma ni awanai koto ga ari, mata Ame no tameni yogoretari, iroiro iyana Koto ga aru. Atode yukkuri Keisan wo suru tokiniwa Inki de kaku koto ni suruto, daizina Kwansoku no Atai to hakkiri Kubetu ga dekite Tugô ga yoi. Keisan wo betuno Kamigire nado ni kaite sorekiri sutete simau no wa yoku nai; sono Tyômen ni keisan-site, Ato wo nokosite okeba, atode Matigai wo mituketari suru noni Tugô ga yoi.

Kwansokusya to Kakite to ga betuna Baai niwa, **Kakite no Tyûi** Kakite wa Kwansokusya no yonde siraseru Atai wo, ôkina Koe de yomikaesite tasikameru koto ga taisetude aru. Mata, Kwansoku no Zyunzyo ya Sikata nimo sizyû Ki wo tukete ite, tokidoki Kwansokusya ni Tyûi wo ataeru no mo Kakite no Yakume de aru. Yomitori nado ga utagawasii to omou Baai niwa itiiti toitadasite tasikamesaseru. Kwansokusya wa, Yomitori wo Kakite ni sirase, matawa zibun de kakitometataode, mô itido Yomi wo minasite tasikameru yôni sureba naosara daidyôbu de aru.

Yomitigai ya Yominaosi wo kakinaosu tokini, moto **Yomitigai no Naosikata** kaita Mozi wo Gomu de sukkari kesitottari, mata Enpitu de nuritubusite simau no wa yoku nai. Tada, karoku kesitê, motono Atai ga yoku wakaruyôni site oku. Yomitigai no atta to iu Koto ga wakareba, sore dake de Sankô ni naru bakari de naku, tokitositewa matigatta to omotta hazimeno Atai no hô ga kaette yokatta to iu Koto ga atode wakaruyôna Baai ga nai demo nai. Ningen no Matigai to iu mono wa zituni husigina Gensyô de atte, tôtei arisônimo nai

yôna Matigai ga okoru koto ga tokidoki aru kara, Sin'yô no aru Kekkwa wo eru tameniwa, Nen ni Nen wo ireneba naranai.

Yamuwoenai Baai ni, kimatta Tyômen de nai hokano Kami ni Kwansoku no Kekkwa wo kaki-
Motono Kiroku to sore no Utusi to no Tigai totta tokiniwa, sono Kami wo taisetuni hozonsite oite, atode Tyômen ni harituke, Syôko ni nokosite okaneba naranai. Utusitoru tokini man'itino Matigai ga okoru kamo sirenai; nominarazu, Genba de kaita Kamigire niwa, sono Toki no Awatadasisa ya, iroirona omowanai ikita Syôko ga nokotte iru mono de aru. Sonoba de kaita mono to atode kaita Utusi to wa marude Neuti ga tigau mono de aru.

Tokubetsuna Kwansoku no Rei.

Kûki no Ondo wo hakaru tokino Kokoroe.

Ondo wo tadasiku hakaru to iu Koto wa zongwai mudukasii mono de aru. Kore ni kwansuru iroirona Tyûi wo tugini nobete miyô.

Kandankei wa, hazimeniwa tyôdo sonomama de **Kisa no Sirabe** tadasii Ondo wo simesu yôni natte itemo, dandan tukatte iru utini Tama no Yôseki ga kawari, sitagatte Hyôten ya Huttôten ga kurutte kuru mono de aru. Sorede, itido Kentei wo site, *Kisa* (Kikai no Naosi) no Hyô ga tuite iru no demo, tokidoki Kentei wo sinaosu Hituyô ga aru.

Ondo 1° no 1/100 mademo hakaru yôna Kandankei dewa, Kuda no Ookisa no husoroina tameni okoru Matigai ga kanarini ôkii koto ga aru kara, Sin'yô no dekiru kuwasii Kenteihyô no tuita mono de nakutewa,

sekkaku 1/100 made yondemo Yaku niwa tatanai.

Mata konôyôna kuwasii Kandankei no, Nagasa no **Katamuki** nagai no dewa, kore wo tateni sita Baai to **no Eikyô** nekasita Baai to de kanari Yomi no tigau koto ga aru kara, tukau tokiniwa **Ki** wo tukete, sono Tigai no aru-nai wo tasikame, mosi Tigai ga areba, tateni site sadameta Kenteihyô ya Kisa wo sonomama nekasita Baai ni tukattewa naranai.

Goku Kanzi no yoi Kandankei wa Aturyoku nimo **Aturyoku** kanziyasui kara, Midu no Ondo wo bakaru **no Eikyô** tokini, sononaka ni sasikomu Hukasa ni yotte Ayamari wo syôzuru koto ga aru. Yoi Kandankei niwa konotameno Naosi no Hyô ga tuite iru Hazu de aru. Sorede, Kandankei no Tama wo amari kataku sibattari, mata kituku sasikondari suru no wa yorosiku nai. Atari-maeno hadakano Kandankei de Ido no Soko ya, Umi no naka no Ondo wo hakattewa ikenai.

Kûki no Ondo wo hakaru tokiniwa, Kûki no Den-**Hukusyanetu** neturitu no tiisai noni, Mawari no Mono **no Eikyô** kara kuru Netu no Hukusya no tameni atata-merareru Osore ga ôi kara, yohodo tyûisinaito, marude matigatta Kekkwa wo eru koto ga aru. Narubeku Kaze-tôsi no yoi, tyokusetuni Hi no ataranai Tokoro wo erami, mata Mawari ni aru Mono karano Hansya ya, atuku natte iru Kabe ya Dimen karano Hukusya no Eikyô wo sakeru yôni sinakereba naranai. Kandankei wa itumo zibun no Kazakami ni sasidasi, Iki ya Karada no Hotobori no kakaranai yôni tyûisinakereba naranai. Tama no Tikaku wo Te de nigittari suru koto wa Kinmotu de aru. Hune no ue de naraba, kanarazu Kazakami no Hunaberi ni Karada wo noridasite hakaru ga yoi. Ookina Hune no Kazakami to Kazasimo to dewa kanarino Tigai ga aru.

Itudemo "*Kazakami no Hikage*" to iu Koto wo wasuretewa naranai.

Kaze no mattaku nai yôna Baai niwa, Hukusya no Eikyô ga kotoni itizirusii kara, sonotokiniwa Kandankei no Atama ni Himo wo tukete, sibaraku hurimawasita notini isoide yomu ga yoi.

Umi no ue de Kion wo hakaru tokiniwa, Nami **Tama no nurenai Tyûi** no Sibuki ya Ame no Kiri de Kandankei no Tama ga nureru koto ga sibasiba aru. Tama ga nurete itewa hontôno Kion yori hikui Ondo wo simesu no ga tûrei de aru kara, yoku Ki wo takenakereba naranai.

Umi no Hyômen ni sekkinsita Tokoro to, 2-3 mêtori **Takasa no Eikyô** mo takai Tokoro to dewa, Kion ga itizirusiku tigau koto ga ôi kara, Kandankei no Tama no ôyosono Takasa wo Tyômen ni sirusite oku ga yoi.

Kandankei ga mawarino Kûki no Ondo ni natte **Kanzi no Hayasa** simau madeni kakaru Zikan wa, Kaze no Tuhayasa yosa nimo yori, mata Kandankei nimo yoru. Hurimawasite hakaru nara Kaze niwa yoranai kara, arakazime tukau Kandankei ni tuite kono Zikan wo tamesite sitte okuto, Tugô ga yoi.

Kaisui no Ondo wo hakaru tokino Kokoroe.

Tugini, Kaisui no Ondo wo hakaru ni tuitewa, **Mawarino Ondo no Eikyô** mata tokubetuna Tyûi ga iriyô de aru. Umi no Hyômen no Midu no Ondo wo hakaru tameni Saisuiki ya Baketu de Midu wo kumiageru tokiniwa, madu itido ippai kumiagete, sono Midu wa sutete simai, suguni nibanme wo kumiagete sore no Ondo wo hakaru ga yoi. Tutu ga nidyûni natta, Huta no tuita Saisuiki naraba yohodo ansin de aru ga,

zukkuno Baketu nado dewa, kumiagete Kandankei wo sasikomi, sore ga Midu no Ondo ni naru no wo matte iru aidani, Midu no Ondo ga kawatte kuru. Kore wa, kotoni Midu no Ondo to Kûki no Ondo to no Tigai no ôkii tokini itizirusii. Sonoyôna Baai niwa Baketu wo hutatu tukatte, madu hazimeni kumiageta no ni Kandankei wo tukete, oyoso sono Ondo ni natta tokini, sarani nidomeno Midu wo kunde, suguni kore ni sasikomi, tebayaku hakaru ga yoi. Mosi Midu ga Kûki yori atatakai Baai naraba, Ondo no agaritumeta Tokoro wo yomeba yorosii. Baketu no amari tiisai no wa ikenai. Sikasi, tomokakumo Baketu wo tukau no dewa, 1/10-do no Kurai de ikurakano Ayamari no okoru Baai ga aru mono to kakugosite inakereba naranai.

Tutu no nidyûni natta Saisuiki wo tukau Baai demo, yoku tyûisinaito, yahari Ayamari wo syôzuru; kotoni Kion to itizirusii Tigai no aru Baai niwa, Tutu ni yoku Huta wo site, sore no Ana kara Kandankei wo sasikomi, Tama ga Tutu no Nakahodo ni aru yôni si, sosite sukosi Kandankei de Midu wo kakimawasi nagara, tokidoki yomi, Ondo ga itteisuru no wo misumasite tebayaku yomitoru. Amari itumademo kangae nagara mite iruto, mata Ondo ga kawatte kuru. Itudemo, Ondo no agaritume matawa sagaritumeta Tokoro wo yomu koto ni sureba yoi. Hukai Tokoro no Midu wa Kion ni kurabete tumetai Baai ga ôi kara, kotoni Natu nado wa Ki wo tukenakereba naranai.

Tukatta Kandankei no Bangô wo Tyômen ni tuku
Bangô koto wo wasuretewa ikenai.

Ondo wo yomu tokini, nanameni miage mata miro-
 suto, maeni nobete oita yôna **Sisa** no tameni
Sisa itizirusii Yomitigai wo syôzuru.

Hidyû wo hakaru tokino Kokoroe.

Tikagoro wa Kaisui no Hidyû wo hakaru niwa
Bunseki kwagakutekino Bunseki ni yoru no ga itiban
 yoi to iu Koto ni natte iru (p. 19 wo miyo).
 Sikasi, kore mo iroirono komakai Tyûi ga yukitodoka-
 naito, Ayamari no okoru Miti wa ikuramo aru. Hyô-
 zyun ni naru Kaisui ni yotte, Kosa wo sadameta Syô-
 sangin no Yôeki ga zyôhatusite, koku naru no ni Ki ga
 tukanakattari, Yôeki wo ireta Byûretto no Kuda ni Hi
 ga atatte itari, mata sekkaku Domori no Sisa wo naku-
 suru tameno Renzu ga hidoku katamuite itari sita no
 dewa nan nimo naranai.

Konogoro wa itigaini Ukibakari wo kenasite tuka-
Ukibakari wanai yô de aru ga, tadasii Ukibakari wo sei-
no Neuti tóni tukaeba, ôkuno Mokuteki niwa rippani
 Yaku ni tatu yôna Kekkwa wo eru koto ga dekiru.
 Tokubetuna gakuzyututekino Sirabe wa nozoite, taiteino
 Baai niwa yahari Ukibakari ga mottomo benri de aru.
 Tada, kanarazu Sin'yô no dekiru Kentei wo sita mono
 wo tukau koto ga taisetu de aru.

Ukibakari de Hidyû wo hakaru niwa, *Seiketu* to iu
 Koto ga nani yorimo daizi de aru. **Midu no**
Seiketu Iremono ya Ukibakari ga yogorete itari, mata
 Kûki ni Gomi ga tatte iru Tokoro dewa ikenai.

Madu; Hidyû wo hakarubeki Midu de Utuwa wo
Midu no araisusugi, kore ni ippai atarasii Midu wo ire,
Atukaikata komakai Awa ga kiete simau no wo matte,
 Hyômen no Midu wo sukosi kobosi, Hyômen wo
 kireini suru. Sorekara, seiketuna Gâze de yoku huki-
 kiyometa Ukibakari wo ire, mata Kandankei wo ireru.
 Sonotoki mosi Midu no Hyômen ni sukosi demo Aburake

ga uku yô dewa dame de aru. Mata, Ukibakari no ueno hosoi Bô ga Suimen ni dete iru Sakai no Tokoro ga mawari itiyôni yoku nurete iru koto ga hituyô de aru.


Hidyû wa Ondo ni yotte kawaru kara, kore wo hakatta Toki wo Ondo ga wakatte inakereba nanno
Ondo Yaku nimo tatanai. Kono Ondo wo hakarubeki Kandankei wa, sono Tama ga Ukibakari no Dô no yoko ni kuru guraini site, tokidoki yomitori, Ondo ga dandan kawari wa sinai ka Ki wo tuku. Hakarubeki Midu no Ondo ga mawarino Kûki no Ondo to itizirusiku tigattari, aruiwa Nikkô ga atatte itari, matawa Soba ni atui Mono ga aruto, Utuwa no naka de Midu no Kôryû ga okori, sonotameni Ukibakari ga ikuraka ukiagari matawa sidunde Ayamari wo syôzuru koto mo aru kara, sonoyôna Basyo wo sake, mata Midu no Ondo ga Kion ni tikaku naru no wo matte hakaru ga yoi.

Hune ga yurete iru tokiniwa, Ukibakari wo tukau
Midu no no wa mudukasii kara, narubekuwa Midu wo
Hozon Bin ni irete Minato no nake ka, Riku e motte kite, yukkuri hakaru ga yoi. Bin no Sen wa Koruku nado dewa, ikuraka Midu ga zyôhatusuru kara yoku nai. Tomoguti ka Gomusen ga yoi. Aruiwa korukuno Sen wo sita ueni Parahwin wo tokasite nuttemo yoi. Aomi wo obita Garasu no Bin no hô ga Midu ni tokenakute yoi sô de aru. Bin ni Midu wo ireru maeniwa, sono Midu de yoku seiketuni naka wo aratte okaneba naranai koto wa motiron de aru.

Domori wo yomu niwa, Midu no Hyômen no sita
 kara mitôsitate, dandan Me wo Suimen ni tika-
Yomikata duke, ittaino Suimen ga Domori wo kiru Tokoro wo yomu no de aru.

○ Tokubetuna Mokuteki, tatoeba Hyôzyun to narubeki

Hidyûbin Midu no Hidyû wo seimituni hakaritai to iu yôna Baai niwa, *Hidyûbin* wo motiite, Tenbin de tyokusetuni Zyôryûsui to kuraberu ga tasika de aru. Sikasi, hontôni seimituni hakaru niwa, madu Tenbin kara yoku sirabete, sono Tasikasa no Do wo yoku ginmisi, mata sono Hundô no Ayamari wo seimituni sadamenakereba naranai. Sorekara, Ondo mo kanari seimituni hakaraneba naranai; 1° C. no 1/10 matigaeba, Hidyû wa Syôsûten ika 5-keta no Tokoro de 2 ya 3 guraiwa tigau. Sorede, narubeku Ondo no Henkwa no nai Heya de, Midu no Ondo ga Kion to onazini naru yôni site hakaraneba naranai. Bin no nakani sukosi demo Awa nado ga attewa ikenai koto wa motiron de aru. Mata, Midu wo irete, tyôdo Bin no Kubi ni aru Sirusi no Tokoro made mitasô to suru noni, atatakai Te de Bin wo nigitte itewa Midu ga bôtyôsi, Tenbin e nosete Kion to onazini natta tokiniwa, mohaya Sirusi ni todokanai yôni naru. Bin wo osaenakereba naranai yôna Baai niwa, Kire no yôna mono de osaeru ga yoi.



SAKUIN.

(tuketari, yôyôna Kotoba no Eigo)

Nanamena Zitai wa Gwaikokugo; Zi no aida wo sukasite aru no wa Koyûmeisi; () no naka no tatta Rômazi wa, sore no mae ni aru Gwaikokugo no aramasino Yomikata; Sûzi wa Pêzi no Kazu.

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日本式ローマ字擴めの機關・ローマ字文研究の機關
土岐哀果氏編輯・多數の學者及び文士助力

RŌMAZI SEKAI

毎月一回一日發行

一部十錢郵税五厘・半年郵税共五十錢・一年同一圓（外國は壹圓貳拾錢）

我國の世界的發展の爲に緊急な國字問題の實地解決とローマ字文の書き方の標準を與へるのが此雜誌の目的

- 「論説及び評論」には國語國字問題其他一般の評論。
- 「新しい智識」には斯界第一流の學者の學術上の記事。
- 田中館博士擔當の「飛行だより」には飛行船飛行機に関する新しい論文や出來事を載せる。
- 「家庭」には園藝、お伽噺、其他健全な家庭趣味。
- 「文藝及び雜録」には進歩的文士畫家の新鮮な作物。
- 「日本語研究」は此雜誌に獨得な眞面目な讀み物。
- 「讀者文藝」欄は汎く讀者諸君に提供した文藝研究の庭。

發行所 日本 の ロー マ 字 社

■■■■東京市本郷區駒込曙町十一番地 ■■ 振替東京二一五〇四 ■■ 電話下谷五七一〇■■■

日本式綴り方の要點 ローマ字の日本式綴り方は、此迄外國語や外國人關係の方面で發達した關係から外國語の寄生物として出來て居るローマ字書き方を棄て、日本語の性質を本位とした綴り方で、假名の五十音の各行に一定の父字を宛て、又キャシヤ等の拗音も凡て一樣な規則に従て書く綴り方です。

日本式綴り方と英語風の綴り方と違ふのを示せば次の通り。

シ si, シ り zi, シヤ シュ ショ sya syu syo, シャ シュ ジョ zya zyu zyo; フ hu, チ ti, チ di, チャ チュ チョ tya tyu tyo, チャ チュ チョ dya dyu dyo; この綴り方が兒童其外の初學者に學ばせるに容易であるは云ふまでもないが、之が日本語の性質に合つて居ることは、次のやうな文法上同格な動詞の變化や音便の變化を見れば明です。

日本式 なれば	{ kak-u, -anai, -i, -e, -ô	英語風即ち へボン式なれば	{ kak-u, -anai, -i, -e, -ô
	{ kumin, -anai, -i, -e, -ô		{ kumu, -anai, -i, -e, -ô
	{ os-u, -anai, -i, -e, -ô		{ os-u -anai, -hi, -e, -ô
	{ tat-u, -anai, -i, -e, -ô		{ ta-tsu, -tanai, -chi, -te -tô

日本式では四つの動詞が全く同じ型で行くが、へボン式ではそうは行かない。

日本式	{ Tama	{ tikai	{ Ture	へボン式	{ tama	{ chikai	{ tsure
なれば	{ Akadama	{ tedikai	{ Mitidûre	なれば	{ akadama	{ tejikai	{ michizure

日本式では t が d になるといふ規則一つで盡きて居るに、へボン式では三通りの變化になる。

■日本のローマ字社の組織

一、大正四年五月から財團法人になつて居る。

二、理事

（	理學博士	田中	館愛橋	
	文學博士	芳賀	矢一	
	工學博士	子爵	大河内	正敏
	理學博士	田丸	卓郎	

三、賛助員 本社の事業を賛成される知名の士で本社から賛助員たることを御願した人、及び一時金五十圓以上を本社に寄附された人。其内には、

菊池男爵、山川東京帝大總長、澤柳文學博士、坪内文學博士、岡田貴族院議員、高田文部大臣、阪谷男爵、新渡戸農法學博士、北條東北大學總長、上田文學博士、福原文部次官、大久保陸軍中將、上村海軍少將

其他博士學士等朝野の名士七十餘名、故人となつた賛助員には乃木大将、林(董)伯爵、加藤(弘之)男爵等の名もある。

四、維持員 維持費一口(毎月五十錢一年六圓)以上を引受ける人。

賛助員及び維持員は本社の事業を助け、又は本社の事業について意見を出す。

五、評議員 本社の要な事務に就いて評議する人、賛助員維持員の内から御願する。

相羽恒次氏(神戸) 本莊熊次郎氏(大阪) 佐島啓助氏(大阪) 丹野茂樹氏(大阪)
立原任氏(神戸) 上田常記氏(大阪) 關一氏(大阪)

六、社友 社友費毎年一圓以上を出し、本社と同じ方針でローマ字の普及發達を努める人。

但し外國に居る人は社友費用毎年壹圓貳拾錢以上、日本内の小學校の教員及び諸種の學校の生徒徒弟は七十錢。

社友はローマ字世界毎號一部宛の配布を受け、本社の發行物を定價の二割引で買へる。

七、支社及び取次所

米國支社 c/o Sakaizawa-Fsao, 1134 Georgia Str., Los Angeles, Cal., U.S.A.

大阪取次所 西區土佐堀通二丁目基督教青年會 常安橋南詰南入福井交德堂

京都取次所 下京區佛光寺通烏丸東入東枝書齋店

神戸取次所 山本通五丁目七十二番邸六號相羽恒次方

■基本金と維持費 我々の事業は絲口と見込だけは立つた。然し實地に目的を達するには、尙有益な書籍を澤山に出すこと、社會に對して吾々の趣意を鼓吹普及すること、ローマ字の講習を爲すこと等爲すべきことが非常に澤山あるので、それには確實有力な資力が必要である。これが特に我々が識者有志者に訴へて其基本金と維持費を募集して居る所以である。

一、基本金 に對する寄附金には一定の額はない。

基本金に二十圓以上寄附する人は終身社友の扱にする。

これ迄五十圓以上寄附して賛助員となつて居る人及び理事の出金高(未拂濟、條件附の分共)は次の通り、

●千圓 松本健次郎氏 ●五百圓づゝ 新莊吉生氏 大河内正敏氏 田中館愛橋氏 田丸卓郎氏 ●三百圓 芳賀矢一氏 ●二百圓 鹿島精一氏 須田利信氏 ●百圓 入澤達吉氏 志立鐵次郎氏 ●五十圓づゝ 伊吹山徳司氏 船橋了助氏 白石元治郎氏 野口遼氏 作山喜吉氏 伊藤忠兵衛氏 佐藤勇太郎氏

一、維持費 は毎月五拾錢(年六圓)宛を一口とし、維持員は一口以上を引受ける。

但し維持費の出金は五ヶ年を一期とし、満期の上は改めて御願する。