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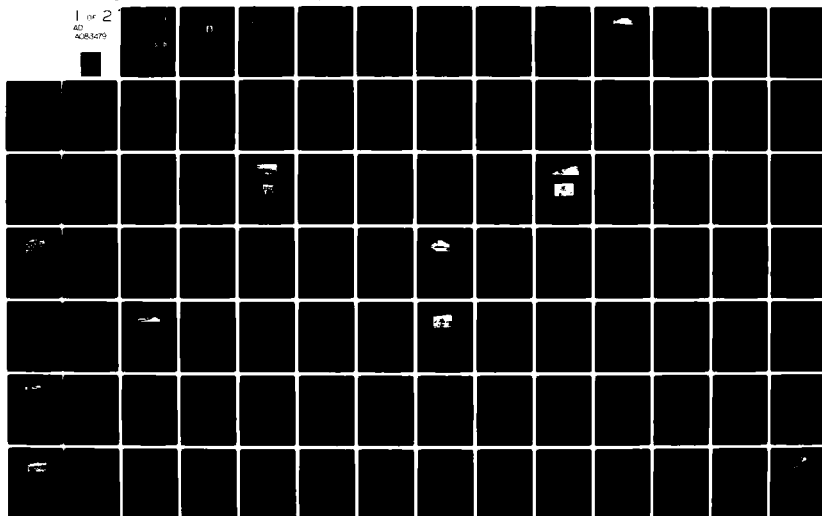
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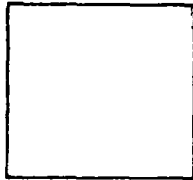
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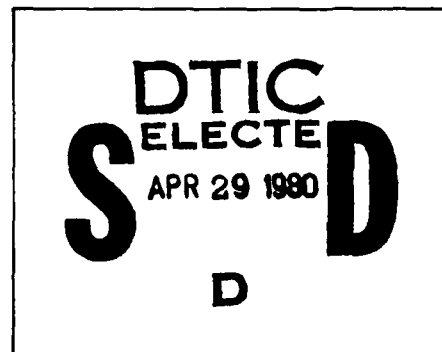
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## FOREIGN TECHNOLOGY DIVISION



GEOLOGY OF THE USSR  
(CHAPTER IV)



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## UNEDITED MACHINE TRANSLATION

FTD-ID(RS)T-1266-79

5 October 1979

MICROFICHE NR: FTD-79C-001313

GEOLOGY OF THE USSR (CHAPTER IV)

English pages: 136

Source: Geologiya SSSR, Vol. 26, 1970, pp. 60-108  
Moscow.

Country of Origin: USSR

This document is a machine translation.

Requester: Department of Navy

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WP.AFB, OHIO.

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Date 5 Oct 19 79

# U. S. BOARD ON GEOGRAPHIC NAMES transliteration SYSTEM

Block	Italic	Transliteration	Block	Italic	Transliteration
А а	<b><i>А а</i></b>	A, a	Р р	<b><i>Р р</i></b>	R, r
Б б	<b><i>Б б</i></b>	B, b	С с	<b><i>С с</i></b>	S, s
В в	<b><i>В в</i></b>	V, v	Т т	<b><i>Т т</i></b>	T, t
Г г	<b><i>Г г</i></b>	G, g	У у	<b><i>У у</i></b>	U, u
Д д	<b><i>Д д</i></b>	D, d	Ф ф	<b><i>Ф ф</i></b>	F, f
Е е	<b><i>Е е</i></b>	Ye, ye; E, e*	Х х	<b><i>Х х</i></b>	Kh, kh
Ж ж	<b><i>Ж ж</i></b>	Zh, zh	Ц ц	<b><i>Ц ц</i></b>	Ts, ts
З з	<b><i>З з</i></b>	Z, z	Ч ч	<b><i>Ч ч</i></b>	Ch, ch
И и	<b><i>И и</i></b>	I, i	Ш ш	<b><i>Ш ш</i></b>	Sh, sh
Й й	<b><i>Й й</i></b>	Y, y	Щ щ	<b><i>Щ щ</i></b>	Shch, shch
К к	<b><i>К к</i></b>	K, k	Ъ ъ	<b><i>Ъ ъ</i></b>	"
Л л	<b><i>Л л</i></b>	L, l	Ы ы	<b><i>Ы ы</i></b>	Y, y
М м	<b><i>М м</i></b>	M, m	Ь ь	<b><i>Ь ь</i></b>	'
Н н	<b><i>Н н</i></b>	N, n	Э э	<b><i>Э э</i></b>	E, e
О о	<b><i>О о</i></b>	O, o	Ю ю	<b><i>Ю ю</i></b>	Yu, yu
П п	<b><i>П п</i></b>	P, p	Я я	<b><i>Я я</i></b>	Ya, ya

\*ye initially, after vowels, and after Ъ, Ь; e elsewhere.  
When written as ѐ in Russian, transliterate as yě or ě.

## RUSSIAN AND ENGLISH TRIGONOMETRIC FUNCTIONS

Russian	English	Russian	English	Russian	English
sin	sin	sh	sinh	arc sh	sinh <sup>-1</sup>
cos	cos	ch	cosh	arc ch	cosh <sup>-1</sup>
tg	tan	th	tanh	arc th	tanh <sup>-1</sup>
ctg	cot	cth	coth	arc cth	coth <sup>-1</sup>
sec	sec	sch	sech	arc sch	sech <sup>-1</sup>
cosec	csc	csch	csch	arc csch	csch <sup>-1</sup>
		Russian	English		
		rot	curl		
		lg	log		

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#### Chapter IV.

#### ISLANDS OF BARENTS SEA. THE EARTH FRANZ JOSEPH AND ISLAND VICTORIA.

The Earth Franz-Joseph and examined/considered here also about Victoria are arranged/located on the northeast of the Barents sea between  $79^{\circ} 50'$  and  $81^{\circ} 50'$  N and  $24^{\circ}$  and  $66^{\circ}$  E.

The largest (submeridional) straits/spills of archipelago British canal and Austrian strait/spill divide it into three groups of the islands: Zapadnayas (Earth of Alexandra, Earth Georg, North Brook, etc.), central (island of Rudolf, Jackson, Salisbury, Hooker, Gall, etc.) and eastern (Earth Wilczek, Is. Graham-Bell, etc.).

Archipelago consists of more than 150 islands, which were expanded on 360 km on longitude/length. In this case only the Earth Georg, the Earth Wilczek, Graham-Bell and Alexandra Earth have areas, which exceed 1000 km<sup>2</sup>. Of a number of remaining islands 22 have areas

more than 100 km<sup>2</sup>, 23 from 10 to 100 km<sup>2</sup>, and remaining possess the area less than 10 km<sup>2</sup> each.

Very small area (about 12 km<sup>2</sup>) occupies also the Is. Victoria, free from ice part of which is measured altogether only by several hectares (cape Knipovich).

The relief of the Earth Franz-Joseph is characterized by considerable ruggedness and is represented, as a rule, typical plateaus in high from 50-100 to 500-600 m. The greatest marks (from 500 to 620 m) are confined to nunataks and domes of the islands of the southern half the central and eastern groups from which most high are arranged/located on islands Wiener-Neustadt (Fig. 1), Earth Wilczek, McClintock, Graham-Bell, Champ and Gall. Remaining islands have the height less than 500 m. Considerable impression on the relief of archipelago put glacial-nivation processes with which were created the numerous cirques and the short, but deeply cut into glacial troughs, now semiburied under cover ice, but by places drowned by sea.

The large/coarsest sections of the low land, free from ice, measured by hundred square kilometers, are confined to the extreme western and eastern islands of archipelago. However, as a whole for entire archipelago are more usual the numerous, very insignificant by

area (unit and tens of square kilometers) capes and nunataks, which are, as a rule, monadnocks of basalt or dolerite plateaus.

About 85o/o of area of archipelago are occupied with glaciers. Glaciation on the majority of islands is related to semi-blanket type and is in accordance with the underlying radical relief two-level. This most characteristically for the near-axial part of archipelago, while on extreme eastern and western islands predominate the glaciers only of upper tier.

Franz-Joseph's fluvial processes on Earth are located on earliest stage of their development when linear runoff as such only just is conceived.

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The majority of the water flows, known in the free from ice sections of land (island the Earth of Alexandra, the Earth Georg), has in essence glacier nourishment. These are typically outwash plain by their nature streams whose drainage basins yearly anew are formed/shaped on glacier integuments. On the surface of land they lay the very weakly cut into, ramifying, frequently alternate and bifurcating river beds.



For the development of plant integument and soil formation in archipelago very unfavorably manifests itself very cold and short summer, and also permanent destruction and silting of grounds by snow and especially outwash plain flows. Furthermore, on some islands the development of vegetation is inhibited by intense fluttering (Is. Graham-Bell). All this conditions the strong rarefaction of a soil-plant integument, confined only to separate comparatively favorable in this respect sections where usually are formed/shaped skeletal/skeleton soils - on rubbly-loamy grounds.



Fig. 1. Cape is the tyrol on Wiener-Neustadt - typical example is. of the two-level structure of the ice from ice sections of land. of V. K. Razin's photo.

#### Stratigraphy.

The islands of the Earth Franz-Joseph are composed sedimentary and volcanogenic, predominantly Mesozoic, by deposits. They are represented the maritime precipitation of Carnian age, the substantially continental carboniferous thickness, related to the Norian and Rhaetian tiers and lower Lias, by the Middle Upper Jurassic deposits, dismembered to the series/number of tiers and substages, by a sedimentary-effusive thickness of lower cretaceous and finally by the maritime deposits of Cenomanian tier. Furthermore, in archipelago are known the traces of development supposedly Lower Carboniferous carboniferous, offshore-marine Pliocene (?) and quaternary deposits.

Island Victoria is complex by Middle Carboniferous limestone and

by dolomite.

Paleozoic group.

Carboniferous system.

Lower division.

In the foot of Washington (Is. Ziegler) cape V. K. Razin in 1957 selected from talus the piece of unusual for archipelago of banded carbon/coal (alternation of vitrain and fusain), probably, that fell from the layer, confined to those laying under basalt to arenaceous deposits.

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Cryptogamous-pollen analysis of carbon/coal, produced in 1962 A. F. Dibner, showed the abundance of well preserved spores Azonomonoletes Lub. (38o/o) and Zonotriletes Waltz. (35o/o), which were represented in essence the forms/species: Azonomonoletes vulgaris (Ibr.) Lub., A minutus (Ibr.) Lub., Zonotriletes aquosus Isch., Hymenozonotriletes heterotomus (Waltz.), H bialatus (Waltz.), Euryzonotriletes fragilis Isch., E. pressus Isch., E. crassipteris (Waltz.). Furthermore, are revealed the disputes of the subgroup:

Leiotriletes Naum.-13o/o (L. vetustus Isch., etc.), Trachytriletes Naum.-<sup>4.5%</sup>~~4.5%~~ (T. punctulatus Waltz., etc.), Acanthotriletes Naum.-3.0o/o, Dictyotriletes Naum.-1.0o/o, Pereplecotriletes Naum.-0.5o/o. Pollen (5o/o), discovered in this sample/specimen, is related to subgroup Entylissa Naum.

Another similar find was made to year earlier (in 1956) on the the contradictory/opposite (southeastern) to the edge of archipelago among the ruins of the basis of the American expedition of Wellmen on cape Tegethoff (Is. Gall cape. There V. D. Dibner found the large/coarse (15x10x50 cm) picked ore of semilustrous stratified carbon/coal. Taking into account that among ruins are nowhere encountered the remainders/residues of carbon slag and that during wintering the expedition of Wellmen was heated by fire, it is possible to assume that the mentioned picked ore of carbon/coal was selected from some of the coworkers of this expedition in the vicinities of basis as geologic sample/specimen. Main argument in favor of this assumption is petrographic resemblance and identity of cryptogamous-pollen sets of both samples/specimens.

Petrographic of the investigation of these carbon/coals, produced by N. M. Krylovoy (1963), showed that by their textural special features/peculiarities and composition of the coal-forming components (alternation of the thin bands of vitrain from to layers,

enriched by clayey material and fusain) they are very similar to Carboniferous carbon/coals of Moscow basin. According to petrographic signs and refractive index of N. M. Krylov's vitrain it related this carbon/coal to gas ones. Cryptogamous-pollen spectrum, according to data A. F. Dibner, is close to the same from sample/specimen from Washington cape). Here also predominate disputes Azonomonoletes Lub. (48o/o) and Zonotriletes Waltz. (31o/o), which are represented in essence the forms/species: Azonomonoletes vulgaris (Ibr.) Lub., Zonotriletes aquosus Isch., Euryzonotriletes crassipteris (Waltz.), E. fragilis Isch., E. modicus Isch. The disputes of other taxons are located in the following relationships/ratics: subgroup Trachytriletes Naum.-13o/o (T. punctulatus Waltz.), Leiotriletes Naum.-3o/o, Dictyotriletes Naum.-1o/o. Pollen composes 4o/o and is related to subgroup Entylissa Naum.

Composition of both cryptogamous-pollen spectra indicates, on conclusion A. F. Dibner and other palynologists <sup>1</sup>, to Lower Carboniferous, most likely Vizeyskiy, age.

FOOTNOTE <sup>1</sup>. The sample/specimen of carbon/ccal from Tegethoff cape was studied also by palynologists E. M. Andreyevoy and Ye. K. Vanderflit. ENDFOOTNOTE.

In light of already aforesaid one should be returned to old

data, which relate to the very first geologic investigations on the Earth of Franz-Joseph. So, in region of the southern extremity of Is. the Earth Georg - on Cook's scales (Tween Pocks)- at height of approximately 100 m above sea level a participant in the English expedition of Jackson botanist Fisher revealed/detected the bundle of those falling very gently (2°) on SSV "multicolored sands and unconsolidated slates in basis of which lay the layer of carbon/coal in visible power/thickness to 2 feet" (Kettlitz, 1898).

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This carbon/coal burned in oven by bright flame, also, in contrast to lignitized wood, characteristic for younger layers, it consisted of the "crushed and pressed plant material". Microscopic examinations (Kettlitz, 1898) also showed that carbon/coal by places consists of the mykrois of the macrospores, similar to the same of cryptogamous/sporiparous carbon/coals, very usual of the productive thickness of the Carboniferous period of British islands whose age is defined there, as is known, in an interval the lower Carboniferous period - lower Permian period. It is not difficult to also see that these given by Kettlitz general/common/total indicators completely answer banded cryptogamous/sporiparous gas coal of our collections. In the foot of the scales of Cook, lower than multicolored carboniferous deposits mentioned above, R. Kettlitz (1898) did

reveal/detect the disintegration of the blocks of the laminated bituminous shale, containing the indefinable impressions of plants, and also the scale of fishes (?). All these layers Ye. Newton and D. Till (1898) conditionally related to Permian ones; however, in light of data presented it is possible to assume that already their upper part, containing carbon/coals, is related to average/mean Carboniferous period. However, similar carbon/coals were brought by Jackson's expedition from the local moraine, developed in the foot of Richthofen cape on Luigi Is. (Newton and Till, 1897). Finally, here one should say that by M. M. Ermolaev in 1935 (during high latitude expedition on "Charge/shrinkage") to the southeast from Is. the Earth Wilczek from the bottom of sea were raised the lump of limestone and carbon/coals - and those, etc. of "paleozoic", in his opinion, appearance (oral communication/report). It is possible that these and "Richthofen" fragments of carbon/coals have also Lower Carboniferous age.

Average/mean division.

Contemporary coast rises/swells/ramparts on Knipovich (Is. Victoria) cape are composed by the uniform in composition pebble of the carbonate rocks which M. V. Klenova (1960) considers arisen as a result of local rewashing<sup>1</sup>.

FOOTNOTE 1. At present this is caused no doubts in connection with the thawing out from under ice dome small/fine radical outcrops of these species/rocks (oral communication/report of L. S. Govorukhya).  
ENDFOOTNOTE.

Among the latter predominate the dolomite, dolomitized and organogennic limestone whose base mass is composed by coarse-crystalline calcite with the scattered grains of fragmental quartz. Here is observed the abundant fauna of fusulina among which A. D. Miklukho-Makla determined: *Profusulinella prisca* (Deprct), *Pseudostaffella cf. gorskyi* (Dutk), *Tuberetina aff. collosa* Reith., *Textularia* sp., *Globivalvulina* sp., *Schubertella* sp. On its conclusion, this complex indicates as a whole the average/mean Carboniferous period, the first two forms (*Profusulinella prisca* and *Pseudostaffella cf. gorskyi*) making it possible to relate the carbonate rocks of Knipovich cape to the Vereian and Kashira horizons/levels or the Bashkir substage, according to the scheme, accepted for an eastern-European platform.

It should be noted that and within archipelago itself the Earth Franz-Joseph on his different islands in Upper Triassic ones - lower-Lias intraformational conglomerates they are known pebble cryptocrystalline pelitomorphic limestone, in base mass of which are encountered the numerous remainders/residues of the Foraminifera,



inlaid by fine-grained calcite. Hence from the samples/specimens, assembled on Hefer (Is. Earth Wilcheck cape, M. F. Solovyev it determined: Paraturammia sp., Tuberitina collosa Reith., Glomospira sp., Tolypammia sp., Ammoverbella aff. vaga Reith., Globivalvulina sp., Tetrataxis sp. and Globivalvulina sp., and also primitive small/fine forms more precise than indefinable Schubertella sp. and the single forms of large/coarse, but also primitive fusulinid from subfamily Fusulinae Moell.

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Schubertells and fusulinids, and also Tolypammia and Ammoverbella as the presence of the traces of numerous seaweeds, they indicate, on the conclusion by M. F. Solov'yeva, to the average/mean Carboniferous period. Thus, is not excluded coevality of these species/rocks and Vereian-Kashira limestone Is. Victoria.

Limestone and dolomite Is. Victoria, probably, correspond to the separate interlayers of analogous species/rocks, usual in Western Spitzbergen's "lower gypsum-bearing series" (region of Bille-Fiord) whose upper part, as are considered Forbes, etc. (1958), is described by there knowingly post-Namurian brachiopods Choristites sp. This series will lie on the carboniferous "Billefiord" sandstones of culm, related according to flora and palynologic data to tour - lower

Namurian inclusively (Playford, 1962) and, thus, completely compared with the problematic deposits of the Earth Franz-Joseph, that contain the layers of carbon/coals with Lower Carboniferous (Visean?) disputes.

Triassic system.

Upper division.

These deposits are represented the maritime layers of Carnian tier and their covering substantially continental precipitation, which generate lithologically single Upper Triassic-Lower Jurassic thickness. In the limits of the triassic in this thickness we secrete the Wilczek and Vasil'yevskiy suites, related on the basis of paleontological and other data respectively to Norian and undifferentiated Norian and Rhaetian tiers.

Carnian tier.

On cape Hansa (Is. Zemiya Wilczek) in the basis of section/cut will lie the bundle of shale siltstone with the interlayers of aleuritic, pelitomorphie and organogennic limestone in visible power/thickness approximately 20 m which are brought out here to topographic surface, probably, in connection with block motions and

processes of diapirism (Fig. 2). In these species/rocks, and is also in their overfilling pyritized calciferous concretions discovered the rich fauna of ammonoids and pelecypod. Hence Yu. N. Popov (1958, 1960) determined ammonite *Cyrtopleurites* aff. *strabonis* Mojs. For zone *Trachyceras aenoides* of the lower substage of the Carnian layers of Alps C *strabonis* he is leader. From the mentioned exposure Yu. N. Popov described two new forms/species of ammonite - *Hauerites ganzae* Popov (ex MS) and *Sirenites piroshnikovii* Popov (ex MS), and are also determined the pelecypods: *Palaeonello* cf. *tobieseni* Bohm, *Nucula* cf. *striatillata* Goldf., *Halobia* cf. *zitteli* Lindstr. and *Cardinia* cf. *ovula* Kittl. - boreal forms, general/common/total with the same from the Carnian and Ladinian tiers of the Earth of Ellesmere and Is. of bear. The described above deposits Yu. N. Popov relates to the lower substage of Carnian tier. From these layers V. A. Basov determined Foraminifera among which they discovered the forms, characteristic for maritime Carnian and Lias deposits in region of the Khatanga bay/gulf: *Dentalina gladioides* var. *gladipides* Gerke, D ex. gr. *tenuistrata* Terq., *Nodosaria* aff. *mitis* (Terq. et Berth.), *Neogoinitzina* ex gr. *alaskensis* (Tappan), etc. hence ohms M. Lev did determine to ostracod *Ogmokoncha acuta* (?) Gerke et Lev, known in the Carnian Lias deposits of the Norovik region. Thus, the given microfauna is of large interest as the first standard complex for the Carnian deposits of the Earth Franz-Joseph.

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From the organogenic limestone, component/term the basis of the section/cut of the Carnian deposits of the cape Hansa, by M. A. Sedova was possible to separate palynological complex, in which predominate the disputes of pteridospermaphytes (740/o). Among them the dominant role belongs to disputes from the morphological groups *Leiotriletes* (*L. gleichenites* Sed., etc.) and *Phyllotheccites* (*Euryzonotriletes microdiscus* K.-M., *Stenozonotriletes microdiscus* K.-M., etc.). Them accompany single *Hymenozonotriletes politus* K.-M. and *Azonotriletes intertextus* Naum. var. *triassica* K.-M., and also *Selaginella*, *Cibotium*, *Matonia triassica* K.-M., *Osmundaceae*, *Marattiaceae*. Pollen spectrum (250/o) is represented *Ginkgoales*, *Bennettitales*, and also single *Coniferae*, *Araucariaceae*, *Podozamites* and ancient *Pinaceae*.

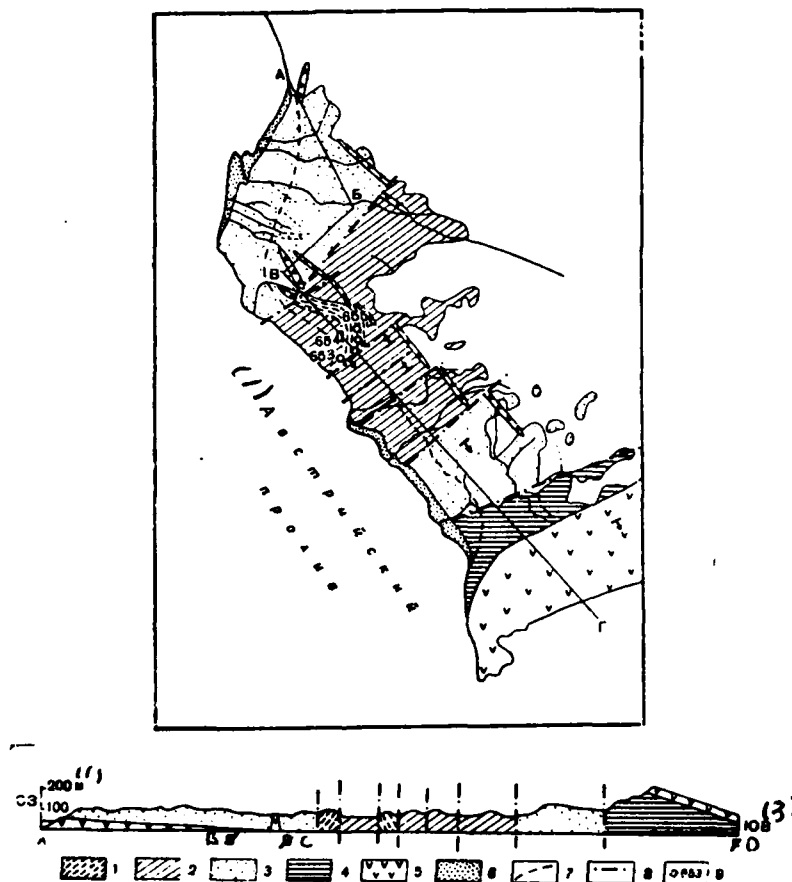


Fig. 2. Schematic geologic map/chart/card of Hansa cape. 1) the Carnian deposits; 2) the deposit of Wilczek suite; 3) the deposit of the Vasil'yevskiy suite; 4) the deposit of the Kimmeridgian tier; 5) the sheet intrusion of the dolerite; 6) the maritime quaternary deposits; 7) the back suture of 15-meter abrasive terrace; 8) the line of the faults; 9) observation point.

KEY: (1). Austrian strait/spill. (2). m. (3). SE.

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Close in composition cryptogamous-pollen complex was extracted by N. A. Pervuninskaya from the neptunian dikes (diapir fold<sup>?</sup>), prepared in the form of ridge-like monadnock of pelitomorphic limestone among its accomodating sands on the north Is. Graham-Bell. These sands contain disputes and pollen of younger (Rhaetian?) complex. In connection with this fact the outcrop of the pelitomorphic limestone, which protrude among sands in the form of secant is thawed, it can have diapiric nature. In a cryptogamous-pollen complex, discovered in limestone, predominate representatives Matoniaceae (52o/o) who in considerably smaller quantities (14o/o) are known in the bottoms of Norian-Rhaetian deposits of Hansa cape and only in single forms (1-3o/o) are encountered in younger deposits. On the basis of this tendency of the decrease of the content of spores Matoniaceae upward on section/cut, and also taking into account, that according to data of E. N. Kara-Murz (1958) these ferns in East Taimyr are characteristic predominantly for the upper triassic, it can be assumed that their presence in limestone Is. Graham-Bell in quantity 52o/o indicates the

affiliation of the latter with the Carnian ones of deposit. In favor of this assumption speaks and entire remaining composition it is cryptogamous/sporiparous - the pollen complex of pelitomorphic limestone, in which are present archaic - Permo-Triassic - form of spores (Lycopodiaceae with dense edging, etc.) and pollen (Protopinus striatus K.-M.).

One additional outcrop of Carnian, and possibly, and more ancient Triassic deposits is feasible on Rudolf Is., where between the Auk capes and column in the beginning of our century by participants in duke Aborutskiy's expedition was found the crater of pre-Aalenian (on contemporary schemes) pelecypods, defined by Paron as Megelodon (Snezia, 1903).

Norian and Rhaetian tiers.

At the end of the past century R. Kettlitz (Kettlitz, 1898) and F. Nansen (Nansen, 1900) on Stephen (Is. Earth Georg capes and Flora (Is. of Northbrook) established/installed the outcrops of continental deposits with the poor impressions of leaves, that lay under faunistically described Aalen <sup>1</sup>.

FOOTNOTE <sup>1</sup>. On the schemes of those days these deposits were related by I. Pompecky (Pompecky, 1900) to Bayos. ENDFOOTNOTE.

In this case of the collection, brought by R. Ketlits from layers, is component/term the basis of cape Stephen, A. Nathorst (Nathorst, 1900) determined impressions Pterophyllum of the Triassic type. On the presence of the latter A. Nathorst considered it proved that "... layer in knot Stephan corresponds to Rhaetian layer in Van-Keylensbae on Spitsbergen and in Belsunn region". The much late wide development of analogous deposits on the islands of archipelago was established/installed by F. N. Spizharskiy (1936) and N. P. Lupanova (1932), which, however, without special to that bases accepted them for the facies analog of maritime Upper Jurassic deposits.

New confirmation about the presence on the Earth of Franz-Joseph of the continental deposits, more ancient than maritime of Aalen, and detailed materials on their stratigraphy was obtained by V. D. Dibner, L. P. Pirozhnikov and V. K. Razin during the years 1953-1957. The especially essential materials of distance field works in 1957, when, in particular, were revealed faunistically described Carnian deposits, which determined the lower age limit of continental thickness.



Finally, the palynological investigations of samples/specimens in the section/cut, described by L. Yu. Budantsev and I. N. Sveshnikova (Botanicheskoy the institute of the AS USSR) on height Flora, allowed M. A. Sedova to arrive at conclusion about the lower-Lias age of terrigenous deposits, directly laying under the maritime of Aalen, and about the transition of them downward on section/cut into the deposits of Norian-Rhaetian age. On the basis of floral collections, N. D. Vasilevsky's processed, and especially in connection with  M. A. Sedova's detailed palynological investigations the thickness in question was rugged to three suites - Wilczek, Vasilevo (Norian and Rhaetian tiers) and Tegetkhofsiy, relating already to lower Jurassic.

Wilczek suite.

Wilczek suite is named on Is. <sup>Zemlye</sup> Wilczek ~~East~~, in northern coast precipices of which is revealed the most ancient part of Upper Triassic-Lower Jurassic terrigenous thickness.

For the real composition of the suite whose best sections/cuts are known on Hayes islands and <sup>Zemlye</sup> Wilczek ~~East~~, characteristically preponderance is sandstone and siltstone, the general/common/total increase in the coarse-grain size upward in section/cut and the almost purely silicide-quartz composition of the fragmental part of

these species/rocks (80o/o of quartz and 15o/o of quartz-chalcedony flints). Together with common for an entire thickness carbonate basal cement with structure Fontainebleau in Wilczek suite are observed the sandstones with silicide cement, transient to quartzite-sandstones. In the upper layers of suite are encountered the thin lenticules of porous burnt clays, which consist of the small/fine, well rounded pebbles of quartz, flints and quartzite, cemented by fine-grained silicide-quartz sandstone.

The heavy fraction (from psammite-silt subfraction) of the lower layers of suite consists almost to 50o/o of the titanous minerals (leucoxene, anatase, etc.), and also from black ore ones (magnetite, ilmenite)-12o/o, garnet - 13o/o, tourmaline - 10o/o, etc. In the tops of suite the place of titanous minerals occupy the pyroxene, and the content of black ore minerals grows/rises to 30o/o due to the disappearance of tourmaline and certain decrease of the content of the garnet and other minerals.

On the conclusion by M. A. Sedova (Dibner, Sedova, 1959), the deposits of Wilczek suite differ from the deposits of Carnian tier by the richer composition of pollen and dispute. Here appear disputes Hymenophyllaceae, Cyatheaceae, Dicksonia, Hausmannia, Onychium, Cheiroleuria, Gleichenia, Todea and single disputes Calamites. Places is retained comparatively large quantity Matonia triassica

K.-M. (to 170/o) and is encountered another typically Triassic form - *Azotriletes intertextus* Naum. var. *triassica* K.-M. Noticeably is increased a quantity of pollens of ancient coniferous ones, among which are present such archaic forms, as *Lebachia*, *Striatopodocarpites*, *Striatopinites* and *Vittatina*. Is increased the content of ancient pine ones, and by the places also of the pollen of *Bennettitales* and ginkgoic. Appears pollen *Caytoniales*, *Cycadales*, *Podocarpaceae*. The general/common/total composition of complex makes it possible to count the age of Wilczek suite for Upper Triassic ones, and, taking into account some of its differences from cryptogamous-pollen complex of Carnian layers, it is possible to assume the Norian age of suite. For Wilczek suite as a whole is characteristic the absence of plant remainders/residues and carbon/coals, which will bring together it with the lower "silent" layers of Nemtsovskiy suite of East Taimyr, also referred by N. A. Shvedov in 1957 supposedly to Norian tier.

The total power/thickness of the Wilczek suite, developed predominantly on Hayes Is. and Wilczek Land, is equal to 240 m.

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Vasil'yevskiy suite.

It is named so on one of the most complete ones and it is good palynologically and florally described sections/cuts of these deposits on Vasiliev (Is. Wiener-Neustadt cape. Suite is characterized by diverse real composition, which most vividly becomes apparent in the middle part of the section/cut, to which is confined a 50-60-meter bundle of multicolored sands and it is sandstone diverse granulometric composition, enriched by mica. This bundle contains sometimes whole the interlayer of the mineralized woody remainders/residues, leaves of horsetails and araucarians, a large quantity of charred detritus and pyritic concretions. Especially are secreted met in this bundle of multicolored deposits on the Camp Is. Unconsolidated sandstones, which consist more than to 50o/o of the large/coarse paleolae of the clarified biotite, and of remaining part from grains of quartz, flints, the feldspar and small quantities of very unconsolidated clayey (?) cement. Macroscopically this species/rock with difficulty differs from micaceous slate.

In the section/cut of suite as a whole prevail in small particles-medium-grained sands and to a lesser degree sandstones whose light fraction is characterized by predominantly polymict composition. Substances by it together with quartz and flints, which comprise only about 50o/o, are observed the fragments of acid plagioclases, potash feldspar, acid effusions, chloritized species/rocks, carbonaceous-micaceous slates, cinder, etc., which

comprise total from 12 to 350/o of light fraction. The composition of the heavy fraction is characterized by large mutability/variability. In the bottoms of suite predominate the garnets, which compose 800/o of the heavy fraction, whereas in younger layers is observed the exceptional colorfulness of its composition. Characteristic minerals are here the black ore minerals of the group of epidote - zoisite, biotite and chlorite, titanous, zircon, garnet, staurolite and disthene.

The sandstones of Vasil'yevskiy suite are cemented by predominantly basal cement which in the bottoms of suite in composition calcite, but above on section/cut is changed by consecutively/serially ferruginous-carbonate, ferruginous, argillo-silicon and silicide.

Together with sands and sandstones among the deposits of suite are encountered single interlayers and lens of silt, siltstone, argillite and pelitomorphic limestone, and also porous burnt clays and conglomerates. The latter form layers and lens by power/thickness up to several meters, mainly within the multicolored bundle mentioned above on the islands of Northbrook, Hayes, Zerlya Wilczek, Graham-Bell, etc. (Fig. 3, 4).

Conglomerates consist of the comparatively well rounded pebbles

of those reaching on eastern islands 10 cm in diameter. To 90o/o this of the pebble of quartz, substantially chalcedony flints and quartzite. The remaining 10o/o pebbles compose radiolarites, jasper, silicide-clayey slates, quartzite-sandstones, acid effusions (amygdaloidal porphyries), granites, and on the islands of Zemlya Wilczek and Graham-Bell among them are encountered micro-granulated and pelitomorphic limestone with Middle Carboniferous Foraminifera and liptobiolith carbon/coals of Middle Devonian appearance (Dibner, etc., 1961; Korzhenevskaya, 1957).

In the upper part of the section/cut of suite appear most ancient at the Earth Franz-Joseph the layers of Mesozoic brown coal, the reaching 2 m power/thicknesses and consisting of the alternation of durain and durain-clarain carbon/coals and thin interlayers of fusain, which is noted by Dibner, Krylova in 1963.

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In Vasil'yevskiy suite are scattered the fragments of wood of araucarians this Araucariopitus dibneri shilkina whose propagation in the Mesozoic deposits of Arctic, on the conclusion by I. A. Shilkina, is limited by the tops of the triassic - lower Jurassic. Furthermore, by I. A. Shilkina from the suite in question are described also wood Araucariopites gregussii Shilk. and Xenoxylon Latiporosum (Cramer)

Gothan, which by it are established/installed also in younger Lower Cretaceous deposits.

In biostratigraphic sense are more interesting those discovered on Hayes islands, Wiener-Neustadt, large by komsomolsk, Zemlya Wilczek and Graham-Bell the single impressions of leaves and haulms, including *Neocalamites cf hoerensis* (Shimp.) - the form, characteristic, on the conclusion by N. D. Vasilevsky, for the Rhaetian deposits of East Greenland, Sweden (Nathgorst, 1910) and Taimyr (Shvetsov, 1957), also, for Norian-Rhaetian deposits of Chelyabinsk basin.



Fig. 3. Sands and sandstones of Vasil'yevskiy suite, which generate low plateau on the north Is. Graham-Bell. V. D. Dibner's photo.

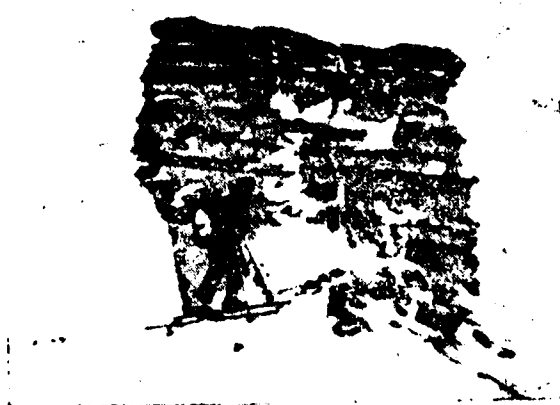


Fig. 4. Bundles of skew-laminated ones it is sandstone with fragile clayey cement, that interrupt themselves from thin horizontal interlayers of ferruginous sandstones. Vasil'yevskiy suite on Is. Graham-Bell. V. K. Razin's photo.



As has already been indicated higher, on Steven (Earth Georg cape) were known the old finds of remainders/residues Pterophyllum, also indicating, according to A. Natuyorst, on Rhaetian.

Cryptogamous-pollen complexes, studied of M. A. Sedova (Dibner, Sedov, 1959; Dibner, 1960), from the series/number of the sections/cuts of these deposits, are characterized by the comparatively small content of spores of the typically Triassic plants, predominantly fixulac (*Leiotriletes gleichenites* Sed., *Clathropteris*, *Cheiropleuria*, *Osmundaceae*, etc.), and by the supremacy of the pollens of Bennettitales, ginkgoic and especially others coniferous ones, among which strongly grows/rises a quantity of relatively young "Jurassic" forms, in particular araucarians and ancient pine. Many forms dispute and pollens are morphologically similar to those discovered E. N. Kara-Murz (1958) in upper - carboniferous (!) the part of the Nemtsovskiy suite of cape it is flowering (East Taimyr), which N. A. Shvedov (1957) on the complex of plant macro-remainders/macro-residues considers Rhaetian.

In the bottoms of Vasil'yevskiy suite on Hayes Is. are discovered Foraminifera *Fronicularia brisaeformis* Born. (single crater) and numerous *Ammodiscus* sp. (ex gr. *asper* Terq.), that, on V.

A. Basov's conclusion, do not give grounds for refining the age of the accomodating layers, but they indicate the local intermittence of the ruling continental deposits with the offshore-marine. About this tells the discovered in the middle part of the suite vertebra more precise indefinable ichthyosaurus (A. K. Rozhdestvenskiy's oral conclusion).

Thus, the Vasil'yevskiy suite whose total power/thickness is equal to 280 m, on palynological complexes, remainders/residues of sheet flora and wood is related to the Norian and Rhaetian tiers of the upper triassic. In this case, there are foundations for assuming that the large part of the suite is knowingly Rhaetian.

Jurassic system.

Lower division.

The Lias deposits include upper third of terrigenous Upper Triassic-Lower Jurassic deposits - Tegetkhoffskiy suite (on similar/analogous cape on the Is. Gall) whose sections/cuts are described also on islands the Zemlya Georg, Northbrook, Hooker, McClintock, Alger, Becker, Bergkhauz, etc. (Dibner, Sedova, 1959; Dibner, 1960). For the real composition of Tegetkhoffskiy suite are characteristic consertal substantially silicide-quartz sands and

sandstones by the places with silicide cement, that again (as in Wilczek suite) it is accompanied by appearance in the section/cut of the layers of quartzite-sandstone. Are observed separate layers and bundles of siltstone, less frequent than pelitomorphie limestone, but by places numerous seam of pebbles and conglomerates (Fig. 5, 6) together with which in section/cut appear the layers of carbon/coals 1.

FOOTNOTE 1. The latter are known on the Is. of Alger (Horn, 1932), and furthermore, they can be assumed in the Lias layers, component/term the very basis of the section/cut Is. ~~de~~ Bergkhauz, since sloping above them Upper Jurassic calcareous sandstones bear the distinct traces of subterranean fire (pastry-cooks, 1958).  
ENDFOOTNOTE.

According to data of V. D. Dibner et al. (1961), psephitic deposits consist of pebbles quartzite-sandstone, flints, quartz, micro-quartzite, also, of the smaller part of the micro-granulated and pelitomorphie limestone sometimes with brachiopods, corals and microfauna of carboniferous and Permian periods.

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For cryptogamous-pollen complexes of the deposits of Tegetkhoffsky suite are characteristic the laws, which were outlined even in Wilczek and Vasil'yevskiy suites. Upward in section/cut is increased the content of pollen above disputes (respectively to 60 and 40o/o). Among the latter almost by whole disappear archaic - "Triassic" (finned) forms, but is increased the content of the Jurassic forms of fixilic ones (Osmundaceae, etc.), Lycopodiaceae and equisetaceous plants, while among pollen (Podocarpus, Bennettitales, ginkgoic, etc.) it is more and more supremacy converts/transfers to coniferous ones. In this case is very characteristic the appearance of very large/coarse pollen of ancient pine, nowhere known ones earlier of Lias. This cryptogamous-pollen complex is similar to complex, described by N. A. Pervuninskaya (1958) from the lower-Lias deposits and also overlap of the Tegetkhoffskiy suite of faunistically described Aalen makes it possible to consider its age lower-Lias.

The maximum total power of Tegetkhoffskiy suite is equal to 220 m, and an entire terrigenous Upper Triassic-Lias thickness - about 800 m.



Fig. 5. The exposure of Lower Jurassic silt, it is sandstone and marrying section/cut quartzite-sandstone.) Galkovskiy (Is. Becker cape. V. K. Razin's photo.



Fig. 6. Lens of fine-pebbled conglomerate in sandstone from deposits of Tegetkhoffskiy suite of Sedov cape. V. D. Dibner's photo.

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In conclusion it should be pointed out that this thickness is represented on the Earth Franz-Joseph the section/cut, most complete

of a number of known ones in entire East Europe, which is confirmed by the gradualness of a change in its palynologic complexes.

Average/mean and upper divisions.

The Middle Upper Jurassic substantially aleurite-clay, partial calcareous maritime deposits are common on the islands of archipelago very unevenly, which is connected with deep Pre-Cretaceous eroding/scouring. These deposits contain rich fauna it is mollusck ammonoids, belemnite, Foraminifera, etc., which makes it possible to date them with an accuracy to substage (Dibner, 1958; Dibner, Shul'gina, 1960).

Aalenian tier.

Upper substage.

On cape Flora (Is. of Northbrook), at the foot of mountain Churluanis (Is. Hooker) and on western shore the Is. Rainer directly on Lias will lie the silt, siltstone and argillite from *Oxytoma jacksoni* var. *kelimiarensae* Body 1, *Pecten* (*Varianussium*) *oleneki* Body 1, *Ludwigia* sp. (? cf *murshisonae* Sow.) and by other forms, which lead for upper Aalen (*Lingula beani* Phill., *Discina reflexa* Sow., *Hibolites* (*Belemnites*) cf *deyreci* Opp. Microfaunistic complex is

represented by the same Foraminifera, that they are common in the limits of Aalen - lower bays of the Khatanga basin/depression: *Ammodiscus pseudo infimus* Gerke et Sossip., *Lenticulina* ex gr. *protracta* Born., *L* ex gr. *mironovi* Dain and *L* aff. *nordwikensis* (Mjatl.). (determination of G. P. Sosipatrova and V. A. Basov).

The maximum visible thickness of Upper-Aalenian deposits is equal to 30 m.

Batskiy tier.

On cape Flora, according to F. Nansen's data (Pompecky, 1900), above 80-meter talus, developed is higher than the outcrops of Aalen, outcrop the horizontally layered clays with a thickness of 24 m. They are overfilled by phosphorite concretions and fragments of arenaceous marl, concretion contain *Arctocerphalites koettlitzii* Pomp., *A. pilaeformis* Spath, *A. ellipticus* Spath, which on contemporary stratigraphic schemes should be related to upper Bath.

Kelloveyskiy tier.

On the coasts of bays Tikhaya (Fig. 7) and Yuri, on capes Medvezh'yem (Fig. 8), Sedov, to Charlyan's mountain and other points the Is. of Hooker, by R. L. Samoylovich and I. M. Ivanov (1931), by

T. N. Spizharskiy (1936), but later in more detail by V. D. Dibner are described outcrops of thin-platy laminated less frequently lumpy aleuropelites in visible power/thickness to 35 m with scattered pyrite and by numerous concretions of cryptocrystalline limestone. The latter, just as partly and aleuropelites themselves, contain the abundant fauna of the ammonite among which on entire section/cut is established/installed knowingly Callovian Cadoceras sp. indet., together with Bath-Kelloveyskiy forms - Parallelodon schourovskii Rouill. and Inoceramus ex gr. retrorsus Keys.

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Furthermore, on Sedov cape among taluses T. N. Spizharskiy found the vertebra of plesiosaurus Peloneustes cf philarchus (Seeley), characteristic, according to A. N. Ryabinin, for Kellovey.

Are exclusively to the lower part of the layers in question confined Arcticoceras ishmae Keys., Cadoceras elatmae Nik., C. (Catocadoceras) ognevi Body 1. and confined in essence to themselves aleuropelites belemnite Cyllindroteuthis tschernyschewi Krim. and C. tornatilis Phill., indicating the lower substage of Callovian (Bodylevskiy, 1957).



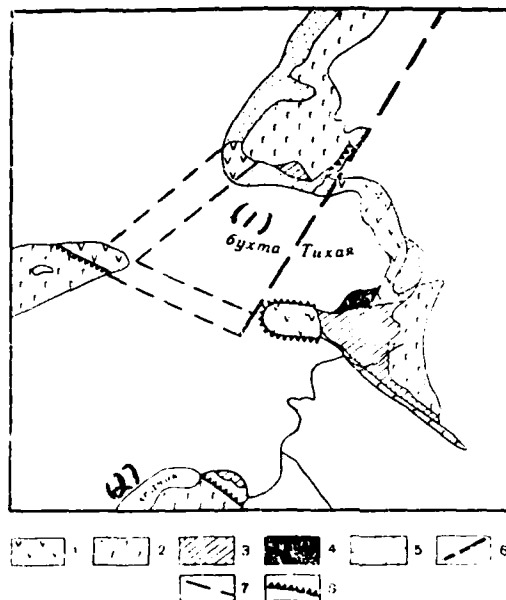


Fig. 7. Schematic geologic map/chart/card of region of the bay of calm on Hooker Is. 1) the sheet and secant diorite intrusions; 2) the Lower Cretaceous basalt intergments; 3) Callovian deposits; 4) the Middle Jurassic deposits; 5) the Lower Jurassic deposits; 6) the predicted fault; 7) the boundary of intrusions under water; 8) structural steps.

Key: (1). bay is calm. (2). bay.



Fig. 8. Outcrop of Callovian deposits on cape bear (Is. Hooker).

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Besides the forms enumerated above in taluses are assembled *Cadoceras nanseni* Pomp., *C. (Longaeviceras) ex gr. nikitini* Sok., *Quenstedticeras* sp., *Belemnites borealis* Orb., *Pachyteuthis panderi* Orb., etc., which indicate already the upper substage of Callovian. Middle-Callovian fauna in the described deposits is unknown.

The separate interlayers of aleuropelites contain the very peculiar complex of sand Foraminifera, among which V. A. Basov determined: *Ammodiscus pseudoinfinus* Gerke et Sossip., *Ammobaculites* spp., *Haplophragmoides* sp., *Recurvoides* sp., *Verneulina ex gr. sibirica* Mjatliuk, *Trochammina* sp., *Lenticulina* sp.

For Callovian deposits Is. of Hooker is known also spore-pollinic spectrum for which, according to G. M. Romanovskaya, a characteristically high content of the pollen of coniferous ones (Araucariaceae, Podozamites, Picea, Pinaceae - 50o/o) and a large quantity of pollen of Bennettitales and ginkgoic - 15o/o; disputes (34o/o) are represented ferns of the family of Osmunds (11.5o/o), selyaginells (11o/o), and also Lycopodiaceae, Cyatheaceae, Schizaeaceae, Leiotriletes, Lophotriletes and Camptotriletes.

Another point where are known the outcrops of Callovian, is cape Flora on the Northbrook Is. (Fig. 9), where outcrop the layers of upper substage. Here, according to data of P. Nansen (Pompecky, 1900) and R. Kettlitz (Kettlitz, 1898, 1899) at the height of 150-172 m above sea level, higher than talus, creeping in to Batskiy deposits, outcrop clays with numerous formations of the type "cone into cone" and with the interlayers of the large/coarse arenaceous concretions, overfilled by remainders/residues the pelecypod also of ammonite. Hence by I. Pompecky are determined *Pseudomonotis cf ornata* Q, *Pecten lindstroemi* Tullb., *P. cf. gemissus* Phill., *Lima cf. duplicata* Goldf., *Leda cf nuda* Keys., *Parallelodon stschourovskii* Rouill., *Cadoceras tschefkini* Orb., *C. stenolobum* Nik., *C. nanseni* Pomp., *Cylindroteuthis subextensa* Nik., *Pachyteuthis panderi* Orb.

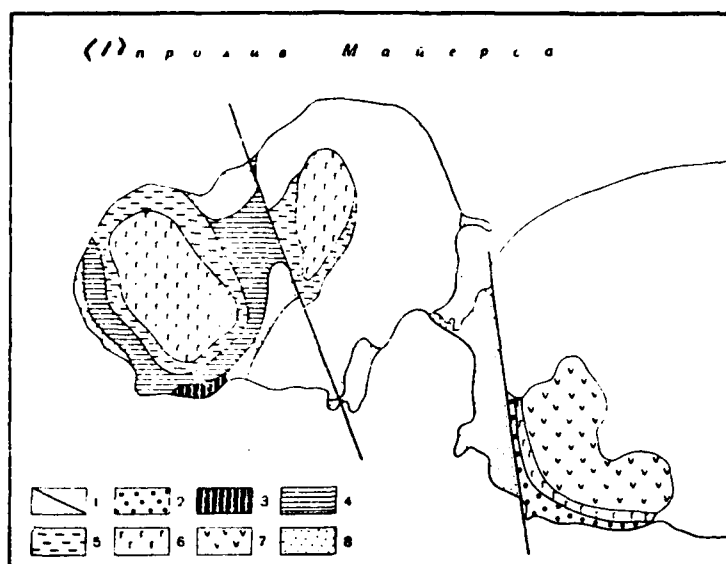


Fig. 9. Schematic geologic map/chart/card of region of cape Flora (Is. Northbrook). 1) fracture dislocations; 2) Upper-Triassic terrigenous deposits; 3) the Lower Jurassic terrigenous deposits; 4) the Middle Jurassic maritime deposits; 5) the Upper Jurassic maritime deposits; 6) the Lower Cretaceous basalt integuments; 7) the sheet intrusions of the dolerite; 8) contemporary maritime deposits.

Key: (1). Myers strait/spill.

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As consider V. I. Bodylevskiy, this faunistic complex on the presence in it *Cadoceras nanseni*, *C. tscheffkini* and *C. stenolobum*, most likely,

he indicates the lower zone or upper Callovian.

Here, in talus, near the contact of the described layers with their covering (just as on Hooker Is.) basalt F. Nansen and R. Ketlits found *Quenstedticeras vertumnus* Sinz. On contemporary schemes this ammonite is related to the upper layers of upper Callovian - to zone *Quenstedticeras lamberti*.

The oxfordian stage.

Upper substage.

On Cape Khefer~~a~~ (Zemlya Wilczek) L. P. Pirozhnikov revealed/detected the disintegration of the marl concretions, containing *Aucella bronni* Lah., *A. sinzovi* Pavl., *Amoeboceras alternans* Buch. The latter from these forms (on the conclusion of that defined fauna N. S. Voronets) is, as is known, that leads for upper Oxford.

Kimmeridgian tier.

On the southeast of cape Hansa (Zemlya Wilczek) in an interval of 10-60 m above sea level outcrop the laminated weakly-cemented siltstone, which contain calciferous concretions and abundant,

including ammonitic, fauna.

It is hence from L. P. Pirozhnikov's collections determined (N. A. Shul'gina): in an interval of 35-40 m (above sea level) - *Aucella bronni* Rouill., *Amoeboceras* (*Hoplocardioceras*) *decipiens* Spath, *Amoeboceras* (*Amoebites*) *bodylevskii* Schulg.; in an interval of 10-15 m - *A bronni*, *Pecten* (*Entolium*) *demissus* Phill., *Amoeboceras* (*Amoebites*) *spathi* Schulg. <sup>1</sup>, *Rasenia* sp.

FOOTNOTE <sup>1</sup>. New forms/species, isolated and described for the first time by N. I. Shul'gina (1959). ENDFOOTNOTE.

On Hansa cape are represented those isolated by V. I. Bodylevskiy and N. I. Shul'gina for the Arctic regions: the zone of lower Kimmeridge *Amoeboceras kitschini*, for which is characteristic *A. spathi* (very close to *A. kitschini*), and the zone of upper Kimmeridge - *Amoeboceras decipiens*, adjusted on similar/analogous ammonite (Shul'gina, 1960).

On the Bergkhauz Is. (Fig. 10) outcrop the very gently sloping layers of the arenaceous and silt-arenaceous limestone, which contain by places the rich of fauna pelecypod, ammonite and belemnite. Hence from the sample/specimen, undertaken with the height of 35 m above sea level, N. I. Shul'gina determined *Amoeboceras* (*Amoebites*)

bodylevski Schulg. <sup>2</sup>, which, judging by section/cut on Hansa cape, can indicate the upper zone of lower Kimmeridge.

FOOTNOTE <sup>2</sup>. From geodesist O. V. Mironov's collections, transmitted in 1957 in NIIGA. ENDFOOTNOTE.

Judging by encountered above aucellas, among which to height on the order of 100 m above sea level are encountered Oxford Kimmeridgian A. ex gr. bronni Rouill, here it is possible to assume the development of the layers of Kimmeridgian age (Dibner, Shul'gina, 1960).

In talus on Khefeca cape, near the disintegration of concretions with Oxfordian fauna, L. P. Pirozhnikov assembled belemnite *Pachyteuthis explanata* Phill., which, on V. I. Bodylevskiy's conclusion, can indicate Kimmeridge.

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Lower and upper Volga tiers.

On Khefeca cape 20-100 m above sea level (higher than the disintegration of Oxfordian concretions) from unconsolidated lamellar clayey-arenaceous limestone L. P. Pirozhnikov gathered the fauna among which N. S. Voronets determined *Aucella fischeriana* Orb. and

ammonite *Perisphinctes* sp. The latter is very similar with *Dorsoplanites* and, thus, can indicate the lower to Volga tier. However, if by new collections presence *Dorsoplanites* is not confirmed, then on presence *Aucella fischeriana* these layers can prove to be Upper-Volga (Sak, etc., 1963, pg. 158).

On the *Bergkhaus* Is., as has already been indicated (Dibner, Shul'gina, 1960), in an interval of 370-100 m above sea level of higher than the layers from *Aucella bronni* Rouill. were developed the following deposits: 370-345 m - a sheet intrusion of dolerite (or basalt integument); 345-175 m - sands with separate interlayers were sandstone; 175-100 m - arenaceous and aleuritic limestone, analogous to developed below Kimmeridgian layers.

At the same time (Dibner, Shul'gina, 1960) were assumed that the sedimentary layers, component/term island from mark 100 to mark 175 m, must correspond to upper Volga tier, but it is above - Valanzhin.

In 1960 the new collections of fauna were produced on the *Bergkhaus* Is. by L. P. Pirozhnikov, whence N. S. Voronets it determined from the following heights (above sea level) these forms/species: 106 m - *Laugeites* aff. *stschurowskii* (Nikit.), *Aucella russiensis* Pavl., *A. gracilis* Pavl., *A. cf. mosquensis* (Buch.); 30-32 m - *Aucella* cf. *krotovi* Pavl., *A. cf. terebratuloides* Lah.; 0-10 m - *A. cf. mosquensis* (Buch), *Nucula* cf. *ovatus* Phill.



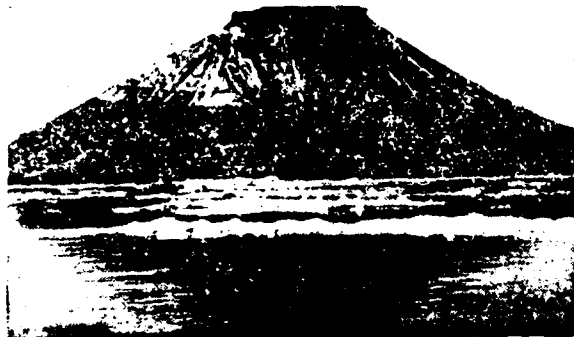


Fig. 10. Horizontally layered Kimmeridgian and Volga layers to the Bergkhauz Is., armored by basalt integument or dolerite sill. Photo of Chernokal'tsev.

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In the given list the fauna is arranged/located on entirely in accordance with its natural position in section/cut. As already indicated N. I. Shul'gina (Sacks, etc., 1963), if we in accordance with conclusion N. S. Voronets relate the horizon/level from Laugaites and by Lower-Volga aucellas (106 m) to epivirgatite layers of lower Volga tier, then it is unclear, how at the height of 30-32 m are present younger on age, predominantly Upper-Volga Aucella cf krotovi and A.cf. terebratuloides. Those assembled by L. P. Pirozhnikov in the basis of section/cut A.cf. mosquensis can be both Upper-Kimmeridgian (which will agree with O. V. Mironov's

collections) and Lower-Volga (from lower or average/mean substage).

Thus, these collections show that on the Bergkhaus Is. actually/really is outcrops of Lower-Volga (upper part) and Upper-Volga deposits and that they, as their underlying layers, have maritime origin. Larger, namely the stratigraphic joining of outcrops with separate characteristic forms to section/cut, to make, unfortunately, until it is cannot, as it cannot be agreed with the reference of all lower 106 m of the section/cut Is. of Bergkhauz to epivirgatite horizon/level of lower Volga tier (pastry-cooks, 1961). V. N. Sacks et al. (1963) indicate that layers with L aff. stshurovskii Nikit., to more probably relate to upper Volga tier. Does not add clarity isolated from the series/number of layers on entire interval of collections (0-106 m) complex of Foraminifera from *Ammodiscus veteranus* Kosyr. and *Haplophragmoides emeljanzevi* Schlieff. which, on V. A. Basov's conclusion, is known on the north of central Siberia in the tops of lower Volga tier and in upper Volga tier.

Undifferentiated Middle Upper Jurassic deposits.

On the Earth Franz-Joseph are known also the separate outcrops of the maritime deposits which before their detailed investigation should be related to the Middle Upper Jurassic undifferentiated deposits.

On islands Bell and Mabel in the clays, which lay under basalt thickness, V. Grant (participant in whether-Smith's expedition, 1880), found to belemnite, which Eteridge related to Oxford (Markam, 1881), and Ye. Newton and J. Till (1897) so/such supposedly - to Callovian.

In the arenaceous clays, which outcrop on the Al'dzher Is. it is higher than the continental Lias deposits (150-190 m above sea level), G. Horn (Horn, 1932) found belemnite whose age by it is not indicated. According to overall stratigraphic situation these are - Middle Upper Jurassic deposits.

The accurately indefinable, but unconditionally (on V. I. Bodylevskiy's conclusion) Jurassic belemnite were assembled by geodesist O. V. Mironov, who revealed/detected their whole deposits in 1956 on the beach of eastern shore Is. Bryce. The analogous deposits of belemnite were observed at the same time and by geodesist I. M. Martynenko (oral communication/report) in the foot of cape Frankfurt. Is possible that this Kimmeridgian or Volga layers, which are stretched here from the arranged/located by series/number Is. of Bergkhauz.

In 1958 glaciologist M. G. Grosval'd (oral communication/report) observed on nunatak "Saw" (eastern shore the Is. Hooker) lower than the basalt integuments the outcrops of siltstone with the abundant fauna of belemnite which, probably, it is possible to compare with also by very rich in this fauna and described higher silt of Callovian on cape bear (western shore the Is. Hooker).

Total visible thickness of the Middle Upper Jurassic deposits of approximately 400 m. However, their actual total section/cut is known to us, probably, it is not more than half. For the yet not sufficient study of the geologic structure of archipelago the Earth Franz-Joseph, or distinctly block character/nature of his tectonics they give grounds to assume that even in many places can be revealed/detected at present the unknown horizons/levels middle- and of Upper Jurassic deposits.

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Cretaceous system.

On the Earth Franz-Joseph Cretaceous system is represented sedimentary effusive thickness, in essence this basalt, their tuffs and partly the precipitation of the continental origin of lower division. The younger layers of the offshore-marine origin are

related to the Cenomanian tier of upper cretaceous. Cretaceous, just as more ancient Mesozoic, formations of archipelago are pierced by the numerous secant and sheet intrusions of dolerite and gabbro-dolerites.

Lower division.

Sedimentary-effusive thickness.

This thickness is subdivided by us from bottom to top into the terrigenous bundle of the layers of valanzhin-Goterivskiy (?) age and two suites, composed in essence by effusive formations - basalt, their tuffs, and to a lesser degree by terrigenous deposits (suite of the bay of calm and suite of Salisbury). Latter/last two suites on the time of formation are related to Goteriv - Alb.

Terrigenous (Valanzhin-Goterivskiy?) layers.

They include the problematic sedimentary deposits, known thus far only in several points.

One of such few (revealed) places is Al'dzher Is. where is known 35-meter bundle of sands and it is sandstone with the thin layer of brown coal in basis, which contains the impressions of leaves

Sphenobaiera sp. - ginkgoic, common for Goteriv-Barremskiy complex of plant remainders/residues archipelago (Florin, 1936). This bundle will lie above layers with knowingly Jurassic belemnite and is changed upward on section/cut by basalt integuments (Horn, 1932).

Another point is) Khefera <sup>Zemlye</sup> (~~Buzh~~ Vil'chek), cape, where of the talus (lower than the basalt integuments) L. P. Pirozhnikov found the fragments of the fired siltstone with the impressions of subsaline pelecypod Cyrena cf. venulina Martins. and C. cf. uvatica Dunk. On G. G. Martinson's conclusion, these forms indicate Valanzhin - Goteriv.

Finally, to these problematic deposits, component/term the basis of Lower Cretaceous section/cut, can be supposedly referred sands with interlayers it is sandstone, that slope on the Bergkhauz Is. in an interval of 175-345 m above sea level - between aleuritic-arenaceous limestone with Upper Jurassic fauna and which armors the apex/vertex of island basalt integument. Judging on this section/cut, the maximum visible thickness of terrigenous layers is equal to 170 m. On the basis of the fact that pelecypods Cyrena were discovered in the species/rock, apparently, which tested the traces of firing by lower basalt integument the age of problematic layers should be restricted Valanzhin-Goteriv. This is confirmed also by their occurrence higher than the layers with lower-Upper-Volga fauna on the Bergkhauz Is. and this does not contradict Goteriv-Barremsian

age of leaves Sphenobaiera on the Alger Is.

#### Effusive formations.

Effusive formations are widely developed in archipelago and in many respects determine its external appearance. They will lie on the deeply washed away surface of Upper Triassic-Jurassic deposits and are dismembered by us with the considerable degree of conditionality to two suites - the bay of the calm (Goteriv-Apt) and Salisbury (Apt-Alb).

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#### Suite of the bay of the calm (Goteriv-Apt).

On Sedov capes, by Medvezh'yem (Is. Hooker), etc. in the basis of suite in deep (to 50 m) valley-like decreases in the ancient relief it will lie 8-10 basalt power fluxes in from 1-2 to 10-15 m, divided by layers tuffs. Above are arranged/located 5-7 basalt integuments in maximum power/thickness to 60 m each. Integuments by places are interbedded with aleuropsammite and agglomerative tuffs which are upward gradually changed by siltstone, clays, carbonaceous-clayey slates and other sedimentary rocks with the subordinated to them layers or mined coal.

In many places the integuments (Fig. 11) will lie one on other. In this case of the boundary between them they are established/installed on mandelstone edgings, clinker or to cortex of wind erosion in the underlying integument, and also on the presence of the fragments of petrified wood in the bottom of the overlying integument.

Sedimentary formations contain the impressions of leaves whose determinations are given below according to data of A. Matgorst, R. Florin, V. D. Prinady and M. D. Vasilevsky, brought to contemporary toponymy according to I. N. Sveshnikova and L. Yu. Budantsev (1967). This *Cladophlebis* (*Polypodites*) *arctica* Pryn., *Ginkgo haiburnensis* (L. et H), *G. lepida* Heer, *G. polaris* Nath., *G. reiniformis* Heer, *G. coriacea*, *Phoenicopsis angustifolia* Heer, *Stephenophyllum solmsi* Flor., *Windwardia crookallii* Flor., *Culgoweria mirabilis* Flor., *Sphenobajera paucinervis* Flor., *S. horniana* Flor., *Arctobaiera fletti* Flor., *Czekanowskia rigida* Heer, *Podozamites gramineus* Heer, *Pinus maakiana* Heer, *P. cf. gramineus* Heer, *Pityophyllum staratschini* Heer, *P. lindstroemii* Nath, *P. longifolium* Heer, etc. In suite is contained also the charred, calcitized and silicified wood of the coniferous *Protocupressinoxylon* (*Cupressinoxylon*) *koettlitzii* Seward, *Cupressinoxylon diskoense* Walton, *Keteleerioxylon arcticum* Shilkina,



(determination of I. A. Shilkina), and also core Papaninia involucrata Pedin <sup>1</sup>.

FOOTNOTE <sup>1</sup>. The determination of A. Kh. Pedin (1943), which considers that this core together with the obtained here wood Pityoxylon elggense and leaves (needle) belongs to one and the same form/species, close to Elatides curvifolia. ENDFOOTNOTE.

In collections from islands the Earth of Alexandra, McClintock, etc. (coll. V. D. Dibner) is discovered also Xenoxylon barberi (Seward) Krausel - form, known beginning with lower Jurassic, and is also established/installed new form/species - Cedroxylon arcticum Shilk. (Shilkina, 1967).



Fig. 11. Basalt integuments (suite of the bay of calm), which carry section/cut of one of the capes the Is. Ziegler. V. K. Razin's photo.

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From carbonaceous-aleuritic slates (bundle of the sedimentary rocks between basalt integuments on cape bear) V. D. Korotkevich secreted a cryptogamous-pollen complex, consisting to 720/o of the pollen coniferous (Podozamites, Protopicea mesophytica Pokr., P. biangulina (Mal.) var arctica K-M., Pinus (subgen. Diploxylon) sp., etc.; disputes (220/o) were represented exclusively ferns (Cyatheaceae, Osmundaceae, etc.). V. D. Korotkevich considers that this cryptogamous-pollen spectrum indicates Apt.

For solving a question about the age of the suite of the bay of calm great value have: a) numerous ginkgoic, they are which on Spitsbergen they are encountered together with *Elatides curvifolia* - coniferous, characteristic for the layers of Goteriv-Barremian; b)

*Pityophyllum staratschini* - coniferous, common for Barremian - Apt;  
c) Palynologic spectrum, characteristic for Apt - bottoms of Alba.

Taking into account these data, and also taking into account underlying of effusions post-upper-Volzhskiy, most likely Valanzhin-Goterivskiy, by deposits, the age of the suite of the bay of calm is defined as Goteriv-Apt.

Total power/thickness of the suite of the bay of calm of approximately 280 m.

Suite of Salisbury (Apt-Alb?).

Beyond the conditional lower boundary of suite is accepted the roof of the powerful/thick sheet intrusion higher than which on the central and western islands of archipelago are developed the homogeneous with underlying basalt integuments, divided by bundles it is sandstone, sands, siltstone, clays, carbonaceous argillite and brown coal (Fig. 12). These terrigenous deposits differ from the suite of bay in terms of calm larger power/thickness (to 60 m) and larger the degree of presence of coal. In them on cape Kaval'i (Is. Salisbury) are contained the diverse impressions of plants. Initially hence by V. K. Razin were assembled the impressions of leaves, referred of N. D. Vasilevsky to the new form/species *Taeniopteris*,

similar to *T. junboana* Krysat. from the Lower Cretaceous deposits of southern littoral and Aldan, and also Lena-Khatanga basin/depression where the latter was characteristic for Apt ("Ogoner-Yuryakhskiy" suite). From this phloronos horizon/level very rich collections were produced in 1960 by L. Yu. Budantsev and I. N. Sveshnikova. Hence by them, in particular, they are determined and described (including new forms/species): *Nilssoniopteris polymorpha* Sveshn., *Tyrnia solsbieriensis* Budants. et Sveshn., *Heilungia* (?) cf *aldanensis* Samoyl., *Podozamites* cf *angustifolius* (Eichw.) Heer, *Cephalotaxus microphylla* Sveshn. et Budants., *Florinia borealis* Sveshn. et Budants., *P. brewifolia* Sveshn. et Budants., *Pityophyllum lindstroemi* Nath., etc. This complex L. Yu. Budantsev and I. N. Sveshnikova consider Apt-Albian. From M. A. Sedova's this horizon/level ("e") throughout two samples/specimens is isolated cryptogamous-pollen complex, in which predominates the pollen of coniferous ones and participates the pollen of *Taxodium*, *Benettitales*, cycads and ginkgo, singly are encountered *Cedrus* and *Caytoniales*, disputes - *Sphagnum*, *Lycopodium*, *Selaginella* (in filmy perispore), *Coniopteris*, *Gleichenia*, and also different representatives of family *Schizaeaceae* (*Anemia*, *Mohria*, *Lygodium*). The given complex indicates, on the conclusion by M. A. Sedova, to lower cretaceous. The younger parts of the section/cut are developed on central drier than Alexandra Earth where outcrop three basalt integuments in total power/thickness approximately 60 m. On by the prepared denudation of the slagged

surface of upper integument were preserved (in the primary inequalities of roof) the eluvium of platy marl slates, and also the vitrinized and silicified wood.

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The latter is represented fragments, and by places by the whole petrified shafts, among which I. A. Shilkina (1960, 1967) secreted and described new genera and forms/species *Keteleerioxylon arctitum* Shilk., *Paleopiceoxylon arcticum* Shilk., *Podocarpoxylon sciadopityoides* Shilk., characteristic for lower cretaceous, and also *Xenoxylon barberi* (Seward) Krausel, ascending to the lower Jurassic, *X latiporosum* (Cramer) Gothan and *Araucaiopitys gregussii* Shilk., known ones beginning with the upper triassic.

In the sands, which were preserved somewhere on the roof of the upper integument of the Zemlya Alexander, V. D. Korotkevich secreted cryptogamous-pollen complex, consisting mainly of coniferous ones - 64o/o (*Pinus* subgen. *Haploxylon* sp., *P sacculifera* (Mal.) K.-M., *Protopicea mesophytica* Pokr., *P biangulina* (Mal.) var. *arctica* K.-M.), and also from the spores of ferns - 16o/o (*Coniopteris*, *Hausmannia*, etc.).

Apt - lower Alb includes also (on the conclusion by N. D.

Vasilevsky) the impressions of narrow leaves *Pityophyllum lindstroemi* in the fragment of sapropelite, discovered by the author among the rock waste of basalt on Is. Scott-Kelti.

In the given cryptogamous-pollen complexes, just as among the impressions of leaves and remainders/residues of wood, predominate coniferous, but yet completely are not absent angiosperms. This combination indicates Apt - lower Alb. With this treatment of the age of the suite of Salisbury is connected well the fact that the deposits of Franz-Joseph's lower Cenomanian on Earth are represented already in maritime facies.

The total (seen) thickness of basalt integuments and sedimentary deposits of apta-Alba is determined by us 260 m, and the power/thickness of an entire effusive thickness (together with sheet intrusions) about 600 m.



Fig. 12. Basalt integuments and their dividing sand carboniferous deposits (suite of Salisbury). Cape Kaval'i, Salisbury Is. V. K. Razin's photo.

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Upper division.

Cenomanian tier.

According to V. D. Dibner's data (1961), on northern shore against Hoffman will lie (from bottom to top) the platy quartzite-sandstones with muscovite, which contain the indefinable impressions of branches and leaves and rich fauna pelecypod, among which N. I. Shul'gina determined the Cenomanian form of *Oxytoma*

pectinata Sow. Visible power/thickness of the horizon/level 15 m. Above are arranged/located loose aleuropelites, which contain regarding N. I. Shul'gina, remainders/residues Schloenbachia aff. subvarians Spath. This form/species characterizes in East Greenland zone Varians, which there is related to the lower Cenomanian.

Several kilometers east, on Sugr obov cape, apparently, from these deposits of N. M. Bondarenko it did reveal/detect the single badly/poorly preserved disputes, similar to disputes Selaginella, Lygodium, Lycopodium triquetrum K.-M., the pollen of coniferous ones - Podocarpus flava K.-M., Protopicea sp., Pinus (subgen. Haploxyton) sp. and P (subgen. Diploxyton) sp., and also pollen Taxodiaceae (?) and angiosperms - Carya and Extratriporopollenites. The presence of the latter indicates, most likely, the bottoms of the Cenomanian.

Visible thickness of the deposits of the lower Cenomanian of approximately 40-45 m.

Danish tier (?).

In the northern part of "Holy Anna's trench" in the ground column, raised by M. M. Ermolaev in 1936 (ice-breaker by "Charges/shrinkages"), in an interval 60-70 cm Z. G. Shchedrin (1958) it revealed/detected Foraminifera Bulmina pseudopuschia Subbotina,



*Stensioina caucasica* (Subbotina), *Globerina trivialis* Subbotina and other forms, characteristic for Danish tier. Is rounded these minerals of rhizopods, and also the combined determination of contemporary forms, including knowingly shallow form/species *Elphidium gorbunovi* Stschr., he indicates their redeposition. Taking into account that the deep course in "Holy Anna's trench" is directed from the north to the south, and remembering about the force of Coriolis, it is possible to assume eroding/scouring by this course of Danish deposits somewhere on the northeastern periphery of the underwater base of the Earth Franz-Joseph.

Cenozoic group.

Paleogene system.

Eocene.

To the south from Is. <sup>Zemly</sup> Wilchek ~~Earth~~, in region 79° N (depth from 100 to 500 m), from the trawling collections of an Austro-Hungarian expedition (Payer, 1875) the micro-paleontologist A. Grunov (1884) established/installed the redeposited complex of the maritime diatomaceous seaweeds, identical "to lower-tertiary diatoms in deposits b. Simbirs province", related on contemporary stratigraphic schemes to lower Eocene (Zhuze, 1948). Apparently,

somewhere in this region at comparatively small depths occurs eroding/scouring the lower-Eocene kieselguhrs, destroyed as a result of subaerial denudation on very islands of the Earth Franz-Joseph.

Here should be noted the find of the single redeposited Foraminifera *Truncorotalia velascoensis* (Cushman). This form leading for lower Eocene of the North Caucasus and Mexico, was discovered by Z. G. Shchedrina (1958) in benthic sedimentation of holy Anna's trench - in the column, mentioned already higher in the examination of the traces of Danish deposits. The find in an interval 27-33.3 cm of this column of the contemporary and knowingly sublittoral form *Elphidium gorbunovi* Stschedr. indicates, in the opinion of Z. G. Shchedrina, the redeposition of the minerals of forms/species as a result of eroding/scouring by sea waves of pre-Quaternary deposits on that being adjacent it is drier or, let us add, shallow banks and their underwater slopes.

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Neogene system.

Pliocene.

On Hoffman Is. in 1.5 km to the northwest from the extremity of Cape Sugrobov Cenomanian sandstones, apparently, are covered by (contact is hidden - under rock waste and moraine) cleaved and in places rumpled light grey siltstone, aleuro-argillite and fine-grained sandstones. These are thin-platy species/rocks (Fig. 13), composed of fragmental, predominantly silt grains of quartz (90/o/o), flint (5o/o) and feldspar (5o/o), and also single grains of zircon and tourmaline, cemented by a silicide-clayey, partially recrystallized cement. In the latter are scattered the microscopic remainders/residues of the charred plant detritus whose banded distribution conditions the micro-foliation of species/rock, and also authigenic formations - micrograin of pyrite, clusters of oxides of iron and smallest grains of carbonate, by the places of generatrices edgings around fragmental grains. Are observed also the smallest paleolae of muscovite and biotite. By places siltstone and argillite

contain the thin (to 4 cm) interlayers of polymict conglomerates. Furthermore, in rock waste were observed the uneven blocks of the dark gray organogennic arenaceous limestone, consisting of the accumulation of the finely chipped shells (by partly substituted by calcite) and of small/fine pebbles of calcareous siltstone, cemented by the argillaceous-carbonate material. Total visible thickness of these deposits, overlapped from above by the thin layer of bottom moraine, about 25 m.

From several samples/specimens of these species/rocks N. M. Bondarenko isolated 170 grains of pollen (85.50/o) and spores (14.50/o). As a whole predominates the pollen of conifers, which comprises in this spectrum 80.00/o. Is especially numerous pollen *Pinus* of subgenus *Diploxylon* (49.0/o) and *Picea* sp. (9.50/o); are individually encountered also grains of pollen *Podocarpus*, *Glyptostrobus* and *Psophosphaera*. Angiosperms, in totality constituting 24.0/o, are represented *Betula* (12.50/o), *Alnus* (5.60/o), *Corylus* (?) (2.50/o), *Juglandaceae* (1.50/o), *Tilia* (1.50/o) and single *Fagaceae*. Are discovered also single pollen grains *Ericaceae* and *Compositae*, but among spores - *Sphagnum* sp. (8.0/o), *Polypodiaceae* (5.0/o) and single *Bortichium* (?) and *Equisetum* (?). According to the conclusion of E. N. Kara-Murzy and N. M. Bondarenko, similar complex in view of presence in all samples/specimens *Corylus* (?), *Juglandaceae*, and also *Fagaceae* and *Glyptostrobus* (?) can indicate,

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most likely, the Pliocene.



Fig. 13. Outcrop of platy aleuro-argillite (Pliocene?) on Cape Sugrobov (Hoffman Island). V. D. Dibner's photo.

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Quaternary system 1.

FOOTNOTE 1. The deposits of this system in connection with their small power/thickness on the accompanying geologic map/chart/card are not shown. ENDFOOTNOTE.

Among the quaternary deposits of Franz-Josef Land are secreted the Pleistocene glacier deposits, connected with the continuous glaciation of archipelago; the late Quaternary (late Pleistocene) and contemporary (Holocene) deposits of the maritime terraces; the glacier and water-glacier deposits of contemporary glaciers and coeval by them newest flowing-lake, diluvial, diluvial-proluvial, eluvial and aeolian deposits.

### Glacier Pleistocene deposits.

They include the glacier formations, the component/term forms of relief, oriented independent of the contemporary boundaries of continental ice and shore line of islands. So, on Alexandra Land (near Dezhnev bay) morainial ridges/ranges and their dividing lake basins are elongated in the northwestern direction and cut off by the front of the glacier of lunar. A similar glacier relief is observed also in the adjacent part of George Land - in Armitage peninsula. In these all sections the moraine is confined to the slopes of the drumlin-like exaration hills in high to 15-20 m. On capes Nansen, Johansen, Stolbov, Shmaru, Heller, Sugrobov and others glacier deposits are represented morainial mantles.

Moraine is composed usually of detritial-block disintegrations (by often almost not distinguished from the products of frost weathering) with the separate well rounded boulders to 1.5 m in diameter or (which is more typically) by cartilaginous boulder loams and by sandy loams. In Central Land and the western extremity of Alexandra Land (Cape Mary Harmsworth), whose territory is composed of some basalts, alien species/rocks are boulders and pebble of granitoids, gneiss, quartzite, quartzite-sandstone, more rarely dolomitized limestone. These boulders were, probably, brought from islands more to the southeast - from developed there Upper

Triassic-Liassic conglomerates. The northern direction of the transfer of boulders is fixed on the eastern periphery of archipelago where on Neogene deposits O. Hoffman by us was observed the mantle of morainal loam with the boulders of quartz ones it was sandstone. According to Z. Z. Ronkina (Dubner et al., 1961), the latter have in the composition of the heavy fraction of grenades with very high refractive index, known for Lias ones is sandstone, component/term the eastern extremity of that arranged/located south O. Becker, On the same, apparently, speaks also find by Yu. Payer (Payer, 1875 of granite boulder on basalt of cape Germany (Is. Rudolf), where he could hit, also, from Upper Triassic-Liassic deposits, known only south of this cape.

Since the propagation of erratic boulders and the location of edge/boundary forms it indicates connection/communication of the examined glacier deposits with existence and subsequent degradation of the ice shield, which covered entire archipelago as a whole, we then relate to Pleistocene.

The visible thickness of these deposits judging by cover morainal loams the Is. Hoffman, it is equal to 2.5-3.0 m.



Maritime late Quaternary (late Pleistocene) and contemporary (Holocene) deposits.

In the western half archipelago on the rocky capes of the islands of George Land, Bell Land, Maybell Land, etc. R. Kettlitz (Kettlitz, 1898) observed narrow terraced areas/sites from 55 to 250 m of height with the well rounded boulders and the pebble of the local (basic) species/rocks, usually carrying the traces of wind erosion. In several points on these pads are discovered the bones of seal and walrus, but on Hooker Is. at height of approximately 150-160 m are known the single finds of *Saxicava arctica* and *Mya truncata*. Maritime (abrasive) origin have, apparently, and the placer [?] surfaces of relief in high to 95-100 m above sea level on Hayes and Graham-Bell Islands, which, in contrast to the monotonous relief on Alexandra Land and George Land, do not bear the traces of glaciation and it is comparatively intensely rugged by the radial network/grid of streams as any surfaces, gradually uplifting from under sea level.

The radio-carbonaceous investigations of driftwood from a 26-meter shore line of Cape Dandy determined its age into 7500 summers/years. Consequently, the terraces in question are more ancient. Furthermore, following as M. G. Grosval'd (1963) it is necessary to take into consideration, that here, as in Spitsbergen,

the terraces of "upper complex" were risen from under sea level minimum 10 times more rapid than the "lower terraces" whose age is younger than 8000 summers/years, i.e., with a rate of not less than  $(26 \text{ m}/7500 \text{ years}) \times 10 = 35 \text{ m}/1000 \text{ years}$ . Hence the formation of a 250-meter level should be related approximately to 15-16 thousand summers/years.

The given calculation, and also the single finds *Mya truncata* and *Saxicava arctica* indicate that the terraces by the height of 55-250 m on Franz-Josef Land correspond in essence to Spitsbergen's late glacial cold interval.

To the contemporary (Holocene) maritime deposits on Franz-Josef Land are referred the widely developed terraces of "lower complex" by height from 3-5 to 35-40 m. These terraces are characterized by a good state of preservation of maritime deposits, represented by sands, pebbles, gravel and badly/poorly rounded fragments, thinner/less frequent - by boulders and by pebble of basalt and dolerite. Among stone material are observed the accumulations of lithothamnium, craters and bones of maritime animals, and also driftwood, interlayers of algal peat and lens of the concealed/buried sea ice (Fig. 14).

The terraces with a height of 35-40 m according to their

geomorphological manifestation and degree of the state of preservation of unconsolidated integument occupy the intermediate position between upper and lower complexes. The met here single fauna it is mollusck it is represented the forms: *Astarte borealis*, *Mya truncata*, *M. arenaria*, *Saxicava arctica* and *Balanus* sp. At these levels are encountered the bones of seals, whales, ancient fin and destructive integument of algal peat. According to their biostratigraphic characteristic and position - directly under the terraces of knowingly upper complex - 35-40-meter terraces of Franz-Josef Land can be compared with Western Spitsbergen's upper Astartic terraces, which were being formed/shaped in the beginning of the postglacial warm interval (they correspond to the levels 40-16 m in Bille fiord).

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Best of all the expressed in archipelago terrace with a height of 20-25 m in its substantially sand deposits contains folds *Astarte borealis* (Chemn) f *typica* Morch., *Mya truncata* var. *uddevalensis* Hancock, *Saxicava arctica* (L) f *typica*, and also single *Gastrodas Margarites* (*Pupillaria*) *cinereus* (Couthouy) and fragments *Balanus* sp. On this terrace M. G. Grosval'd revealed/detected the half-buried shaft of the driftwood which in the radio-carbonaceous laboratory of the geochemical institute of the AS USSR was dated by the age of

7445+-135 summers/years. Judging by the location of driftwood in the highland edge of terrace, the time of its formation could end on 1-1.5 thousand summers/years later, i.e. encompass 6000-7500 summers/years.

Terrace 15-18 m (often this rise/swell/rampart on the slope of 20-25-meter terrace) is characterized by the most diverse complex of the fauna of invertebrates, in which together with the predominant Arcto-boreal forms *Balanus crenatus* Brugn, *Natica clausa* Brod. et Sow., *Polynices pollidus* (Brod. et Sow.), *Sipho islandicus* Chemn., *Astarte borealis* (Chemn) f typica, *A borealis* (Chemn.) var. *placenta* Morch., *Mya truncata* L f typica, *Saxicava arctica* (L) f typica, *S arctica* (L) f *pholadis*, and also Arctic *Trophonopsis clathratus* (L), *Musculus discrepans* (Gray), *Astarte montagui* (Dill.) f typica Jensen, *Buccinum groenlandicum* Chemn., *B hydrophanum* Hanc. var. *elata*, *B glaciale* L, *Neptunea borealis* Phill., *Cyrtodaria curriana* Dunk. and other high-Arctic form/species *Serrapes groenlandicus* (Chemn.) encountered also boreal form/species - *Mya arenaria* L. On the surface of terraces are encountered in essence the larch driftwood and the bones of whales, observed at these levels especially frequently. The age of a 15-18-meter terrace as intermediate between 20-25 and 8-10-meter terraces (see below) we relate to the period of 5000-6000 years ago. Thus, 20-25 and 15-18-meter terraces of the Earth Franz-Joseph, probably, correspond to "lower Astartic terraces" of

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Bille fiord where they have the height of 6-17 m above sea level.

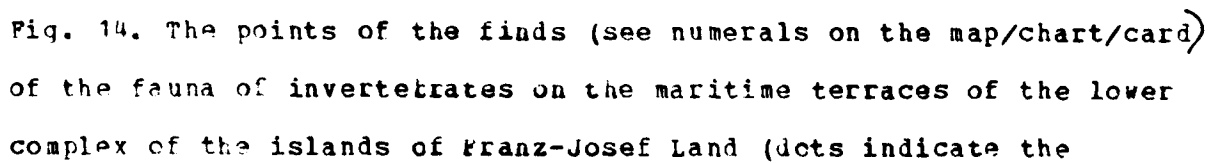


Fig. 14. The points of the finds (see numerals on the map/chart/card) of the fauna of invertebrates on the maritime terraces of the lower complex of the islands of Franz-Josef Land (dots indicate the

sections of land, free from ice).

Key: (1). o. Rudol'fa. 2. o. Yeva-Liv. 3. o. Karla-Aleksandra. 4. o. Dzheksona. 5. o. La-Rons'yer. 6. Zemlya Aleksandry. 7. o. Tsiglera. 8. o. Green-Bell. 9. o. Solsberi. 10. o. Luidzhi. 11. o. Champ. 12. o. Kheysa. 13. Zemlya Vil'cheka. 14. o. Sal'm. 15. Zemlya Georga. 16. o. Gukera. 17. o. Northbruk. 18. o. Gallya. 19. o. Mak-Klintoka.

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In the maritime deposits of 8-10 meter terraces the fauna of invertebrates bears predominantly Arcto-boreal and partly Arctic character/nature. On the coasts of Dezhnev bay this is exclusive *Saxicava arctica* L, *Mya truncata* L, that generate by places the unconsolidated shell rocks/coquinas which together with the calcareous incrustations of seaweeds *Lithothamnium* compose the layer with a thickness of 0.2-0.4 m. On the isthmus of cliff Rubini (Is. Hooker) to these two forms is connected *Astarte borealis* (Chemn) var. *placenta* (Morch). Further to the east, on Hayes Is., to these very common for ones the terraces of the Earth Franz-Joseph to forms are connected different Arctic forms/species of *Buccinum* - *B. hydrophanum* Hank. var. *elata*, *B. glaciale* L f *typica*, *B. tenue* Gray and belonging the same complex *Neptunea borealis* (Phill).

Two samples/specimens of ancient fin from the surface of a 10-meter terrace were subjected to radio-Carboniferous investigations. The first sample/specimen, brought by V. D. Dibner in 1956 from a boulder-pebble terrace of the southern shore of Alexandra Earth (10 m above sea level), was investigated in the Radio-Carboniferous laboratory of the institute of archaeology of the AS USSR, where his age they determined into  $4250 \pm 90$  summers/years. The second sample/specimen, delivered in 1960 L. S. Govorukha from a 10-meter terrace, developed in the northeastern outskirts the Is. Hayes, was dated in the radio-Carboniferous laboratory of the geochemical institute of the AS USSR by very close age,  $4775 \pm 135$  summers/years, about which they reported Groswald et al. in 1961. The excellent convergence of these data is, in particular, the best proof of the legitimacy of the correlation of the single-height terraces between the removed from each other points of archipelago. The time of the formation of 8-10-meter terraces of the Earth Franz-Joseph we relate to the period of 2500-5000 summers/years, which in Bille fiord corresponds to "terraces Mytilus", which have there the height of 3-6 m above sea level.

To the deposits of contemporary coast rises/swells/ramparts and beaches should be related boulder-pebble, rubbly, and less frequently sand-fine sediment alluviums, developed from shoreline to the height of 3-5 m above sea level. For them is characteristic the complex of



invertebrates, in which predominate Arcto-boreal forms - *Balanus balanus* L, *B crenatus* Brugniere, *Puncturella noachina* (L), *Buccinum fragile* G Sars, *Natica clausa* Brod et Sow., *Plicifusus kroyeri* (Moller), *Astarte borealis* (Chemn) f typica, *A borealis* var. *placenta* (Sow. h), *A compressa* L, *Mya truncata* (L) f typica, *Mya truncata* var. *uddevalensis* Hancock, *Saxicava arctica* (L) f typica L, *S arctica* f *pholadis* L together with the enumerated forms/species are encountered predominantly the Arctic forms *Astarte montagui* (Dillw.) f typica Jensen, *A montagui warhami* Leche, *Buccinum hydrophanum* Hanc. var. *elata*, *B glaciale* L f typica, *B tenue* Gray, *Neptunea borealis* (Phill.), *Cyrtodaria curriana* Dunk., and also the high(ly)-Arctic form/species *Serripes groenlandicus* (Chemn).

As a whole the given faunal complex is characterized by an even greater diversity than the complex of 15-18-meter terraces; however, in connection with the full/total/complete absence of boreal forms/species contemporary complex appears more cold-favorable.

The formation of the deposits of low terraces, coast rises/swells/ramparts (3-5 m) and contemporary beaches should be related to the latter 2000-2500 summers/years and compared with the lower terraces of Bille fiord, which have there the height of 0-3 m.

Glacier, water-glacier and other contemporary (Upper Holocene) deposits.

Contemporary glacier deposits are accumulated in essence lower than sea level, which occurs via thawing out of fragmental material both directly from the underwater parts of the glacier barriers and from numerous icebergs. Subaerial facies of contemporary glacier deposits are represented the lateral, median and comparatively rarely encountered frontal, final and basic moraines. To lateral moraines they are related, in particular, moraines of glacier Yuri and other ice flows the Is. Hooker (glacier Medvezhiy, etc.). Lateral moraines are also known on the islands of Nansen, Breydi, Luigi, Salisbury, Gall both on other islands of central group and also on Zemlya Vil'cheka, that possess the most rugged radical relief.

The frontal, final and basic moraines of contemporary glaciers are encountered comparatively rarely, since the overwhelming majority of the glacier flows slips down in sea. Only the independent glaciers and the "parasitic" ice flows, which somewhere slip down to coastal nisins through slit-like decreases in the edges of plateau (region of the cape Villas, etc.), plotted the concentric rises/swells/ramparts (to four) of the final moraines, composed of loamy-rubbly and lumpy

material. On Vasiliev cape and in other places between the internal edge of the finite moraine complex and the front of glacier are chaotically scattered the conical hillocks of basic moraine. The latter are expressed ever more clearly in proportion to approximation/approach to the edge of the glacier, from peripheral part of which they melt out.

Contemporary water-glacier deposits are known only in the form of the debris/efflux of the outwash-plain fields (Fig. 15), which are formed as a result of the seasonal activity of numerous continuously which change their river beds streams, which flow from ice covers and on their way to sea of those washing up again and widely carrying away the material of contemporary and more ancient moraines (Earth of Alexandra, peninsula Armitidzh, plateau of Sedov's cape on the Is. Gukera, Is. of Nansen, etc.).



Fig. 15. Modern outwash plain near the ice dome of Kropotkin on Is. Alexandra Earth. V. D. Dibner's photo.

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With the deposits of contemporary moraines and sands are everywhere connected generating simultaneously with them lake-glacier deposits, which are formed in essence in troughs - in front of the fronts of ice covers.

Contemporary alluvial-lake (flowing-lake) deposits are connected with that part of that of only just being incipient in archipelago of drainage system, which in contrast to outwash-plain flows obtains the purely snow nourishment; with its activity is connected the formation only of floodland facies.

Are more typical than alluvial deposits on islands Graham-Bell, Hayes and some other homogeneous sections of land where gradually rising from under sea level sections are eroded (by places up to the state of badland) by the network/grid of the relatively stable water flows which deposit the large part of the alluvium in their rudimentary deltas and delta fronts. The fine sediment deposits of contemporary lakes are precipitated out on the day of those detached by the former sand bars of ancient lagoons. According to data of L. S. Govorukha et al. (1965), their now desalted water have a mirror at the level to 20-25 m, which corresponds to the heights of contemporary (Holocene) maritime terraces, to which they are confined (Govorukha et al., 1965).

Diluvial formations are represented by rocky-lumpy taluses which even at the outcrops of sedimentary Mesozoic from surface are usually composed by the fragments of basalt and dolerite, in the considerable sections of slope wholly hiding from observer radical outcrops and taluses of sedimentary rocks.

To diluvial-proluvial deposits one should relate the products of the destruction which are accumulated/stored in the lower parts of dells and ravines.

Eluvial formations are formed/shaped in essence in the individual sections of the basalt and doleritic plateaus, deprived of the glacier and maritime deposits where they are represented rocky-lumpy material with the admixture/impurity of gravel.

#### MAGMATISM.

The magmatic formations of archipelago are represented basalt flows, integuments and connected with them tuffs, and also basic hypabyssal intrusions, which were incorporated between effusions and in their underlying and covering sedimentary deposits. As it will be shown below, their geologic positions and petrochemical all these formations as a whole correspond to the plateau basaltic formation, which differs from basalt of Greenland and Scandica in essence only in terms of more ancient age.

D. V. Levin on the southeast of Salisbury Is., in region of the scales of the unattainable by the methods of aeromagnetic photographing revealed the vertically sloping body, which is characterized by reverse magnetization, that, apparently, as the Siberian platform, he indicates the presence of the intrusion of ultrabasic composition (Levin, etc., 1963).

Basic effusions.

The thinnest (2-3 m) flows and the integuments are composed by amygdaloidal basalt of almost black color with the hyaline or hyaloplitic structure of base mass. In more powerful/thick integuments mandelstones compose upper edging in power/thickness to 4 m.

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In the deep parts of these integuments in proportion to the decrease of a quantity of glass their base mass acquires tholeiitic, intersertal or even transient to ophitic structure. Towards the basis of integuments the basalt again become vitreous, but they are characterized by the here almost full/total/complete absence of tonsils and a dark-red color (in the zone of tempering).

Amygdaloidal basalt contain tonsils from 0.2 to 7.0 mm in diameter, formed by the sheaflike and radiant aggregates of the crystals of zeolite or by iddingsite - howlingite it is still thinner/less frequent - by calcite. As a whole, amygdules are from 20 to 70% of this species/rock. In the basalt integuments of cape

Flora F. Nansen (Nansen, 1900) observed the tonsils, reaching three inches in length and elongated in the southwestern direction. Since the lava/longwall on topographic surface spread, most likely, it is perpendicular to the direction of the supplying cracks, it is possible to assume that the latter had the northwestern course/strike. In the slag edgings of basalt integuments together with usual tonsils are observed the large/coarse liberations/excretions of calcite and the geodes (to 20-30 cm), carried out by calcite and different modifications of quartz. Among the eluvium of basalt are frequent the finds of the fragments of chalcedony and siliceous sinters, which contain the plant remainders/residues, which indicate that the hydrothermal activity flowed/occurred/lasted also on topographic surface.

In back contact of one or the other integument the basalt (usually hyalobasalts) form the thin (6 mm) crust, which consists of brown glass with the idiomorphous phenocrysts (to 1.4x1.0 mm) of plagioclases, pyroxene, etc.

According to data of N. P. Lupanova (1953) and T. N. Spizharskiy (1947), contact action of integuments on the covered by them species/rocks it manifests itself the depth of 0.2-0.4 m. In this case the greatest change undergo the clays which not only strongly ~~uplifted~~ <sup>darkened</sup> and acquire the dark-red or violet hue, but sometimes



even they are converted into tain-schistose clay shales, containing the small/fine balls/spheres of brown glass and pierced by the finest veins of calcite. Noticeable firing (also at the depth indicated) undergo the sedimentary rocks of psammitic and psephitic composition. Carbon/coals in hot junction are graphitized or are converted into ash.

The volcanic tuffs, which are rarely encountered between lower basalt integuments, are the dark gray poriferous disintegrating with shock species/rocks, which contain in the pores of the liberation/excretion of zeolite, a thin- gypsum. The tuffs, which slope in the basis of the basaltic rock mass of Dandi cape, according to N. P. Lupanova's data, usually consist of the subglobose fragments (to 3.0 mm) of palagonitic basalt, prisoners in vitroclastic palagonitic mass. Another variety/subspecies of tuffs consists of the fragments of plagioclases, pyroxene and obsidian with the spherical vacuums, carried out by calcite. In tuffs are encountered volcanic bombs to 0.2 m in diameter.

Hypabyssal intrusions.

On the Earth Franz-Josepa are widely developed the secant and sheet intrusions, close by their mineral composition to effusions. They differ from them in the structure of base mass which depending

on the power/thickness of one or the other body and degree of re-crystallization is modified from transparent to ophitic and gabbro-ophitic.

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In the territory of archipelago are everywhere common the dikes. Especially clearly they are secreted in the east, there where as a result of the absence of basalt integuments on the considerable area of topographic surface outcrop their contacts with unconsolidated sedimentary rocks. Dikes are confined in essence to the systems of the cracks of the northwestern and northeastern courses/strikes. They are outlined for the elongation/extent of many tens of kilometers and available capacity from several ones to 20-25 m (without considering separate bulges).

Most vividly is secreted the system of the dikes of the northwest and close to it the directions which are clearly represented on islands Graham-Bell, Earth, where in them, in particular, are related nunataks of the "mountains of Vyullerstorff", and also on the islands of La-Rons'yer, Hayes, Yuzhnyy Komsomolsk and others. Because of their sharply pronounced denudation ridges these dikes sometimes even manifest themselves in the relief of insular ice and are outlined from one island to another in the relief of the sea

bottom. Thus were possible, for example, to trace for dike, intersecting archipelago in the northwestern direction from o. Gokhshtettera through the islands of Gall, Hayes, Champ and Luidzhi up to Petigaks cape inclusively - for elongation/extent of approximately 140 km (?). This to dike we below will call "dike of diagonal".

The contacts of dikes are almost vertical. The formed by them crest-like monadnocks have often greatest relative height in the least powerful/thick dikes, composed by more durable (vitreous) species/rocks. Usually dikes are broken into parallelepipedal blocks/modules/units of the individuality with a height of 1.0-2.0 m and with a width of 0.3-0.5 m, the elongated transversely dikes to its full/total/complete power/thickness.

The dikes of the northwestern course/strike are, probably, feeders to basalt integuments and, furthermore, by youngest, since always cut the dikes of the northeastern course/strike. These dikes of best anything are studied on islands Graham-Bell and Hayes, where they are outlined on the ridges of hills, composed by psammite of the Vasil'yevskiy suite, at a distance from 1-2 to 6-7 km from each other. Dikes are characterized by exceptional straightness and small power/thickness, which does not exceed usually 3-7 m. This picture everywhere is observed on Is. Graham-Bell. On the contrary, on Hayes

Is. dikes one way or another "are bent" and sustained according to power/thickness. This, as is known, it is characteristic for the apical parts of the dikes, which were being formed in synmagmatic cracks near the topographic surface of those days. So, in the West outskirts the Is. Hayes are observed two-three intermittent chains/networks of the dikes (composite/compound component part the dikes of diagonal) of the very nonuniform power/thickness whose separate links by length from 100-300 to 2000-3000 m are confined to the echelon-like arranged/located "torn" cracks which are opened by contemporary denudation shear/section at the depth only several ten meters from former topographic surface. The latter is confirmed by the fact that one of the links of these dikes proved to be composed agglomerative vitroclastic tuffs which at depth are gradually changed by the dark gray, partly amygdaloidal basalt- dolerite, and upward on section/cut they convert/transfer into the typical mouth of explosion. Several kilometers north of the latter in small graben was preserved the sloping on the sandstones of Vasil'yevskiy suite layer of the analogous agglomerative tuff, covered with basalt integument. The analogous echelon-like arranged/located dikes are established/installed, according to data of aerial photography, and in region of                      strait/spill.

Dikes the Is. Hayes arose not all simultaneously, which is seen of intersection one of dikes, having course/strike of 320°, more

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ancient very thin (1-2 m) dikes, stretching on 300°.

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Are known the very powerful/thick dikes of the northwestern course/strike whose monadnocks usually form the basis of large/coarse capes. So, the extremity of cape Tegetkhoff (Is. Gall) is composed by the bifurcateed dike (Fig. 16), which in separate bulges reaches 100-120 m of power/thickness. Both branchings dikes are outlined to those outcropping at height of approximately 250 m above sea level of basalt integuments which they approach as typical feeders. Powerful/thick of the dike of northwestern strike intersects also Hooker islands and Scott-Kelti, where it forms the largest from known ones in archipelago bulges of the scales of Rubini (Fig. 17) and anti-Rubini. These subvolcanic formations, divided between themselves by *M; //enius* strait/spill, available capacity to 600 m. Wonderfully the exposed from three sides, abraded by sea scale of Rubini is widely known in geologic literature in connection with the especially pronounced columnar (six, less frequent than the five- and tetrahedral) individuality, directed at different angles to the horizon and by the places for that diverging it is fan-shaped. Large/coarse columnar individuality characterizes also eastern

extremity the Is. of Scott-Ketll - anti-Rubini's scale. Both bulges arose, apparently, also near topographic surface, which in contrast surface the Is. Hayes was at this time already covered by several basalt integuments. With the latter anti-Rubini's bulge has active contact. Magma entered and congealed in bulges, probably by the separate portions, each of which was introduced between the previously hardened and cooled injections. This mechanism of the formation of the intrusions of Rubini and anti-Rubini can not only explain the special feature/peculiarity of the arrangement of their columnar individuality, but also makes clear surprising homogeneity of petrographic structure, micro-dolerite, component/term seemingly whole complex of comparatively thin elementary intrusions. With rubini - anti-Rubini's dike, apparently, are somehow connected those being, possibly, its apophyses the powerful/thick gabbro-dolerite of the dike of the cape of Sedov and dike of Churlyanis mountain. The latter is curious fact that, in spite of 15-20 m of power/thickness, has the sharply pronounced amygdaloidal structure. This of dike with its numerous large/coarse zeolite tonsils arose, possibly, as a result of filling of some gaping crack, which was being formed on one of the stages of the polyphase introduction of the bulge of Rubini's scale.

The dikes of the northwestern course/strike are supplying to some basalt integuments and, naturally, cut others (more ancient),

which one can see well on the aerial photographs of the western islands of archipelago (Gall, Alexandra, Artur, etc.). On eastern extremity the Is. Hoffman (Cape Sugrobov) is known the youngest dolerite dike of the northwestern course/strike (in power/thickness approximately 10 m), which cuts the sandstones of Cenomanian age.





Fig. 16. Monadnocks of that bifurcateing dikes, that generates the basis of cape Tegetgoff (Is. Gall) A. N. Radygin's photo.

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The dikes of the northeastern course/strike include the above-water (island Kobrug, Torup, etc.) and underwater dikes of the Neymayer straits/spills and Trinigen, dikes, component/term islands of Stolichka, Lamont, and also cape Kremsyuster (Is. Jackson), southwestern cape the Is. of Kunn and many other formations. These dikes have comparatively large power/thickness, measured tentatively from 15 (island of Torup, northern Komsomol) to 100-150 m (island of Gouen, Koburg).

Thin (to 7 m) dikes are composed by porphyric basalt-dolerites, which depending on the degree of crystallization have transparent, hyalopilitic, intersertal and in individual sections ophitic of the

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structure of base mass. The transparent structure of base mass is characteristic for selvages and sometimes it is present on individual sections, more removed from contacts. Hyalopilitic and intersertal structures characterize the base mass of entirely thin ones and the edge/boundary parts of 5-7-meter and more powerful/thick dikes. The center sections of the latter have the ophitic and close to it structures of base mass. Here places already encountered glomerophitic differences which can be attributed to medium-grained dolerite or transient to them species/rocks. Center section the dikes, component/term cape Heller (its power/thickness about 50 m), is composed by gabbro-dolerite, which are the most crystallized difference here in the series/number of species/rocks in question. These dolerite and gabbro-dolerite have respectively ophitic and gabbro-ophitic (with the sections of tholeiitic) structures of base mass. For the characteristic of the rocks, component/term Rubini's scale, we have available the numerous samples/specimens, undertaken with its northern and eastern precipices. They all are represented one and the same species/rock, very close to porphyritic dolerite, but differing somewhat unusual grain fineness, in connection with which it is possible to name micro-dolerite. In it is present from 15-20 to 25-30% of phenocrysts the plagioclase, augite and sometimes bronzite, that generate glomerophitic accumulations.



Fig. 17. Rubini's Scala (form/species from the east) - the largest in archipelago bulge dikes.

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On the Earth Franz-Joseph is very visually visible the character/nature of the reaction of the magma of dikes with the accomodating them weakly and completely not cemented deposits, which was studied by L. A. Chaykoy on materials with Is. Graham-Bell. The selvages of dikes are composed by the amygdaloidal basalt-dolerite, which consist of fresh, almost opaque greenish-brown glass with the rare (3-5o/o) microlites of basis plagioclase (0.3-0.4 mm). In glass are scattered subrounded grains of quartz and incorrect micro-xenoliths (to 2.0-3.0 mm) of silicon-quartz sandstone with basal carbonate cement, seized by magma upon its introduction into

the accomodating psammite. The boundary between such xenoliths and glass is sharp. No chemical changes in xenoliths or minerals of hyalobasalt itself it is fixed. Fragments of sandstone and its separate grains are observed also in the species/rock, undertaken from dikes at a distance of 1.0 m from its contact, and they differ from the samples/specimens described above only in terms of partial crystallinity of the glass, which has therefore by places felsite structure. Already at a distance of 2.0 m from contact basalt-dolerite dikes it acquires the usual intersertal structure of base mass and xenolith material in it disappears. Near one of the dikes of peninsula of hilly from talus was found the fragment of the basalt slag, which is, obviously, exterior of selvage edging. Microscopically this slag is completely limonitized hyalobasalt with vacuums on the spot of the lixiviated crystals the plagioclase also of augite.

The sheetlike sloping magmatic formations previously were related in archipelago to integuments; however, already geologic investigations 1953 showed that there are numerous sheet bodies of the igneous rocks, which are observed among the deposits of the upper triassic - the lower Jurassic which cannot be related to effusions, first of all, because of the full/total/complete absence of any traces of tufagenic material in these deposits. Furthermore, these incorporated in other deposits sheet bodies proved to be the composed

holocrystalline rocks with the ophitic or gabbro-ophitic structures which, as is known, they are absent even in the center sections of the powerful/thick integuments. Remarkably also that that in these sheet bodies almost by whole (even in the endocontact of suspended side) are absent the amygdaloidal textures, widely developed in the upper zones of the basalt integuments of archipelago. The sheet bodies in question have the relief expressed large-columnar individuality with the prismatic columns, arranged/located vertically or by the more rarely divergent vast bundles to the different sides; in this respect they are completely identical to the powerful/thick bulges of the dikes whose intrusive nature causes no doubts, and sharply they differ from the integuments, which have the considerably less distinct columnar individuality and that only in their center sections. Finally, the intrusive character/nature of sheet bodies is finally confirmed by the presence on eastern shore the Is. of Hayes of active front contact of the horizontally sloping there dolerite with the outcropping above sandstones of Vasil'yevskiy suite.

The sheet intrusions of the Earth Franz-Joseph by larger part available capacity from 20-30 to 100 m. They often detect confinement to the defined stratigraphic horizons/levels and therefore just as dikes, are outlined usually from island to island and apparently, are developed over very large areas.

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Such "regional" sheet intrusions, if we enumerate them from bottom to top on normal section/cut, are developed: a) on the boundary of the suites of Wilczek and Vasil'yevskiy (Earth Wilczek, island large Komsonol, Hayes, Fersman, Gall); b) on the boundary of Aalen with the overlying deposits (island of Hooker, Rayner); c) in the basis of sedimentary-effusive thickness of lower cretaceous (Earth Georg, island of Northbrook, Hooker, Alger, Zemlya Wilczek, Ziegler and many others); d) between the suites of Salisbury and bay of calm (Earth Georg, island of Hooker, Salisbury, Luigi, etc.). Furthermore, are encountered the thin sheet intrusions of local propagation (in sedimentary-effusive thickness, in the bottoms of Wilczek suite, etc.). Judging by Spitsbergen's eastern islands, the presence of sheet intrusions is not excluded among the deposits of Upper Mesozoic-Cenozoic structural tier.

The description of separate sheet intrusions we will begin with the sill, which was incorporated between the basalt integuments of Albert Markam cape. This intrusion available capacity of approximately 30 m. Its component/term species/rocks approach porphyritic dolerite of the center sections of the most powerful/thick (5-7 m) northwestern dikes the Is. Graham-Bell. the center section of the sill is composed by gabbro-dolerite, which has

the gabbro-ophitic structure of base mass. Downward and upward from the center section of the sill the structure of base mass is consistently changed by ophitic (with the sections of tholeiitic) and it is still nearer to periphery - intersertal.

Above the intrusion outcrops the upper part of its contained integument of porphyric basalt which are separate/liberated from dolerite by the sharp step of relief and differ from them in terms of the absence of columnar individuality. Basalt of this integument differ from the sheet intrusion described above in terms of other structures of base mass. In sheet intrusion the least crystallized near-contact zone is represented the intersertal structure of the base mass of its component/term species/rocks (with the content of glass 17-18o/o), then in basalt integument this degree of crystallization is observed only in its center section; ophitic and gabbro-ophitic of the structures, which were revealed in the center section of the sill, in basalt integument nowhere they were observed.

Sheet intrusions in power/thickness from 5 to 30 m are fixed/recorded among the basalt integuments of Armitage peninsula, and also on Stephen capes, astronomical and Forbes (southern part of the Earth Georg), on Marie/Mary-garnsuort capes and Thomas (Earth of Alexandra), also, on Is. Scott-Kelti. These sills are composed by porphyritic and glomerophitic dolerite with the ophitic and



tholeiitic or intersertal structures of base mass, by very similar to the species/rocks, component/term the sheet intrusion of Albert Markam cape.

As an example of the sheet intrusions, which were incorporated in Upper Triassic ones - lower-Lias deposits, it is possible to indicate the sills, developed among Wilczek suite in the North coast of the Earth Wilczek. Here, in region of *Villas* cape, V. K. Razin described the powerful/thick (60-70 m) dolerite layer, which carries the apex/vertex of cape and generatrix in an interval of 240-300 m above sea level vertical precipices with columnar individuality (Fig. 18). This layer as places comes forward somewhere from under ice to the east from Willas cape and, in particular, is well exposed "in the edges" of the valley of the glacier of rapid, and then composes the large/coarse sections of land in region of the Shmarda capes and Heller. The sheet intrusions of the North coast of Wilczek land are composed middle- and by coarse-grained dolerite and gabbro-dolerite. These are the holocrystalline rocks with the ophitic or gabbro-ophitic structures of base mass, on the whole they are similar to dolerite and gabbro-dolerite of powerful/thick dikes.

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Especially they are close to samples/specimens of north the dikes the

Is. of large Komsool and cape Heller, with which they draw together the high degree of crystallization, the presence of quartz, biotite, brown hornblende and sections of micro-pegmatite. The separate samples/specimens in which the content of olivine reaches 8-100/o, should be related to olivine dolerite. Species/rocks, apparently, frequently bear the traces of the auto-metamorphism, which pronounced in the substitution of augite by the hornblende, and plagioclase - by calcite. The latter is accompanied by the isolation of silicic acid in the form of xenomorphic grains of quartz.

Thus, on the Earth Franz-Joseph is observed the wide development of the hypabyssal secant and sheet intrusions, which were incorporated between Lower Cretaceous basalt integuments and in their underlying and covering sedimentary deposits. Hypabyssal intrusions petrographically differ from basalt of integuments usually only in structural ratio. Are especially related to the effusions of the species/rocks, component/terms 2-3- meter dikes and edge/boundary facies of more powerful/thick dikes and represented porphyric basalt-dolerite. The latter have intersertal, less frequent tholeiitic structure of the base mass, which are changed to selvages by hyalophilic and transparent structures. The center sections of the comparatively powerful/thick (5-7 m) secant and sheet bodies are composed by dolerite and by gabbro-dolerite with the ophitic and gabbro- ophitic structures of base mass. These species/rocks by

places underwent to a certain degree auto-metamorphism.

For explaining the time interval of the introduction of hypabyssal intrusions should be, first of all, considered observed in the series/number of places, for example on northern cape the Is. Pritchett and cape Bryce (Is. Ziegler), disagreeing occurrence of basalt integuments on Upper Triassic ones - lower-Lias deposits, gently rumpled together with the incorporated in them sheet intrusions. Hence it follows that the sills and some part of the dikes, which outcrop among Upper Triassic-Lower Lias deposits, were incorporated in them, most likely, even to the outflow of basalt. In favor of this assumption speaks still and, the generally typical for trappean and plateau basaltic formations, uniformity of the composition of sheet intrusions.



Fig. 18. Sheet intrusion of gabbro-dolerite in visible power/thickness to 60 m on cape Willas (Is. Zemlya Wilczek).

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The degree of crystallinity of the latter to no extent is not connected with their position in the section/cut of the enclosing rocks, but it is only the power function of one or the other sheet bed. For example, the sheet intrusion, which slopes among the Lower Cretaceous basalt integuments of Albert Marka cape, is represented almost by the same according to the degree of crystallinity by species/rocks as sheet intrusions among the upper triassic of *Zemlye* Earth. To laws governing of this type the first paid L. A. Chayk's attention during the study of Taimyr Permo-Triassic intrusive traprocks, which allowed it to make a conclusion about the duration of the process of their introduction, which compensated (together

with effusive activity and terrigenous sedimentation) such the prolonged sag of the earth's crust.

On the basis of these considerations, we assume that on the Earth Franz-Joseph the magmatic activity was begun not later than the upper triassic and, most likely, yet it did not end completely in the beginning of upper cretaceous, since Apt-Albian effusions and intersecting the Cenomanian intrusions are in archipelago youngest not generally, but only in contemporary denudation shear/section. To lower cretaceous, it is more precise to Goteriv, sedimentation was accompanied only by intrusive activity - the formation of sheet intrusions and fed to them magma to dikes. In Goteriv was begun the intense, effusive and plosive activity, which just as thus far normal sedimentation, was accompanied by the introduction of sheet intrusions. Feeders at this time became probably, the youngest dikes of the northwestern course/strike whose introduction was not interrupted also in the Cenomanian.

According to data of N. P. Lupanova, statistically well substantiated and confirmed by 25 chemical analyses, produced later on V. D. Dibner's collections, the basalt and dolerite of archipelago on the basic components of the chemical composition are similar to traprocks of Siberia, but differ from them in terms of its, on the average by somewhat smaller alkalinity. In mineralogical sense for

the magmatic rock of the Earth Franz-Joseph is characteristic the presence of rhombic pyroxene (to 50/o) and olivine (to 150/o), usually substituted by iddingsite-bowlingite pseudomorphoses, considerably less developed in the Permo-Triassic traprocks. Remarkably and increased content of palagonite (due to the decomposition/expansion of glass), and also increased content (to 15 and even 300/o) of magnetite and titanomagnetite. This just as the increased alkalinity, it is, apparently, indication of the suboceanic character/nature of hypabyssal intrusions and effusions of the Earth Franz-Joseph and its nearness to Upper Cretaceous-Paleogene plateau basalt of shaven-Arctic province (Tuleyskiy formation) and Verkhoyansk-Chukotskiy zone, which is noted by Speranskaya in 1963.

#### TECTONICS.

The Earth Franz-Joseph is the part of the intraplateform (epicontinental) downwarp/trough of the southwestern course/strike which we below will call Grumanlanskiy. This downwarp/trough is carried out by the thickness of the substantially Mesozoic deposits, upper whose part was formed as a result of the wide development of hypabyssal and effusive basis - subalkaline magmatism in this zone of Barents-Kara platform/plate. The mega-structure of the Earth Franz-Joseph is the part of the Grumanlanskiy downwarp/trough whose near-axial zone is located from) northeastern (between islands white

Earth and Graham-Bell strait/spill in foot-western direction through the straits/spills of Berezkin, Pandorf, (Ermak), through Hayes Is. and most crushed part of archipelago - in region the Is. Hooker.

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This zone almost coincides with established/installed somewhat north according to data of aeromagnetic photographing by the deep fault of the same course/strike and by the connected with it negative magnetic anomaly, which indicates the presence of ultrabasic intrusion on Salisbury Is. It is possible that with this near-axial zone of downwarp/trough are connected the basalt volcanic pipe and the which associate it magmatic manifestations on Hayes Is., and also the introduction of dikes with subvolcanic bulges on islands Wiener-Neustadt and Hooker. The planned near-axial zone of downwarp/trough is localized exactly in the band of the development of the youngest (from pre-Quaternary ones) deposits on the Is. of Hoffman and youngest basalt integuments on the islands, which are concentrated around Hooker Is.

The Earth Franz-Joseph is arranged/located on the intersection of Grumanlanskiy downwarp/trough with block type neotectonic uplift/rise, which are stretched along continental (Spitzbergen-North-agricultural) slope, in connection with which

Mesozoic and even are more ancient (?) formations are advanced here higher than sea level (atlases, etc., 1963). In the southwestern direction the axis of Grumanlanskiy downwarp/trough is immersed and itself it gradually acquires the more clearly expressed character/nature, being outlined through the Persey plateau into trough the Bear Is. On the north of this trough are revealed the traces of the development of the basalt, apparently, coeval to Lower Cretaceous basalt of the Earth Franz-Joseph. It is still southwestern, in deeper sections of Medvezhinskiy trough, are encountered the traces of the propagation of the siltstone, which contain Foraminifera of Upper Cretaceous - Paleogene age. Medvezhinskiy trough in turn, through the flattened part of a Norwegian-Spitzbergen continental slope merges with the Lofotenskiy basin/depression of Norwegian sea, for which is already characteristic oceanic type earth's crust (Ewing, 1959; Dementitskaya, 1965). Thus, the Earth Franz-Joseph should be examined as the part of the very extended downwarp/trough, which arose in the first stages of the "oceanization" of continental cortex. Here, in Barents shelf, this process did not visit on the whole further of the stage of the extensive interstitial outflows of plateau basalt. However, the sub-parallelism of Grumanlanskiy intraplateau downwarp/trough for middle-oceanic spine makes it possible to assume that even in neogen this downwarp/trough composed as one whole with the morphostructures of the northeastern part of Skandak. Subsequently, apparently, after



the formation of continental (Norwegian-Spitzbergen) slope Grumanlanskiy downwarp/trough strongly retarded the rates of its development and therefore it preserved the continental structure of the earth's crust, for which here, however, were characteristic not the how much lowered/reduced values of gravitational force.

For the Mesozoic deposits of archipelago the characteristically horizontal or very gently sloping occurrence of layers.

Separate plicate disturbances/breakdowns are represented flat folds in wingspan from 0.2-0.3 to 2-3 km and fold bends of layers with slope angles from 3-5 to 10-15°. In this case the greatest slope angles, fixed in the folds of different order, are confined usually to Upper Triassic ones - Lias deposits, while the layers, which slope above, are formed almost always considerably flatter folds.

Furthermore, on northern cape the Is. of Pritchett and on cape Bryce (Is. Ziegler) the clearly evidently sharply disagreeing occurrence between the upper triassic - Lias (switching on incorporated in these layers sheet intrusions) and overlying basalt integuments.

On the other hand, by F. Nansen on cape Flora was established/installed the insignificant unconformity between Lias (in contemporary understanding) and Middle Jurassic deposits and parallel occurrence on latter/last basalt integuments.

All this it indicates many small local angular unconformities and certain complication of structure downward on section/cut, which reflects the typical for a platform character/nature of oscillatory motions.

Exception are the Pliocene deposits Is. of Hoffman which in essence will lie horizontally or with the flat (5-7°) incidence/drop on southwest (220-230°), but by places are formed the small folds of the northwestern course/strike with angles of incidence to 45° and flexures with the incidence/drop on southwest or northeast to 75°. Such sporadic, but relatively intense curvatures of Pliocene layers are not observed in the more ancient deposits of the Earth Franz-Joseph. Probably, these dislocations have local character/nature and are connected with some block shifts of folding basement on the northeastern periphery of archipelago. It is less probable that this dislocation by glacier, since otherwise they would be revealed, also, on many other islands of archipelago, composed from surface, although by more ancient, often even more unconsolidated deposits.

In the prototectonic structure of the platform formations of archipelago the Earth Franz-Joseph and Is. Victoria are distinguished four structural tiers: Upper Paleozoic (lower - middle Carboniferous period?), Lower Mesozoic (triassic - Jurassic), Upper Mesozoic (lower cretaceous), Upper Mesozoic-Cenozoic (upper cretaceous - neogen). The quaternary period in the tectonic life of archipelago revealed itself mainly by the intense block shifts (in the beginning of this time) which are considered below as superimposed neotectonic manifestations.

Upper Paleozoic structural tier is represented lower-Middle Carboniferous(?) by the carboniferous deposits whose traces are noted for on islands the Earth Georg, Luigi, Ziegler and Gall and Middle Carboniferous carbonate deposits Is. Victoria.

Lower Mesozoic structural tier is represented the continental and offshore-marine deposits of the upper triassic and all three divisions of Jurassic system. These layers nowhere directly contact with the deposits of more ancient structural tier. However, it is known that Spitsbergen's very fully represented triassic will lie there transgressively on Permian and more ancient formations. Analogous interrelations are observed on the northern Earth between

Upper Triassic-the Jurassic(?) and by Middle Paleozoic deposits (Dibner, Ageyev, 1960).

Within the structural tier in question upper Aalen (on the Is. of Northbrook) lies in with very small angular unconformity on Lias deposits. More or less accurately adjustable stratigraphic interruptions are planned also between Aalen and by Bath, lower and upper Callovian, and also in other epochs. However, the also completely insufficient study of stratigraphy does not make it possible to determine scales and territorial distribution of these unconformities. Therefore the isolation of substages within this structural tier, the total visible thickness of deposits of which reaches 1500 m, until it is premature.

The deposits of Lower Mesozoic structural tier form by places typically paratectonic folds and flexures, which do not have the defined alignment and which are characterized, as has already been indicated, by angles of incidence on wings to 10-15°.

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The center section of peninsula of hilly, of Hayes Is. and some islands, almost by whole hidden under ice (Is. Lya-Rons'yer, etc.), resemble large/coarse dome-shaped uplifts/rises. In this case in

peninsula hilly and in region of Hansa cape are known the formations, similar to the diapiric nuclei or piercement.

Upper Mesozoic structural tier is represented the predominantly volcanogenic formations of lower cretaceous. These layers whose total visible power/thickness reaches 600 m, will lie on the deeply rugged surface of the second structural tier - on the layers of different age: from Volga to Norian-Rhaetian inclusively, and on the southern extremity of the Earth Georg - even on Lower Carboniferous ones.

As has already been indicated above, Lower Cretaceous sedimentary-effusive formations will lie even more gently than their underlying Triassic and Jurassic layers, forming also only sporadic flat dislocations.

Upper Mesozoic-Cenozoic structural tier. On the northeast of archipelago (Is. Hoffman) a sedimentary-effusive suite is immersed below sea level, and on topographic surface do outcrop coastally - Cenomanian and, after interruption in exposures, Pliocene(?) deposit. According to Yu. G. Kichelev's data (1962), seismic-refraction sounding, carried out to the south of archipelago, it showed, as we already mentioned above, that the power/thickness of this supra-basaltic structural tier, most completely represented on day sea, was equal to 150 m. Cenomanian layers will lie virtually

horizontally. However, what Pliocene ones are concerned (?) deposits, then their plication bears unconditionally local character/nature and, apparently, is connected with the block motions of basement - in region of the western slope of "Holy Anna's Trench".

The Mesozoic sedimentary and effusive formations of the second, third and partly the fourth of tiers for the duration of entire Jurasso-cretaceous time intruded by the numerous hypabyssal intrusions of dolerite and gabbro-dolerite.

In archipelago are observed numerous and by places the very intense disruptive dislocations, which contribute supplementary, sometimes very essential, complication into its prototectonics, being laid on all structural tiers examined above.

As the first example of this hearth of disturbances/breakdowns let us point out by several horsts, which were being formed along the lines of the faults of the north-northwestern course/strike in region of cape Flora on the Northbrook Is. These faults were known to already F. Nansen and R. Ketlits, which established that the asymmetric lump of Gertrude cape was raised relative to the analogous lumps of "Scales Galls" and Flora cape respectively on 40 and 200 m (Fig. 19). Another example of disruptive dislocations was observed by V. D. Dibner in the western and eastern edges of the valley of the

glacier of rapid (Earth Wilczek), where is outlined the series/number of the sublatitudinal faults on planes of which separate blocks/modules/units were moved in vertical direction relative to each other on 20-80 m, which is fixed/recorded with the varied-height position of the individual parts of the broken by faults sill (Fig. 20). Judging by the position of lines it is waste on both edges of the valleys which are detected also on the vertical aerial photographs it is apparent that these lines are oriented to northeast-east in parallel to the northern shore of <sup>Zemlya</sup> Vil'chek; West, in region of this shore, the east-northeastern and north-northwestern faults strongly complicated region of the capes of Shmard and Heller.

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Large/coarse sublatitudinal fracture dislocation is noted also in the northwestern part the Is. Hooker, where on the northern and southern shores of the bay of calm at one and the same hypsometric levels outcrop Lias and Callovian layers, and are noticeably moved one relative to another the subvolcanic bulges of single dikes - scale of Rubini and anti-Rubini. Fault shifts with horizontal displacements to 80 m are established/installed on aerial photographs and by direct geologic observations on Hayes islands and large by komсомolsk, also, in many other places.

Additionally to the given geologic data should be considered the already long ago noted special features/peculiarities of the geomorphological plan/layout of archipelago, expressed in the confinement of the shore line of SI especially, as we now know, underwater slopes to the lines of the north - western, northeastern, and also longitudinal and latitudinal courses/strikes. To geological ones - the geomorphological study of the islands and strait/spill Earth Franz-Joseph shows that large/coarsest horsts are the separate



islands or their groups in high to 400-600 m with their underwater bases, which are comparatively gently immersed at depth to 200 m, and the largest grabens are the deepest (to 500-600 m) sections of straits/spills - "canals". In west and on the larger part of the central of the sectors or archipelago predominate fracture dislocations of diagonal directions. If we judge by the reciprocal location of these two systems in the territory of archipelago and in the adjacent regions of a Barents-Kara shelf, neotectonic motions along latitudinal and meridional faults were revealed more lately and more sharply than on diagonal faults. This, in particular, it conditioned widest eroding/scouring Mesozoically - Cenozoic deposits in the east of archipelago, especially on Is. Graham - Bell - it is direct along the "pulled up" western edge of holy Anna's trench.

At present according to the degree of its shattering the neotectonic structure of the Earth Franz-Joseph is nowhere more in Arctic shelf the unique mosaic of the omitted and elevated (amplitude to 1000 m and more) large/coarse and small/fine blocks/modules/units, which were being formed in the beginning of pleistocene.

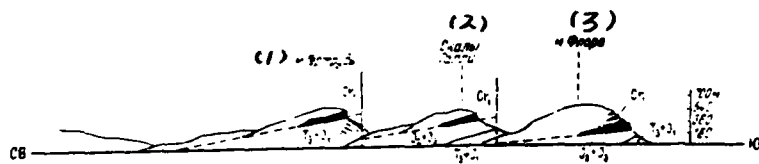


Fig. 19. Fault system in the southwestern part the Is. of Northbrook. According to R. Ketlits.

Key: (1). m. Gertrude. (2). Scales Galls. (3). m. Flora.

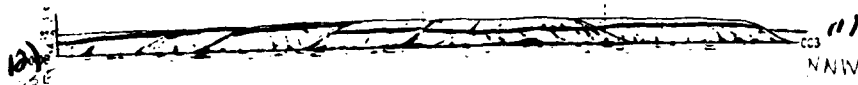


Fig. 20. Broken by faults sheet intrusion. Edge of the glacier of rapid on Is. Vilchek Earth. According to K. P. Nevskoy.

Key: (1). N.N.W. (2). S.S.W.

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The southern periphery of the base of the Earth Franz-Joseph is bordered by the almost confluent between themselves narrow trenches whose separate links have north - western and north - eastern of course/strike. These small/fine trenches together with the depressions of continental slope and the trenches of frang - Victoria and holy Anna create as a whole circular decrease around archipelago, apparently, of compensative character/nature.

## HISTORY OF GEOLOGIC DEVELOPMENT.

The history of the geologic development of the Earth franga - Joseph and Is. Victoria can be examined beginning with Lower Carboniferous time.

In Lower Carboniferous (Visean) time archipelago was the part of the carboniferous basin, which was placed on the north - barentsevo - Karskoy's west platform/plate even in the second half Devon (region of Billefiord on Western Spitsbergen and Is. bear).

In Bashkir century the paleogeographic circumstances sharply changed: from the south (judging by the generality of the fauna of fusulina with Vereian-Kashira of Russian platform) in Barents shelf invaded sea. Region of the Earth Franz-Joseph became his more open part (carbonate deposits), than Spitsbergen, where approximately at this time were deposited gypsum-bearing (lagocn) layers.

An interval the upper Carboniferous period - the average/mean triassic is inclusively thus far gap/spacing in the geologic chronicle of region.

The complex of Carnian ammonite it indicates, on Yu. N. Popov's conclusion (1958), to the compound of that existed then seas with the Alpine and Himalayan seas or Tetays and speaks about the specific barrier, which separate/liberated the Carnian sea, which was being spread from region of the Earth Franz-Joseph to Alaska, from sea, which existed at the same time in region of Spitsbergen and Is. of bear. By this barrier could be arranged/located where - that between the present ones Spitsbergen and Earth Franz-Joseph the uplift/rise of the sea bottom with the chain of low and flat/plane islands, which were the region of removal/drift. The divided islands shallow straits/spills had their local temperature conditions, salinity, degree of turbidity, which, apparently, impeded the propagation of the ammonite of one basin in another, but it did not prevent the interpenetration of less sensitive ones to environment pelecypod, among which on the Earth Franca - Joseph it is possible to find the series/number of the forms, general/common/total with Carnian forms the Is. of bear and VilcheK Earth (Popov, 1958). It is cryptogamous/sporiparous - pollen data show that on Carnian islands ruled the fixilic vegetation.

It is Late Triassic - lower-Lias thickness was formed/shaped in barentsevo - Karskoy's epicontinental - Grumanlanskiy - downwarp/trough platform. The basic source of the removal/drift of fragmental material, probably, was at this time the regional

uplift/rise, which was being arranged/located where that after the edge of continental slope. It is possible to assume that this was the mountain range, which was being stretched along an entire northern arc, i.e., to the north from Spitsbergen <sup>1</sup> and Earth franga - Joseph and, possibly, to the north - to east from Is. the northern Earth.

FOOTNOTE <sup>1</sup>. V. N. Sacks considers that in Jurassic and to the Cretaceous the basic region of removal/drift he was arranged/located to the north from Spitsbergen, A. Orvin's some facies data (1940) make it possible to assume that the removal/drift occurred also from the northwest. ENDFOOTNOTE.

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The axial zone of spine was composed by the species/rocks of metamorphic complex, by close by its composition to the Proterozoic epidote-containing species/rocks of greenschist formation, and by crystalline schists with staurolite, chloritoid and glaucophane which now outcrop in North Taimyr and in the southern part of the northern Earth. The southwestern slope of this hypothetical spine was, probably, it was complex by acid effusions, jasper, radiolarites, by siliceous schists with lower Carboniferous radiolaria. In immediate proximity to the region of accumulation, at times and within it were eroded both abyssal rocks (granitoid) and connected with them

pegmatitic veins/strands (cape mountainous) and limestone with Upper Paleozoic fauna and microfauna and Middle Devonian (?) carbon/coals. The enclosing rocks for the latter we could be, most likely, deposit of the type of terrigenous Middle Devonian formation "Red-bay" of Western Spitsbergen. Eroding/scouring these all species/rocks occurred as a result of local uplifts/rises within the region of accumulation. The composed the basic region of removal/drift acid effusions, radiolarites, jasper and the like must be, most likely, lower- Middle Paleozoic, but crystalline schists of the axial zone of the region of removal/drift - Precambrian.

The absence on the Earth of Franz-Joseph of the average and upper, but on Spitsbergen - lower and average/mean Lias it indicates the eroding/scouring before the transgression of sea [in Spitsbergen region it penetrated in Toar (Orvin, 1940; Prebold, 1950), and within the limits of the Earth Franz-Joseph - in Aalen]. Sea, thus, began from west or southwest, which is confirmed also by U. Arkell's indications (1956) about the fact that in Spitsbergen's Toarcian conglomerates are present the ammonite, typical for the coeval layers of the British islands and north of Western Germany.

The composition of the heavy fraction of Aalenian deposits indicates eroding/scouring of the basic rock, which were being formed, apparently, by this time in the region of removal/drift,

which was arranged/located in immediate proximity to archipelago.

The geologic circumstances of Bajocian century and beginning of Bath due to the incomplete nakedness of cape Flora is thus far unclear. It is probable, however, that into the late part of this time the Earth Franz-Joseph, together with Spitsbergen, was the region of eroding/scouring. The phosphorite-carrying nature of outcropping above faunistically of upper Bath's described clays attests to the fact that its deposits were formed/shaped in the beginning of transgression at the depths of 50-100 m - in zone, comparatively close to the shore line of sea. Like other phosphorite-carrying basins of platform type, region of the contemporary Earth Franz-Joseph in Bathonian century had to be the downwarp/trough, opened to the side of ocean, i.e., on southwest, whence, perhaps, only and could enter phosphorite-carrying deep water. This it indicates the existence of downwarp/trough on the spot of Medvezhinskiy trough already in any case in average/mean Jurassic.

Sea, possibly, without interruption continued to exist up to the apogee of transgression in lower Callovian whose deposits with the characteristic to it complex of fauna are widely developed far beyond the limits of the Earth Franz-Joseph - in Novaya Zemlya, Russian (eastern-European) platform, East Siberia, Spitsbergen, East Greenland. The preponderance of plagioclases - in light, pyroxene and

black ore minerals - in the heavy fraction of Callovian pelite indicates the same sources of removal/drift, which existed also in Aalen. In this case angular grains of fresh basic zonal plagioclases, met in samples/specimens with Hooker Is., testify, as is considered Z. Z. Ronkina (1962), about the fact that the basic rock in the region of removal/drift were represented most likely effusive facies.

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The Upper-Callovian transgression, possibly, which was not ceasing from Bath, seized the Earth Franz-Joseph, Spitsbergen, Novaya Zemlya and other more distant territories.

The lower-Oxfordian deposits on the Earth of Franz-Joseph just as in the entire Atlantic coastal region Arctic, they are not established/installed, which can indicate the regional Pre-upper-Oxford eroding/scouring. In upper Oxford in this entire region again there was maritime mode/conditions. On the Earth Franz-Joseph the traces of this transgression are only separate calciferous concretions.

Lower-Kimmeridgian maritime deposits, which are characterized by the mixed mineralogical complex, were formed (apparently, just as in Callovian) as a result of eroding/scouring of basic effusions and



metamorphic thicknesses of the axial zone of the main region of removal/drift. Lower-Kimmeridgian maritime basin was most likely inherited from upper-Oxfordian, which can be judged from the combined presence of deposits of both these substages both on the Earth Franz-Joseph and on Spitsbergen and in East Greenland.

On Spitsbergen the layers, which correspond to upper Kimmeridge, are washed away. On the Earth Franz-Joseph Upper-Kimmeridgian are, possibly, arenaceous limestone the Is. of Bergkhauz, developed higher than analogous limestone of faunistically described lower Kimmeridge. These layers, and also aleurite limestone of the lower Volga and upper Volga of tiers compose the normal layering, connected, apparently, with the single transgression, which was very widely disseminated in Atlantic coastal region Arctic and on the northeast of Europe. In Valanzhin probably, occurred the offshore-marine and lagoon sedimentation, which was changed in connection with new uplift/rise by almost general/universal erosional eroding/scouring. As a result the effusive suites of Goteriv - Apt lay to the unevenly washed away surface of the basement rocks. At the end of Valanzhin - the beginning of Goteriv on the larger part of the present islands were destroyed more ancient Valanginian, upper and Middle Jurassic maritime deposits. In the series/number of places did not survive Tegetkhoffskiy suite. Considerably better was preserved from eroding/scouring the Vasil'yevskiy suite of the upper triassic, which

in the overwhelming majority of the cases is basis for basalt integuments.

After the Middle Upper Jurassic effusive volcanism, which flowed/occurred/lasted, as it was assumed above, beyond the northern limits of archipelago, in to lower cretaceous volcanic activity it was disseminated also to the territory of Earth itself Franz-Joseph.

Initially occurred the ejections of ash material and the small outflows of basalt magma, which was accompanied by the formation of agglomerative (Is. Hayes) and pelite-psammitic (Is. of Hooker, etc.) tuffs and alternating with them thin flows and integuments, which filled the basins/depressions of subvulcanic relief. Then occurred the short-time subsidence of locality under sea level, about which testifies the composition of the lowest integument, outcropping on Hooker Is. and represented there spilite, and also that the encountered there between lower basalt integuments wood is calcitized in contrast to the silicified wood in the sections where outcrop younger integuments.

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The products of the subsequent, more powerful/thick ejections

lay down on the surface, completely evened by basalt flows and tuffs, sloping in valley-like depressions of subvulcanic relief. In the interruptions, which began between separate ejections, region was the newly formed structural plain. Each ejection was accompanied by the simultaneous compensative lowering of locality and by its approximation/approach to sea level, which conditioned the flabbiness of erosional processes and "maintained" thus the plainness of relief up to the moment/torque of its burial under the subsequent lava integument. The plainness of these repeatedly appeared basalt plateaus contributed so that in the comparatively elevated sections of relief under conditions of a warm climate was formed/shaped the cortex of wind erosion, but in relative decreases were deposited carboniferous swampy- lake, thinner/less frequent lake alluvial deposits. The real composition of the latter for which is characteristic the preponderance of monoclinic pyroxene in the heavy fraction, does not remain in doubts of the fact that in time interval between the outflows of basalt the precipitation formation occurred due to the products of their decomposition as into several removed region of removal/drift, so partly, also, on the spot.

The woody remainders/residues, which are everywhere encountered among taluses and in the radical exposures of a sedimentary-effusive thickness, testify about the magnificent bloom of the vegetation, among which predominated different forms/species of coniferous ones

and ginkgoic. The latter were initial material for the layers of the low-ash durain-clarain brown coal, which were being accumulated in the strongly irrigated low-running peat swamps/marshes into which terrigenous material fell only in the form of smallest fragments of quartz. In the individual sections of basalt plateaus the processes of wind erosion and continental sedimentation were supplemented by the activity of the hot, saturated by silica sources from which were precipitated out the dense opaline-chalcedony species/rocks and the present siliceous sinters, containing the scraps of vegetable tissues, and also leaves, needle, cores, etc. These sources conditioned the silicification of branches and whole tree trunks. During the subsequent outflow of the next portion of lava/longwall the flints and the silicified wood were localized in the basis of new basalt integument, forming the there peculiar "boundary" horizons/levels, which are the same reliable witnesses of the interruptions of volcanic activity as continental sedimentary deposits or cortices of wind erosion.

Thus, from Goteriv, and on Spitsbergen from late Valanginian on the wide spaces of the north of Eurasia began to be formed/shaped the vast lake-alluvial plain, on which under conditions for the slow sag of its separate parts were accumulated carboniferous deposits. The Earth Franz-Joseph as the part of the Grumanlanskiy downwarp/trough was beginning with Goteriv-Barren the isolated part of this land,

where the carboniferous deposits periodically were buried under the ejections of tufagenic material and the basalt lava/longwalls, which composed the low repeatedly rejuvenating plateaus.

To Zemlya Franz-Joseph's west-south-west, on the Zemlya King Karl, this circumstances, apparently, existed only in Goteriv, and on Western Spitsbergen and islands of Barendsz and Edzh of Lower Cretaceous volcanism did pronounce in the deposit of the tufagenic material, generating separate interlayers and in the continental deposits of Goteriv-Barren. On the north of Western Spitsbergen V. Goldschmidt established/installed single basalt integuments supposedly also Goteriv-Barren (Frebold, 1950). In Apt on Spitsbergen was begun new maritime transgression, whereas on the Earth Franz-Joseph the outflows of basalt were continued, possibly, also in the beginning of Alba.

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Shaping of the substantially effusive thickness of lower cretaceous, just as the precipitation formation of earlier epochs, was accompanied by the manifestations of hypabyssal magmatism in the form of the dikes which were feeders to sheet intrusions and integuments or (under conditions in rich gases magma) predetermined the appearance of bulges and (basalt) volcanic pipes. In the late

stage of this process in the zone of deep fault did occur the introduction of ultrabasic boss-shaped intrusion (?), of which intersects the basalt integuments of which intersects the basalt integuments.

In the upper Cenomanian was begun the new transgression of sea which on Spitsbergen and Severnyy the island of the Earth arrived already in Apt; in this case, as in Pre-Late-Volga time, sea invaded from west. The real composition of Cenomanian deposits (zircon, tourmaline, rutile) indicates their formation as a result of the redeposition of the terrigenous precipitation of the upper triassic - lower Jurassic.

Thus, in the Mesozoic, especially in to lower cretaceous, the sedimentation on the Earth of Franz-Joseph flowed/occurred/lasted under conditions of the increased mobility of the earth's crust, characteristic, apparently, to entire Gumanlanskiy downwarp/trough. This pronounced, first of all, in the fact that the sag was compensated by here not only normal sedimentation, but also by plateau basaltic magmatism, which is considered by us as the original stage of oceanization. Furthermore, the mobility of territory pronounced also in the fact that the accumulation of Mesozoic deposits was repeatedly interrupted/broken by uplifts/rises and redeposition of local material in individual sections. The most

essential regional erodings/scourings, which covered in Mesozoic entire territory of the Earth Franz-Joseph and determined basic features of its prototectonics, occurred in Bajocian, lower Oxford and, mainly, before beginning Lower Cretaceous volcanism.

Large/coarse gap/spacing in the geologic chronicle of archipelago covers time from the tops of the Cenomanian to the Pliocene. True, we can assume that Franz-Joseph's maritime mode/conditions on Earth was continued to the end of the Cretaceous - Paleogen inclusively. This indirectly indicate the redeposited Danish- Paleogene Foraminifera in the bottom deposits of the trench of holy Anna, and also in sandstones and siltstone, raised from the bottom of sea in the southwestern part of the trough of Medvezhinskiy. Furthermore, above has already been indicated that the redeposited lower-Eocene diatomaceous seaweeds were known to the south from the Wilczek Is., and the single find also of lower-Eocene Foraminifera (*Truncorotalia velascensis*) was discovered in the bottom deposits of "holy Anna's trench". Species composition of diatomaceous ones and Foraminifera of upper cretaceous - Paleogen indicates their connection with the ancient maritime basins of Povolzh' and North Caucasus. Possibly, this was the consequence of the expansion of the meridional paleogeographic relations which were renewed between boreal basin and Tethys in the middle of upper cretaceous through Western Siberia and Pechora (Sacks, 1960).

Offshore-marine carbonate-terrigenous deposits of the Pliocene (?) Hoffman Is. outcrop north all now known outcrops of neogen of Eurasia and even north of the region of the propagation of supposedly Pliocene series "Beaufort" on the northwestern islands of Canadian archipelago.

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Therefore these deposits are of large interest for the reconstruction of the paleogeographic circumstances, which existed on the eve of Pleistocene freezing less than in 1000 km from the contemporary position of the north pole. Monomineral composition of the deposits of the Pliocene (?) the Earth Franz-Joseph it shows that they, just as considerably better studied Mesozoic deposits of archipelago, were formed/shaped due to eroding/scouring of the comparatively removed region of removal/drift.

On the basis of the given data it is possible to assume that for a period of many geologic centuries, beginning with the upper triassic and to the Pliocene inclusively, the basic region of removal/drift was arranged/located most likely to the north from the Earth of Franz-Joseph and Is. Victoria. Probably, this was the zone



of the development of the Caledonian folding on the spot for which in quaternary time will arise underwater volcanic ridge, which is the Arctic continuation of the near-axial zone of the mid-Atlantic ridge and named therefore by spine or "volcanoria" Arctic <sup>1</sup> (Atlasov, etc., 1964; Dibner, etc., 1965).

FOOTNOTE <sup>1</sup>. At present to spine is appropriated the name of professor Ya. Ya. Gakkel of this predicted existence underwater construction as early as 1955. ENDFOOTNOTE.

Quaternary period was begun with general/common/total regional uplift/rise and very intense block motions, which created the basis of the contemporary relief of archipelago. These motions could be begun only after the deposit of the Pliocene precipitation, connected with the hereditary from Mesozoic region of removal/drift on the north. On the other hand, these motions occurred before beginning of Pleistocene freezing which modeled the elevated blocks/modules/units via their exaration.

If the block relief of archipelago arise long before glaciation, then in the grabens of present straits/spills were accumulated great thicknesses of molassa-like late-post-Pliocene conglomerates. Actually, the bottom of straits/spills is composed by Mesozoic species/rocks or their glacier and unevenly covering benthic

sedimentation.

Petrographic composition and distribution of erratic boulders, and also alignment of drumlin-like hills in Alexandra Earth and Aleksandrapeninsula they indicate the former continuous overlap of islands and straits/spills of archipelago by the single glacier shield whose center in the apogee of Pleistocene glaciation was located somewhere to the southeast of archipelago.

The begun at the end of the pleistocene general/common/total degradation of glaciation brought in the specific stage to gradual melting away of the edges of plateau of islands and shaping of terraces on their slopes in proportion to the isostatic uplift/rise of the base of archipelago. This stage, is more clearly expressed on Spitsbergen (Hansen, 1955; Jan, 1961), were begun on the Earth Franz-Joseph of approximately 14-15 thousand summers/years, during the formation of the area/site of 250-meter abrasive level, i.e., if we apply the Scandinavian biostratigraphic scale, in the beginning of Daniglacial subepoch (early Drias). It can be, this date, obtained by extrapolation, is somewhat lowered, but in this case it is necessary to allow the an even high rate of isostatic uplift in the epoch of the formation of the terraces of upper complex, than 3 m accepted in century, which is thus far little probable. Thus, in Zemlya Franz-Joseph's early Drias (in any case on southwest archipelago)

glaciation was, apparently, is not more it is widely developed than now, what completely will agree with the conclusions of R. Feyling-Hansen (1955, 1959 - 1960) and A. Jan (1961) according to Western Spitsbergen.

For a late pleistocene - the Holocene on the islands of the Earth Franz-Joseph (as on Spitsbergen) it is possible to secrete two sharply different development stages of their relief and glaciation.

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The first stage, which was begun at the end of the pleistocene, signified by itself the rapid decrease of cover glaciation. One should assume that at this time occurred the strong reduction in area and power/thickness of glacier integument and its full/total/complete destruction in the most steeply inclined sections of shore line. In the opinion of V. D. Dibner (1965) this process was accompanied by intense isostatic uplift/rise, that, however, it did not find distinct reflection in the granulometric curve of bottom deposits, since the areas of free from ice and eroded land were still very small. At the end of this stage occurred the growth of glacier integument which was revealed, just as preceding general/common/total retreat, along entire its front.

The second stage (8000 years ago - now) is characterized by the slow decrease of the glaciation, which was being morphologically differentiated as a result of its preceding evolution. Intimately depending on the radical relief of archipelago, the thinned ice shield was transformed into ice domes at the apexes/vertexes of plateau and uneven ice covers and flows on their slopes and in the trough valleys, which were being formed even into the initial stage of glaciation. Therefore periodic advances of glaciers in this stage occurred no longer along entire front, but via the growth of separate glacier blades/vanes and flows. The general/common/total isostatic rising during this period is characterized by considerably lower speed. However, in connection with the strong growth of the total area of the local sections of the removal/drift of speed fluctuation of isostatic uplift, depending on growth and decrease of glaciation, found on this stage distinct reflection in repeated changes in the granulometric composition of bottom deposits, toward an increase in their coarse-grain size. The secular growth of glaciers occurred also at the end of the past century (in the times of the investigations of Yu. Peyer - Abbrutskiy), after even number set in begun already in this century phase of the contemporary decrease of freezing. This latter/last advance of glaciers was, probably, by very extensive in connection with which under the widely growing glacier blades/vanes were hidden the traces of their earlier advances in the epoch of "short glacial period", and also 2600, 1600 and 800 years ago.

## ISLAND KOLGUEV.

Kolguev island is located in the southern part of the Barents sea, not far of coast of continent <sup>1</sup>.

FOOTNOTE <sup>1</sup>. Geologic map/chart/card the Is. of Kolguev to scale 1:1500000 is given in the form of fitting on the geologic map/chart/card of Novaya Zemlya. ENDFOOTNOTE.

Above has already been discussed the character/nature of the relief of island, by whole of that composed by unconsolidated quaternary deposits <sup>2</sup>.

FOOTNOTE <sup>2</sup>. According to oral communication/report to T. A. Matveyeva in 1965, it revealed/detected on maritime shore the Is. Kolguev (in 5 km to west from the sett. of Bugrin) the small radical outcrop of siltstone with the plant remainders/residues of supposedly Upper Permian age. ENDFOOTNOTE.

Maximum high-altitude marks do not exceed 170 m above contemporary sea level and are concentrated in central, hilly, part. The elevations, which border dimple inside to islands from the north and

the south are surrounded by the low swampy, slightly terraced plains, which convert into flat/plane to Lide on coast itself. On island is observed well developed drainage network with the deeply cut into valleys and the violently current rivers.

The quaternary deposits of island are most in detail described in 1939 by Yu. L. Rudovits whose materials became the basis most complete outline on Is. Kolguev, carried out by V. N. Sacks (1953).

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