ICE TERMINOLOGY

by

LIEUT.-COMMANDER H. BENCKER, TECHNICAL ASSISTANT.

With acknowledgments to the АЛЬБОМ ЛЕДОВЫХ ОБРАЗОВАНИЙ
(*Albom Liedovik Obrasovanii*)
Album of Ice Forms, published by the Russian Hydrographic Office, 1930.

FOREWORD.

The various Sailing Directions for the Arctic Seas and for the vicinities of Iceland and Newfoundland usually devote one paragraph of the chapter :— *General Information*, to a description of the various forms of ice which the seaman may encounter in these waters and endeavour to define certain generic terms to designate them.

Thus certain definitions of terms relating to forms of ice appear in the *Arctic Pilot*, Vol. II., 3rd Edition, 1921, published by the Hydrographic Department of the British Admiralty. The *Newfoundland and Labrador Pilot*, 6th Edition, 1929, gives similar definitions of some of the more usual terms; yet others were given in the preceding edition issued in 1917. The *Arctic Pilot*, Vol. I., 3rd Edition, 1918, based on Russian publications, also gives, on pages 19 and 20, a list in the English and Russian languages of terms relating to ice-forms.

The Danish Meteorological Institute, Copenhagen, gives in its yearly publication entitled :— *Nautisk-Meteorologisk Aarbog* (Nautical Meteorological Annual) certain definitions of terms and abbreviations to facilitate the reading of the charts showing the ice conditions in the Arctic Seas which it publishes.

The *Instructions Nautiques* N° 320 (Sailing Directions N° 320) for the island of Newfoundland and Belle-Isle Strait, published in 1920 by the French *Service Hydrographique*, also gives (page 31) the definitions of several English terms used to designate ice-forms.

A terminology in the Russian and English languages of certain current terms distinguishing the various forms of ice appears on pages 13 and 14 of the *Lotsia Eniseiskogo Zaliva* (Sailing Directions for the Gulf of Yenisei), published in 1924 by the *Ydrografiski Upravlenie*, Leningrad.

Finally, the *International Ice Patrol Service* of the North Atlantic has also given, in Bulletin N° 3 published in 1915 by the *U. S. Coast Guard*, Washington, several expressions currently used on the Charts showing the iceberg conditions in the vicinity of Newfoundland published by the Ice-Patrol Service in each of its Bulletins. Also the definitions relating to this subject which appear on the back of the *Pilot Chart* of the North Atlantic Ocean for March 1926 are to be noted.

A composite list of the terms relating to ice as provided for seamen by all the Sailing Directions, etc., mentioned above (in which they are generally in alphabetical order) is given below.

Keeping the alphabetical order in English, this list gives the definition of each of these terms, or rather the explanation which accompanies the term in the various volumes of Sailing Directions. An attempt has been made to add the nearest possible equivalent expression in French, with, occasionally, a few Russian terms which it has been possible to find in the publications cited.

The first part of the list is composed of terms designating particularly the different kinds of ice.

The second part contains various nautical terms given in the Sailing Directions which refer to the formation of and navigation in ice.

After this composite list, various works containing nomenclatures of sea-ice are mentioned, then a detailed analysis is made of the new scientific terminology selected by the Russian Committee on Ice; finally several terms relative to ice extracted from various treatises on polar exploration are quoted.

I. — *Composite list of terms relating to ice as given in various* Sailing Directions.

II. — *Bibliography relating to sea-ice.*

III. — *Study of sea-ice.*

IV. — *Terminology adopted by the Russian Hydrographic Office.*

V. — *Other terms relative to ice.*

I — *COMPOSITE LIST OF TERMS RELATING TO ICE,* which appear in the various *Sailing Directions.*

A.

Barrier. (*Barrière*). — The edge of the great glaciers which enter the sea, but remain attached to the land.

Bay or Gulf Ice (*Glace des Baies ou des Golfes*). — (Заливный припай = Zalifni Pripaï = Gulf-Soldering. — Лед бухт = Liod Bukht = Bay Ice).

The young ice which first forms on the sea in autumn, of sufficient thickness to prevent navigation.

Bergy-Bits. (*Blocs montueux de glace flottante*).

Medium sized pieces of glacier ice, or of hummocky pack, washed clear of snow. Typical bergy-bits have been described as about the size of a cottage.

Brash Ice. (*Glace brisée, Bourguignons, Sarrazins*). — (Битый лед = Bitii Liod = Broken Ice).

A collection of small fragments and rounded nodules, the wreck of other forms of ice, through which a ship can easily force her way.

Close Pack. (*Banquise impénétrable*). — (Сплоченный плавучий лед = Splotchenny Plavoutchij Liod = Agglomeration of Floating Ice).

Pack composed of floes, mostly in contact; navigation completely checked. Open spaces of water may exist among them.

Crack. (*Fente*). — Any fracture or rift in sea ice.

Crevasse. (*Crevasse*). — A crack or rift in a glacier or ice sheet.

Drift Ice. (*Glace de dérive*). — (Плавун = Plavun = Float).

Loose, very open pack or unattached pieces of floating ice, where water preponderates over ice, easily navigable. Ships can usually make full speed, without changing course. The floes are usually smaller than in close or open pack, with much *rotten ice* and brash. Known also as *Sailing Ice* (*Glace navigable*).

Fast Ice. (*Glace fixe*). — (Сплошной лед = Splochnoï Liod = Compact Ice).
Sea ice which remains fast in the position of growth throughout the winter, and sometimes even during the ensuing summer.

Field Ice or Ice Field. (*Champ de Glace* or *Banquise*). — (Ледяное поле = Ledianoe pole = ice field).
Area of pack forming a large body of unnavigable flat ice of such extent that its limits cannot be seen from the masthead — thickness 1 foot to 15 feet — sometimes looks as if flagged, other times forming heaps of ice.

Floe. (*Fragments plats de Banquise flottante*). — (Плавающий лед = Plavaioutchtchii Liod = Floating Ice).
An area of ice, other than fast ice, whose limits are within sight. Light floes are between one and two feet (0 m. 3 and 0 m. 6) in thickness; floes thicker than this are termed heavy.

Floe Berg. (*Gros fragments de Banquise en forme de montagne*). — (Ледяныя глыбы = Ledianiya Gluibi = Ice accumulation. — Торосистый лед = Torosisty Liod = hummocky ice).
Heavily hummocked ice from a pressure ridge, usually separated from floes. A thick piece of salt-water ice presenting the appearance of a small iceberg. It is built up by rafting and freezing.

Glacier. (*Glacier*).
A stream of solid ice descending from its source in the high névé of a snow field.

Glacier Berg. (*Gros fragment de Glacier en forme de montagne*).
One calved from the glaciers. Usually much crevassed and with broken strata.

Growlers. (*Grondeurs*).
Smaller pieces of ice than Bergy-bits, appearing greenish in colour because barely showing above water, but large enough to be a danger to navigation; usually caused by capsizing and disintegration of an iceberg.

Heavy Ice. (*Glace épaisse ou profonde*). — (Тяжелый лед = Tiajoly Liod = thick ice).
Accumulation of ice fragments of considerable thickness difficult to get through.

Hummocks, Hummocky Ice (*Glace moutonnée*). — (Торос = toros = downs).
Elevations in field or floe ice caused by two or more bodies of ice being pressed together. Hummocky ice is formed by the edges of ice floes meeting in strong breezes, when they are pushed up and formed into pyramids, which are then named hummocks.

Ice Foot. (*Ceinture* or *Lisière des Glaces*). — (Подошва льда = Podoshva Lda = ice sole).
Ice foot is the ice frozen to the shore, which does not rise and fall with the tide. Properly the low fringe of ice formed about the shore by sea spray. More widely, the banks of ice of varying height which skirt many parts of the Antarctic shores.

Iceberg. (*Iceberg*). — (Ледяная гора = Ledianaia Gora = Ice mountain).
Is a floating mass of land ice, calved from its mother glacier; unsteady, reaching 100 to 200 feet in height; draughting seven to eight times more; up to several hundred square yards in extent.
NOTE. — In the Arctic the icebergs are comparatively small; in the Antarctic they have been known to be 20 miles or more in extent.

Land Ice. (*Glace soudée à la terre*). — (Забереги = Zaberegi = coastal extension).
Ice attached to the shore, within which there is no channel.

Lead or Lane. (*Chenal* or *Passage*). — (Полынья = Polynia = glade).
A narrow surface of open water or a navigable passage through pack ice or other collection of ice; a lead may be covered with young ice.

Moraine. (*Moraine*).
Rock débris associated with a glacier.

Névé. (*Névé*).
The upper portion of a glacier, which is rather frozen snow than ice.

Nunatak. (*Nunatak*).
A lonely peak, generally glaciated, rising from an ice sheet, or from inland ice.

Old Ice. (*Glace ancienne*). — (Многолетний лед = Mnogoletniy Liod = perennial ice).
Ice which has not melted during summer.

Open Pack. (*Banquise pénétrable*). — (Разреженный плавучий лед = Razriejonny Plavoutchij Liod = Open floating ice).
Floes generally separated and composed of narrow belts, with many leads and pools; also known as *Loose Ice* (*glace déliée*); accessible to navigation.

Open Water. (*Eaux libres*). — (Открытая вода = Otkritaya Voda = Open Water).
Free navigable water adjacent to an ice-encumbered channel or sea. (It may be recognised from a distance by the darker colour of the sky over it).

Pack Ice. (*Banquise* or *Pack*). — (Пак = pak).
Term used in a wide sense to include any area of sea ice, other than fast ice, no matter what form it takes or how disposed. Getting through is possible only at leads or other open spaces.
Pack ice is a large collection of pieces of ice from broken-up floes or icebergs, which have to a certain extent closed together again.
Note 1. — The pack is said to be "open" when it presents leads or lanes of water between the pieces of ice, forming more or less promising navigable channels; and "close" when it is not possible to navigate through the collected pieces of ice.
Note 2. — The principal difference between pack ice and floe ice is that for the formation of the pack the presence in the locality of polar ice of many years' standing is necessary, whilst floe ice and ice fields can be formed from one year ice.

Pan. (*Poëlon*).
A large sheet of ice thicker at the edges than in the middle.

Pancake Ice. (*Glace en forme de crêpes*). — (Блиновидный лед = Blinovidnii Liod = Ice made of pancakes).
Small pieces of newly frozen ice, approximately circular, with raised rims, of insufficient thickness to prevent navigation, sometimes separated into cakes suggestive of the name.

Pieces of Ice. (*Glaçons*). — (Льдины = Ldiny).

Piedmont. (*Piedmont.*)
Coastwise stretches of the ancient ice sheet which once covered the Antarctica, remaining either on the land or wholly or partially afloat.

Pool. (*Nappe d'eau, Mare*).
Any enclosed water area in the pack other than a lead or lane.

Pressure Ridge. (*Dorsale de compression*).
Hummocked ice where floes have been pressed and broken against each other.

Rotten Ice. (*Glace pourrie*).
Floes which have become much honeycombed in the course of melting.

Sailing Ice. (*Glace navigable*).
See "Drift Ice".

Sheet Ice. (*Nappe de glace*).
A large piece of floe or bay ice that drifts to sea unbroken.

Slob Ice. (*Bavure de glace* or *Glace morcelée*).
Is loose broken ice in bays and along the exposed edges of floes.

Shore Floe. (*Banquise côtière*). — (Береговой припай = Beregovoi Pripai = Coastal welding).
Is a field or floe ice welded to the shore since the winter, which does not rise and fall with the tide (see also: Ice Foot).

Slot Ice. (*Glace striée*).
Ice slotted by erosion, etc...

Slush or Sludge. (*Bouillie glacée*). — (Сало = salo = grease).
A collection of ice crystals not welded together. The initial stage in the freezing of seawater when its consistency is gluey or soapy. Navigation not checked. The term is also used for brash ice, still further broken down.
(Шуга = shuga, the name given to slush in Russian rivers).

Stamukha. (Стамуха).
Detached hummocks, icebergs or floes which have grounded on shoal water and remain there.

Tabular Berg. (*Iceberg tabulaire*).
(Snowbergs). One calved from the great ice barrier; flat topped.

Young Ice. (*Jeune glace* or *Glace nouvelle*).
All unhummocked ice, no matter of what age or thickness. This ice was formerly known in the Arctic as Bay ice.

Rapaki. (Рапак).
Ice, principally in rivers, but also in bays or on land ice, frozen unevenly as detached bodies of ice, standing vertically or inclined. They greatly hamper progression.

B.

Calving. (*Vêlage*).
The breaking away of a mass of ice from berg or glacier.

Glaciation. (*Glaciation*).
The action of a glacier or sheet ice on the rocks of the country over which it has passed.

Glacierisation. (*Glaciérisation*).
The inundation of land by ice.

Hummocking. (*Moutonnement*).
Process of pressure formation.

Ice Cap. (*Calotte de glace*).
A continuous covering of ice, névé or snow.

Rafting. (*Flottage*).
Is the piling of sheet on sheet of ice by the action of wind and sea.

Frost Smoke. (*Fumée congelée*).
Fog-like clouds which appear over recently formed leads and pools, owing to the contact of the colder air with the relatively warm sea water; known in the Arctic as "Barbers."

Ice blink. (*Clarté des glaces*). — (Ледяной отблеск = Ledianoi otblesk = ice blink).
(Ice Sky). A peculiar whitish glare in the sky, produced by reflection of ice, the ice itself being too distant to be visible.

Land Blink. (*Reflet de la terre*).
Yellowish gloom over distant ice covered land.

Snow fog. (*Tourmente de neige*).
Heavy snowfall with low visibility.

Water Sky. (*Ciel d'eau*). — (Ледяное небо = Ledianoe Niébo = Icy heavens).
Dark streak over the horizon, due to reflection of open water or broad leads or pools in the middle of the ice.

Beset. (*Bloqué, clavé*).
Situation of a ship when closely surrounded by ice and unable to move.

Boring. (*Forage*).
Pressing the ship through small ice or young ice under power or sail.

Nipped. (*Pris*).
Situation of a ship when forcibly pressed by ice on both sides.

Sallying. (*Faire une sortie*).
Rolling ship by means of crew running from side to side in order to loosen ice around ship and allow her to make headway.

Working. (*Se frayer un chemin*).
Making headway through pack.

By studying the above data, *which are extracted solely from Sailing Directions*, the seaman is already in possession of an appreciable amount of valuable information concerning ice, but it may be questioned whether a few

doubtful points and, perhaps, also, a certain confusion of ideas partly due to the arrangement of the terms in alphabetical order, do not still exist in his mind.

The seaman who desires to become rapidly acquainted with ice terminology, would benefit by having these terms in logical sequence, which not only permits clear expression of the definition of the terms but gives also, to a certain extent, the rational relation between the ice terms and the deductions to be drawn therefrom.

Numerous authors have given their attention to the names which are applicable to sea-ice and, in publishing the results of their voyages, the majority of arctic explorers have given lists appropriate to the areas visited, together with various definitions.

The following authors who have made the most important contributions to the study of this question should be particularly noted :—

II. — *BIBLIOGRAPHY RELATING TO SEA-ICE.*

William SCORESBY : An Account of Arctic Regions, Vol. I., p. 226-229, Edinburgh, 1820.
E. K. KANE : Arctic Explorations, Vol. I., p. 13-14 "Glossary of Arctic Terms", Philadelphia, 1856.
Julius PAYER : Narrative of the Discoveries of the Austrian ship *Tegetthoff* in the years 1872-1874 (English Translation), Vol. I., London, 1875.
Karl WEYPRECHT : Oesterreichisch-ungarische Arktische Expedition, 1872-1874, Vienna, 1879
J. THOULET : Océanographie Statique, Partie V., p. 468-483, Paris, 1890.
Sir Clemens R. MARKHAM : Antarctic Manual, p. XIV-XVI, Royal Geographical Society, London, 1901.
E. GOURDON : Expédition Antarctique Française (1903-1905) commandée par le Dr Jean CHARCOT, Partie II, p. 121-133, Paris, 1908.
Henryk ARCTOWSKI : Expédition Antarctique Belge du S.Y. *Belgica* (1897-1898). Rapports scientifiques, Anvers, 1908.
Ludwig MECKING : Das Eis des Meeres- Meereskunde, Vol. 3, N° 11, Berlin, 1909.
A. KOLCHAK : Résultats de l'Expédition Polaire Russe de 1900-1903. Mémoires Académie Impériale des Sciences de St-Pétersbourg, Vol. 26, N° 1, St-Pétersbourg, 1909.
Y. M. SHOKALSKI : Types of Ice of the Arctic Sea and their Life Cycle, pages 25-42. Hydro-Meteorol. Section, Hydrographic Administration, Petrograd, 1918.
E. VON DRYGALSKI : Deutsche Südpolar Expedition, 1901-1903, Vol. 1, N° 4. Das Eis der Antarktis, Berlin & Leipzig, 1921.
J. M. WORDIE : Shackleton Antarctic Expedition, 1914-1917. Transactions Roy. Soc. of Edinburgh, Vol. 52, Part IV, p. 797-799, Edinburgh, 1921.
N. MOROZOV : Manual for Ice Navigation in the White Sea, p. 11-19. Hydrographic Administration, Petrograd, 1921.
C. S. WRIGHT and R. E. PRIESTLY : British ("Terra Nova") Antarctic Expedition, 1910-1913. Glaciology, London, 1922.
N. TIMOFEEVSKII : The Ice Cover of the Gulf of Yenisei, Izvestiya Gosud. Russ. Geogr. Obshchestva, Vol. 57, N° 2, pages 31-32, 1925.
F. A. ZEUSLER : The Ice Drift in the North Atlantic Ocean. — U. S. Pilot Chart of the North Atlantic Ocean, Washington, March, 1926.
N. A. TRANSEHE : The Ice Cover of the Arctic Sea, with a genetic classification of Sea Ice. — Problems of Polar Research, pages 91-123, American Geographical Society, New-York, 1928.
Otto NORDENSKJOLD : The Ice in the Polar Regions. "The Geography of the Polar Regions" — American Geographical Society Special Publication N° 8, pages 21-38, New-York, 1928.
V. AKHMATOV & L. RUDOVITZ : Albom Liedov Obrazovanii (Album of Ice Forms). Hydrographic Department, Leningrad, 1930.
METEOROLOGICAL OFFICE : The Meteorological Glossary. Air Ministry, London, 1930.
Edward H. SMITH : U.S. Coast Guard *Marion* Expedition to Davis Strait 1928.—Washington, 1931.

The above-mentioned works supply very complete information on the question with which we are dealing, *i.e.* on the description and denomination

of different types of ice likely to be met with at sea. (We have not included those authors who concerned themselves with the classification of land ice).

The particularly precise details given in the last works mentioned, of quite recent date, merit particular attention in view of the fact that a lack of uniform terminology to designate the same object, or at least a lack of an equivalent in the ice terms used by different authors of different nationalities, may be not only a serious stumbling-block in any study of ice and ice conditions in the polar regions, but may also give rise to some confusion in the minds of seamen who frequent these areas.

III. — *STUDY OF SEA-ICE.*

The ice which the seaman encounters at sea and which occurs either in the form of frozen stretches of water or in the form of ice-blocks, is of three different types :—

(1) Sea-ice due to the freezing of the surface of the sea.
(2) Ice from the glaciers of polar lands.
(3) Fresh-water drift-ice carried by rivers to the sea.

From their birth these different types of ice undergo changes which considerably affect the aspect under which they appear to the seaman, and this is particularly true of sea-ice. Therefore, any description and any classification of these forms of ice must logically be based on the generic process giving birth to these forms, *i.e.* on the method of formation and growth of ice on land or at sea, on its transformation under the influence of physical agencies or of the mechanical forces which come into action during the drift and the meeting of the ice, and lastly, on the various methods of breaking-up of the ice which may be due to various causes.

Fresh-water ice drifted to the sea by the great Siberian and American rivers forms but a very small proportion of the total mass of Arctic ice. It is very hard ice, the blocks of which are of a characteristic greenish texture ; the blocks are sometimes soiled by earthy matter which they have carried with them.

The glaciers of polar lands reach the sea and the seaman must sometimes skirt them. It is from their seaward edge that the process of breaking-off into ice-bergs under the more or less combined influence of the movement of the glacier and the motion of the waves, known as "calving", takes place ; the compact mass of these icebergs occasionally presents, especially in the Antarctic, very peculiar blue tints and on their surface deep striae caused by erosion in the glacier may occasionally be seen.

The study of sea-ice, its formation and many transformations, for the special purpose of compiling a good ice-terminology, is clearly and precisely described in the preface to the АЛЬБОМ ЛЕДОВЫХ ОБРАЗОВАНИЙ (Albom Liedovik Obrasovanii - Album of Ice Forms), recently published by the Hydro-Meteorological Section of the Hydrographic Department at Leningrad (1930).

In *International Hydrographic Bulletin* N° XII, December 1930, attention has already been directed to the special interest attached to this work. It was at the beginning of 1921 that the Hydrographic Departement at Leningrad published and distributed a questionnaire in order to establish the termi-

nology and characteristics of sea-ice encountered in different localities. Later, the Russian Hydrographic Department convened a Committee of Experts to draw up a classification of sea-ice in accordance with practical requirements. The Committee made use of the replies received to the questionnaire and of information taken from Russian and foreign publications as well as from most of the publications mentioned above.

The Album just published by the Russian Hydrographic Departement gives details of the terminology established by the Committee of Experts based on the consideration of the formation and gradual development of the layer of ice in autumn, of the transformation this layer undergoes in winter, and of its disappearance during spring and summer.

The Album is accompanied by about forty photographs of different kinds of ice, which enhance its interest.

In view, of the importance of this question, not only from a scientific point of view but also in the practical interests of navigation in the Arctic and Antaictic, the International Hydrographic Bureau reproduces the entire text of the definitions of the various terms relating to ice as adopted by the Russian Special Committee.

This text will be found hereafter and it is considered advisable to preface it by a few general remarks on sea-ice extracted, for the greater part, from the work by V. AKHMATOV and L. RUDOVITZ. These give a brief and accurate summary of all that it is necessary to know concerning the formation, transformation and breaking-up of sea-ice.

FORMATION OR GROWTH OF SEA-ICE.

(1) NATURAL FORMATION.

Sea-ice is formed in the following manner :—

After a drop in temperature or after a fall of snow which causes the sea-water to become colder (to — 2°5 centigrade (27,2° F.) according to the salinity), fine ice-crystals in the form of prismatic needles (spicules), which are at first entirely separate from one another, form in the neighbourhood of ice remaining from the previous winter. These primary crystals increase in size, loosely freeze together and form clots which look like gruel composed of pounded ice mixed with snow. The surface of the water at this stage appears as though covered by a layer or by spots of melted grease, with a peculiar steel-grey or lead tint. This layer is sufficiently flexible to follow the movements of the swell, but not those of the wind.

Because of its "ice-gruel" appearance, this first stage in the freezing of the sea-water has been called *slush* or grease (Fr. : *graisse*) and in Russian САЛО (*salo* = grease).

If the frost lasts, this slush (Fr. : *bouillie glacée*) freezes together and, if the cold is considerable, calm waters in bays or calm waters along coasts become covered with a thin and relatively fragile skin of ice called *ice-rind* (Russian : НИЛАС = nylas), hardly able to bear a man's weight and easily broken by waves, or the wind as soon as it rises.

When the upper layers of sea-water are disturbed by a slight surface motion and the temperature is very low, the congelation of the slush (*bouillie glacée*) does not occur uniformly over the whole free surface of the sea, but starts simultaneously at a number of centres, from which it radiates equally in all directions.

The ice crystals group themselves around these centres or nodules forming more or less regular discs from 1 to 2 feet in diameter, the surfaces of which look as if they were inflated. The appearance of this formation, discs with raised edges, has given it the name of *pancake ice* (Fr.: *glace en crêpes* or *en oreillettes*).

With a high wind and a rough sea, the *slush ice* (Fr.: *bouillie glacée*) takes the form of whitish fragments which may attain a thickness of 2 inches, called *sludge* or *brash ice* (Russian ШУГА = shuga).

When very cold sea-water becomes covered with soft snow, a sort of viscous ice forms on the surface having a somewhat pasty appearance, which is called in Russian СНЕЖУРА = sniejura = frozen snow.

It should be noted incidentally that pancake ice (Fr.: *glace en crêpes*), may result from mechanical grouping of small fragments of sludge by rubbing against each other, just as much as from the hardening and solidification of slush. The discs may then attain as much as 6 feet in diameter and their edges of bruised or pounded ice have a swollen appearance.

If the cold persists or increases, each cover of *slush*, of *sludge* (Fr.: *boue glacée*) and of *pancake ice* (Fr.: *glace en oreillettes*) thickens and neighbouring pieces freeze together, due to the freezing of crystals in the interstices, thus gradually forming a larger, thicker and more solid cover known as *young ice* (Fr.: *glace nouvelle* or *jeune glace*; Russian МОЛОДИК = molodik) consisting of wet, steel-grey ice, the surface of which is saturated with brine, about one inch thick, composed of coarse, more or less developed crystals; this is less easily broken by wind and waves. The upper surface of this young ice is fairly smooth or only slightly rough, while the under surface is coarse and rough and sometimes has the appearance of a brush of ice crystals.

Underneath this ice there is a more or less thick layer (about 1 foot deep of water saturated with ice crystals which gradually increase the thickness of the young ice from underneath; young ice is generally about 1 inch thick; it thickens throughout the winter, attaining an average of from 4 to 6 1/2 feet (the maximum thickness observed is 12 feet).

Developing in thickness, young ice (Fr.: *jeune glace*), like ice-rind (Russian = nyla), if not subjected to mechanical action, forms a vast uniform stretch of ice known as *fast ice* (Fr.: *glace fixe*; Russian: СМОРОЗИ = smorozi).

Near the coast, at the heads of gulfs and bays, in the straits, amongst the islands, and generally speaking in all relatively sheltered waters, the layer of ice forms sooner than in the open. It extends to seaward thereafter.

The ice-rind (nylas), sludge (sniejura) and pancake ice, by freezing onto the coast, form a belt or zone along the coast of immovable ice, several yards in width, called *coastal ice* (Russian: ЛЕДЯНОЙ ЗАБЕРЕГ = ledyanoi zabereg = icy extension offshore, Fr.: *glace côtière*).

Its development in width and thickness constitutes what is known as *land floe* or *land-ice* (Russian : ПРИПАЙ = pripai ; Beregovoi pripai = coastal welding).

That part which is in immediate contact with the shore and which does not follow the tides (vertical movements due to tides) is called *ice-foot* (Fr. : *ceinture des glaces* ; Russian : ПОДОШВА ЛЬДА = podoshva lda = ice-sole).

(2) DYNAMIC FORMATION RESULTING FROM MOVEMENT OF THE ICE.

In violent winds and rough seas parts of fast-ice, land-floe, etc. break up and, according to the dimensions and thicknesses of the pieces, form *ice-fields* (Fr. : *champs de glace*), the limits of which extend as far as the eye can see ; *ice-floes*, the dimensions of which vary from 1/3 to 1 mile ; *small floes* (Fr. : *glaçons*, Russian : ЛЬДИНЫ = ldini), large, medium or small blocks, the dimensions of which vary from one yard to a hundred yards ; and lastly, *slob ice* (Fr. : *glace morcelée*), consisting of thick, viscous masses of crumbled ice mixed with slush and *sniejura* (frozen snow).

The slob ice which is formed by the rubbing of pieces of ice against each other or against the outer edge of the land ice, produces accumulations several yards in thickness, which sometimes extend as far as the bottom of the sea.

These pieces begin to drift, driven by wind or carried along by currents ; thus they move from one place to another and, under favourable conditions, may freeze together again.

Speaking generally, the name *pack-ice* (Fr. : *banquise* or *pack*) is applied to any sea-ice which has drifted from its original position or which has more or less rewelded together.

When winds or tidal streams drive floating pieces of ice against land floes, ice-fields, etc., or, again, when the margins of isolated pieces of drifting ice crush into each other, they break each other up and pile onto each other, telescope, overlap or rise up edge to edge in more or less shapeless heaps and freeze together in these positions. The extent of this phenomenon, known as *hummocking*, depends on the size of the colliding masses, their speed, form and solidity. The results are more or less chaotic.

This first stage of hummocking, the rising of the edges under the influence of pressure from 6 to 15 feet above the general level of the ice, is called in Russian РОПАКИ = ropaki.

When the phenomenon is considerably developed and hillocks and ridges projecting from 10 to 25 feet above the general ice-level are formed, the result is known as *hummocky ice* (Russian : ТОРОС = toros).

Single slabs or sheets of ice frozen together thus reach such an accumulation that sometimes they may rise several yards above the surface of the water over a relatively small horizontal area ; such formations are called *floebergs* (Fr. : *fragments montueux de banquise* ; Russian : НЕСЯКИ = niessiaki) and, when stranded on sandbanks or in shoal water, they are given the name of СТАМУХ = stamukhi.

Small pieces of ice (a few yards) of hummocky origin are called *growlers* (Fr. : *grondeurs*) ; some of these have a submarine projection called the *ram* (Fr. : *bélier*).

In certain places, land-ice forms abundantly and when floating ice is thrust against its edge, the slabs of ice pile up onto each other in varied positions and constitute what is known as *coastal hummock* (Russian : ПРИБРЕЖНЫЙ ТОРОС = pribrejnii toros).

The name of *hummocky ice* is applied also to unevenesses of various size, to undulations in the form of humps, projections, hillocks, etc., which rise above the general surface of ice-fields in consequence of the effects of pressure or expansion which arise in the mass itself or in the different layers.

(3) Breaking up of sea ice.

In the Spring, snow falls on the ice and pools of fresh water (СНЕЖНИЦА = sniejnitza) are formed on the surface, which in frosty weather become covered with a thin layer of ice (НАСЛУЗЬ = nasslous).

At the same time the mingled ice and snow along the coasts and on the shore give rise to *offshore water* (Fr. : *flaques d'eau côtières*) which increases and gradually destroys the layer of ice along the shore, thus creating *open water* (Fr. : *espaces d'eau libre*) in such places.

At some distance from the coast, hollows are formed in the ice by the combined action of the sun and the pools of fresh water, and the water accumulated on the surface runs into them.

During the melting of the ice, either of the entire layer or of the pieces into which it has broken up, the ice deteriorates and becomes reduced to single pieces and to spicules which mark the final stage of its transformation before its entire disappearance.

The state of the ice-sheet, even in winter, undergoes many alterations. Winds and currents loosen and break up its continuity, thus creating *channels* (Fr. : *chenaux*), *craks* (Russian : *rasvodya*) and *leads* (Russian : *polynyas*), which may sometimes be used for navigation although they may close up and freeze together, again forming the solid pack.

The following list gives the terminology drawn up by the *Ydrografiski Upravlenie* of Leningrad, which was presented to the IInd General Hydrologic Conference of the Union in 1928 and was adopted by this Assembly for current use.

IV. — *TERMINOLOGY OF THE RUSSIAN HYDROGRAPHIC OFFICE.*

A) FORMS CORRESPONDING TO THE GENESIS AND THE PRIMARY FORMATION OF ICE.

1. *Ice Crystals* (Cristaux de glace).
(ЛЕДЯНЫЕ ИГЛЫ = Ledianie igly = ice needles).

Small ice crystals hardly distinguishable by the naked eye ; their presence causes an alteration in the usual colour and transparency of the water.

Ice spicules constitute the first phase of the ice formation at sea. These originate not only on the surface of the sea, but also within certain deeper layers as a result of a slight drop in temperature.

2. *Slush* (Bouillie glacée).
(САЛО = salo = grease).
Accumulation of ice spicules not frozen together, gathered on the surface of the water and covering the sea with stains like oil-spots and forming a thin film of greyish or lead-grey colour. Slush forms a very thin layer, undulating with the motion of the waves. When there is a wind, the surface covered with slush does not develop ripples but looks smooth.

3. *Ice-rind* (*Nylas*) (Croûtes de glace).
(НИЛАС = nylas).
Thin, elastic, transparent layer of ice. It appears on the calm surface of the sea when the slush freezes together. Winds easily break it into glass-like fragments called in Russian ПАЛАБАЖНИК = palabajnik.

4. *Sniejura* (Neige glacée).
(СНЕЖУРА = sniejura, from СНЕГ = snow).
A viscous mass resembling pea-soup, resulting from a heavy snowfall on water which has been sufficiently chilled.

5. *Sludge* or *brash* (Boue glacée or Glace friable, Bourguignons).
(ШУГА = shuga).
Friable pieces of ice of whitish tint up to 2 ins. and more in thickness. These result from frozen slush and sometimes from *sniejura* which grows and thickens under the action of currents. It sometimes results from bottom-ice, produced by chilling of the waters at the bottom, which rises to the surface.

6. *Pancake Ice* (Glace en crêpes or en oreillettes).
(БЛИНЧАТЫЙ ЛЕД = blinchatii liod).
Separate slabs of ice of rounded shape up to 6 ft. in diameter. They usually have a white border. Pancake ice may be produced either by ice spicules or slush freezing together, or from a mechanical packing of sludge, sniejura or broken nylas.

7. *Young Ice.* (Jeune glace).
(МОЛОДИК = molodik).
Thin ice with a coarse humid surface of light-grey colour. Produced by sludge, sniejura or pancake ice freezing together. Wind and waves break it with more difficulty than nylas.

8. *Fast ice* (Glace ferme).
(РОВНЫЙ ЛЕД = rovnii liod = smooth surface ice).
Solidified ice not subjected to mechanical action. It results from the growth of young ice and ice-rind (nylas).

9. *Coastal ice* (Glace côtière).
(ЛЕДЯНОЙ ЗАБЕРЕГ = Ledyanoi zabereg = icy extension off shore).
Thin immovable ice extending some tens of metres from the coast and consisting of slush, sludge, sniejura and ice-rind (nylas) frozen together.

10. *Land floe* or *Land ice* (Banquise or Glace reliée à la terre).
(ПРИПАЙ = pripai = welding).
Immovable ice attached to the shore and stretching several tens of miles over the sea. It is due to the development of coastal ice augmented by floating ice which freezes onto this sheet of coastal ice.

11. *Ice foot* (Ceinture des glaces).
(ПОДОШВА ЛЬДА = podoshva lda = ice sole).
That part of the land floe directly attached to the shore and not influenced by the variations due to tidal currents.

B) SECONDARY FORMS RESULTING FROM DEFORMATION OF PRIMARY FORMATIONS.

(*a*) By Parcelling.

1. *Ice fields* (Champs de glace).
(ЛЕДЯНЫЕ ПОЛЯ = liedianie polia).
Wide areas (over 1 sq. nautical mile) of floating ice, the limits of which cannot be definitely fixed. Ice fields result either from the growth of large areas of fast ice, or from the freezing together of various types of ice. There are both smooth and hummocky icefields.

2. *Ice floes* (Bancs de glace or Banquise flottante).
(ОБЛОМКИ ПОЛЕЙ = Oblomki polei).
Areas of floating ice, the dimensions of which vary from one cable length (200 yds) to 1 naut. mile. This form of ice results from the breaking of ice-fields into smaller parts.

3. *Small floes* (Glaçons de grandes dimensions).
(КРУПНО-БИТЫЙ ЛЕД = Kroupno-bity liod).
Pieces of ice from 20 to 200 yards wide. These result from fast ice or ice fields which have been broken into many parts by the action of wind and current, or else from the freezing together of smaller pieces of ice collected by wind or current.

4. *Small ice* (Glaçons de petites dimensions).
(МЕЛКО-БИТЫЙ ЛЕД = mielko-bity liod).
Small pieces under 20 yds wide. These result from fast ice, icefields or floe which have been broken into small pieces by the action of wind and current; they may also originate from sludge which has frozen together and from fragments of ice-rind (nylas) which has been broken up by the action of the waves.

5. *Slob ice* (Glace morcelée).
(ЛЕДЯНАЯ КАША = Ledianaya Kasha).
A mixture of crumbled ice with sludge and sniejura. This is found at the edges of the ice or along the coasts, where it forms a dense layer which is several yards thick. This form is very dense when packed under pressure, but, when disintegrating, is very friable.

(*b*) By Piling up.

6. *Ropaki* or *Rubaki*.
(РОПАКИ, РУБАКИ).
Ice fragments piled up edge to edge above the relatively even surface of the ice. It is brought by the ice pressure caused by winds or currents.

7. *Hummocks* (Torose).
(ТОРОС = toros).
Piling up of ice fragments, mostly frozen together, and distributed either in isolated protuberances or in the form of ridges. This is caused by the ice pressure. Ice showing different form of hummocks is called *hummocky ice* (*glace moutonnée*).

8. *Floeberg* (Blocs montueux de glace flottante).
(НЕСАК = nessiak).
A compact form of masses of ice frozen together, rising high out of the water and of deep draught, and of relatively small horizontal area.

9. *Stamukhi* (СТАМУХА).
Pieces of floe or hummocky ice stranded in shoal water.

10. *Arctic pack* (Pack or Banquise Polaire).
(ПАК = Pak).
Stratified ice of great age, of considerable thickness and extending over a wide area.

11. *Sikosak* (СИКОЗАК).
Stratified ice, of great age, which forms in high latitudes in bays and fjords. Each

year the accumulation of new layers and the freezing together of the layers produce different forms of stratification.

(*c*) Glacier Ice.

12. *Ice-berg* (Montagne flottante de glace).
(ЛЕДЯНАЯ ГОРА = ledianaia gora).
Fragments of glacier ice, of great dimensions. Smaller fragments are called *calvings*.

C) FORMS CHARACTERISTIC OF THE PERIOD OF ICE DECOMPOSITION.

1. *Offshore water* (Flaques d'eau côtières).
(ВОДЯНОЙ ЗАБЕРЕГ = Vodianoi zabereg).
Sheets of water formed on the ice along the coast by melting of snow on the shore and on the ice and also by the melting of the ice.

2. *Open water along the shore* (Eau libre le long des rivages).
(СКВОЗНОЙ ВОДЯНОЙ ЗАБЕРЕГ = skvoznoi vodianoi zabereg).
A sheet of water between the ice and the coast resulting mainly from the ice melting in Spring.

3. *Pools* (*Sniejnitza*) (Flaques d'eau douce).
(СНЕЖНИЦА = sniejnitza, from СНЕГ = snow).
Fresh water from melting snow on the ice which accumulates in more or less extensive fresh water pools.

4. *Holes* (Trous).
(ПРОТАЛИНЫ = Protaliny).
Round holes in the ice due to the thermal and mechanical action of the water penetrating into the ice through the fissures.

5. *Nassloos* or *Nasslood*.
(НАСЛУД).
Thin layer of ice formed on the surface of the water which has accumulated on older ice and which results from melting of the ice or from water which has risen from below the layer through fissures in it.

6. *Slood*. (СЛУД).
Skin of frozen snow which forms on the surface of ice (the same as the so-called *nast* (НАСТ) on land).

D) COLLATERAL TERMS PERTAINING TO THE PRESENCE OF ICE.

1. *Promojna* (ПРОМОИНА).
Opening in the ice, washed out by currents.

2. *Leads* (Passes).
(РАСЩЕЛИНА = Raschtchelina).
Channels or passages through different types of ice.

3. *Cracks* (Fissures).
(ТРЕЩИНА = trechtchina).
Narrow strips of water resulting from the action of tidal phenomena, of temperature variations, of wind or of any other cause.

4. *Rasvodye*
(РАЗВОДЬЕ = rasvodye).
Space of open water resulting from the action of the turn of tidal streams.

5. *Polynya* (Clairières).
(ПОЛЫНЬЯ = Polynya = glade).
Space of open water among any type of ice. Polynya between land floe and floating ice is called *ryntzala* (РЫНЦАЛА).

6. *Open water* (Eaux libres de glaces).
(ОТКРЫТАЯ ВОДА = Otkrytaia voda).
Space of free water contiguous to that covered with ice.

7. *Growlers* (Grondeurs).
(ТАРТЫШИ = tartishi).
Isolated ice fragments from one to several yards in length, with smooth surface (koltak) or piled up (tartysh). When the submerged portion projects considerably the growler is said to possess a "ram".

8. *Sheet ice* (Glaces stratifiées).
(ПОЛОСЫ ЛЬДА = Polossy Lda = ice in layers).
Broken ice showing stripes or strata above the water.

9. (ПРИЛИВНОИ ГРЕБЕНЬ = Prilivnoy greben).
Ice thrown against the coast by tides; sometimes mixed with sand and gravel.

10. *Water sky* (Ciel d'eau).
(ВОДЯНОЙ ОТБЛЕСК = Vodianoi otblesk = water reflection).
Darks and streaks characteristic of clouds above open water hidden behind ice.

11. *Ice blink* (Clarté des glaces).
(ЛЕДЯНОЙ ОТБЛЕСК = Ledianoi otblesk = ice reflection).
Whitish glare characterising clouds over accumulations of ice though these are not in sight.

E) ICE CHARACTERISTICS FROM THE POINT OF VIEW OF NAVIGATION.

1. *Drift ice* (Glaces en dérive).
(РЕДКИЙ ЛЕД = Redki Liod = rare ice).
Different types of ice fragments covering an area relatively much smaller than the open water (ice to water as 1 to 3; distributed over the entire visible surface).

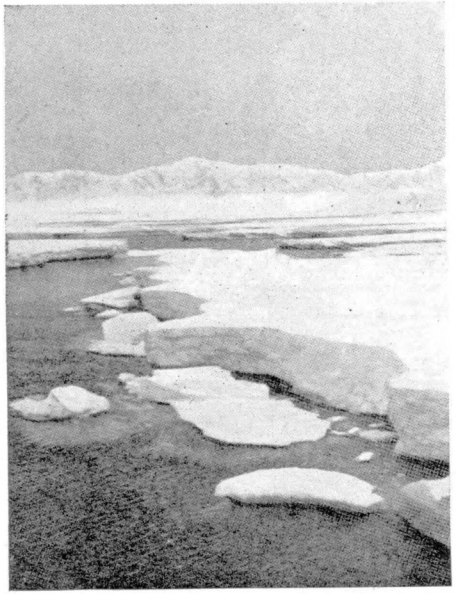
2. *Open ice* (Glace pénétrable).
(РАЗРЕЖЕННЫЙ ЛЕД = Rasriejonny Liod).
Different types of ice fragments covering about one half of the visible area (as 4 is to 6; piles of ice distributed over the entire visible surface).

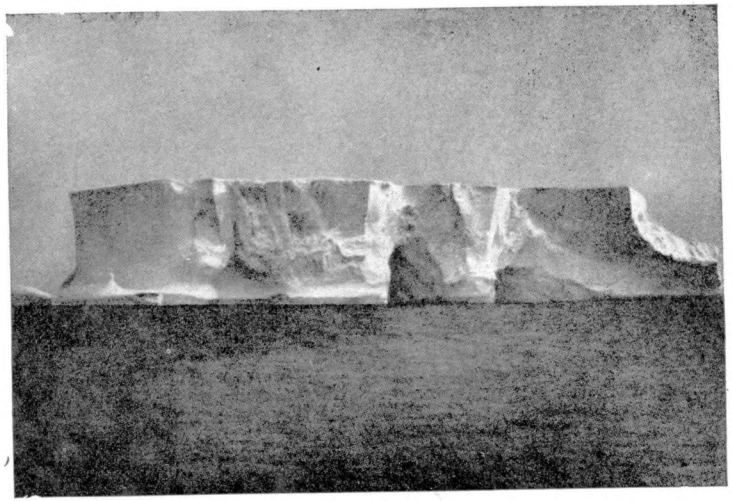
3. *Close ice* (Glace impénétrable).
(СПЛОЧЕННЫЙ ЛЕД = Splotchenny Liod).
Extensive accumulation of various surfaces of ice not frozen together but grouped very compactly.

4. *Compact ice* (Glace compacte).
(СПЛОШНОЙ ЛЕД = Splochnoi Liod).
This forms a single solid mass covering the bays, fjords and straits, and vast areas of open sea.

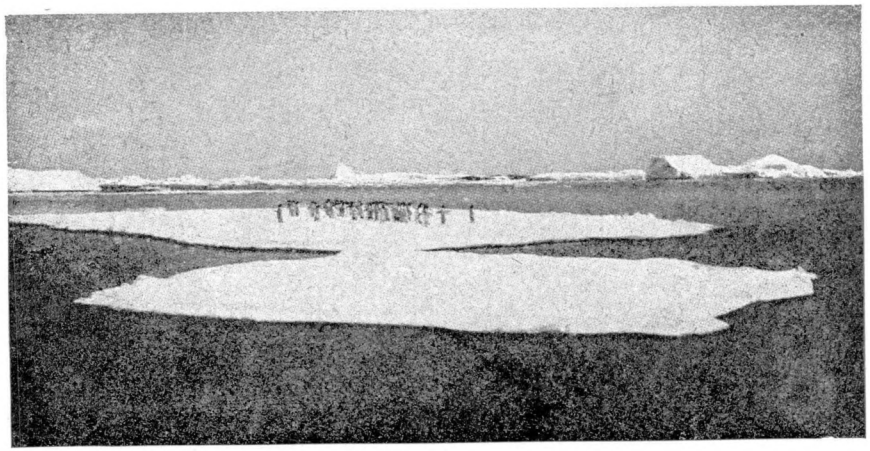
5. *Heavy ice* (Glace épaisse or glace profonde).
(ТЯЖЕЛЫЕ ЛЬДЫ = tiajolie Ldi).
Dealt with with difficulty by the most powerful ice-breakers; hummocky ice-fields, close ice, pack, at least 2 feet thick.

Ice-foot
Ceinture des glaces





Tabular Ice-berg — Iceberg tabulaire



Floe — Banquise flottante

Pancake Ice — Glace en crêpes

6. *Nabivnoy* or *rafting ice* (Trains de glace).
(НАБИВНОЙ ЛЕД = Nabivnoy Liod = heaped up ice).
Consists of numerous layers, resulting froms the telescoping of sheets of ice onto each other.

7. *Fresh ice* (Glace nouvelle).
(МОЛОДОЙ ЛЕД = Molodoi Liod = young ice).
Newly formed ice of different types (nylas, young ice, ledyanoi zabereg and analogous types).

8. *Old ice* (Glaces anciennes).
(МНОГОЛЕТНИЙ ЛЕД = Mnogolietnii Liod = several years old ice).
Ice which has not melted during summer, and which has existed not less than two winters.

We have therefore examined, in the course of this note, on the one hand the terms pertaining to the terminology of ice as published for mariners in the various *Sailing Directions* and, on the other hand, a rational nomenclature drawn up by the Russian Hydrographic Office for the Arctic seas. As has been done by this Office, it is essential that the definitions be accompanied by some typical photographs which will show at a glance the principal forms of ice which may be encountered at sea. We have therefore reproduced several photographs taken from the best prints published in polar bibliography. It is to be hoped that photographs of this kind will be collected and be conveniently placed at the disposal of seamen, as has been done by the Hydrographic Department of Leningrad. This is already the usual practice in Meteorological Offices for conveniently displaying the various characteristic types of cloud forms.

It is evident, from the diversity of the terms and definitions which have been quoted in this short article, that it is necessary to introduce uniformity in, and possibly to simplify, the official designations pertaining to ice.

In conclusion, several terms are given below which are not included in the lists quoted, but which are sometimes met with in the reports of Polar Expeditions. We have added the usual definitions given either in these reports or else in the encyclopaedic dictionaries.

In connection with this article, the International Hydrographic Bureau would be very glad to receive any suggestions which may be offered by readers of the *Hydrographic Review*, with a view to defining accurately, if necessary, and completing the nomenclature for ice by including the more common expressions used in other languages.

It would also be pleased to receive photographs of various types of ice which competent persons may be kind enough to forward.

V. — *OTHER TERMS PERTAINING TO ICE.*

INLANDSIS :
Name given to the ice cap which covers the central part of Greenland and, by extension, to any great accumulation of ice on a continental base.

CONTINENTAL ICE (Glace continentale) :

All ice which is formed and remains in the interior of the land.

HIGHLAND ICE, ICE-MANTLE (Glaciation en manteau. — Hochlandeis) :

Glacial covering of sufficient thickness to form a practically continuous covering, but which is yet not sufficiently thick to hide the general features of the relief of the land.

The terms *island-ice, ice-domes, ice-calottes* and *ice-caps* are applied to the glacial covering special to the islands.

ICE SHEET (Couche or Nappe de glace) :

Vast expanse of terrestrial ice with a flat surface, slightly dome-shaped, which almost completely covers the ground on which it rests so that the snow falls directly on the surface of the ice. At the present time the best known and the most extensive ice-sheets are in the Antarctic and in Greenland.

GLACIERS :

A) *Highland Glaciers* (Glaciers des hautes terres) :

I. *Case in which the form and the movement of the ice depend everywhere on the shape of the ground.*

1. Elevated ridges, free from ice, form dikes between the different basins containing the ice, from which result well-developed enclosed glaciers (Valley glaciers (glaciers de vallées) or Alpine type).
2. Closed basins containing accumulations of ice situated on relatively horizontal plateaus (Plateau glaciers (glaciers de plateaux) or Norwegian type).
3. Case where masses of ice, comprising accumulations of ice in basins associated with Valley or Alpine type glaciers, move together over relatively flat ground at the foot of the mountain and form a continuous field of ice (Piedmont glacier (Glacier de Piedmont) or Alaskan type).

II. *Case in which the form and movement of the ice are either entirely or partly independent of the configuration of the ground.*

4. The ground forms are covered with ice but show distinctly through the ice mantle ; the glaciers produced are proportional to the volume of the basin in which they are formed (Nivation glacier (Glacier de névé) or Spitzbergen type).
5. The ice completely conceals the form of the ground (Inland ice (Inlandsis) or Greendlandic type).

B) *Lowland Glaciers* (Glaciers des Basses terres), in which the surface of formation of the deposit and the surface of dissipation of the ice form one and the same expanse :

6. The ice forms a band which follows the foot of the mountain (ice-foot glacier (Glacier de banquette), or, according to PRIESTLEY, snowdrift glacier (Glacier d'amas de neige).
7. Ice formed principally on the spot and covering both the low land and the shallow water along the seashore (shelf ice).

SHELF-ICE (Glace de Socle, Schelfeis) :

Expression sometimes employed to designate the ice barrier forming a terraced front to the continental shelf which it surmounts.

TONGUE GLACIER (Langue glaciaire flottante) :

The terminal tongue of ice which projects to a greater or less distance to seaward from certain valley glaciers which reach the shore.

BANK ICE or PACK (Banquise or Pack).

Large accumulations of ice on the surface of the sea, of any form and origin, more or less piled up and frozen together and, at times, attaining great heights above the water level (150 to 200 feet in the Antarctic).

The pack is called *coastal* (côtière) when it is attached to the shore.

The more or less permanent pack in high latitudes is known by the name of Arctic Pack (*Banquise Polaire*) (НАБИВНОЙ = nabivnoi).

PALEOCRYSTIC ICE (Glaces Paléocrystiques).
Enormous heaps of very old ice.

ANCHOR ICE, GROUND ICE (Glace de fond. — Grundeis).
All submerged ice attached to the bottom irrespective of the nature of the formation.

FRAZIL ICE (Frazil).
Small needles or plates of ice which form in swiftly flowing rivers; the movements of the water prevents the ice crystals from forming a solid sheet of ice. This formation is best seen in Canadian rivers and the name is a French-Canadian expression, derived from the French word *frazil* (cinders) as, apparently, frazil crystals resemble the cinders from a forge.

SASTRUGIS, SUGROBI.
Undulations of snow on the surface of the ice in the form of dunes which extend in the direction of the prevailing wind.

RASSOL.
A flowering special to the ice field, comparable to white frost on grass and consisting of flower-like crystals formed on the surface due to the separation of saline elements which freeze separately under the influence of a sudden drop in temperature.

WACKES.
Pools of fresh water which form on the surface of the ice during a thaw.

DEBACLE.
Breaking up of the ice at the thaw.

EMBACLE.
Heaping up of the ice following on a renewed freezing.

Several Anglo-French equivalents borrowed from the Meteorological Glossary, 1930 edition, are added below for reference :

Freeze	= Gel.	Snow	= Neige.
Frost	= Gelée.	Snow fall	= Chute de neige.
Glazed frost	= Verglas.	Snow drift	= Amas de neige.
Hoar frost	= Gelée blanche.	Snow slip	= Avalanche.
Rime	= Givre.	Snow line	= Limite des neiges éternelles.
Hail	= Grêle.	Blizzard	= Tempête de neige.
Hailstone	= Grêlon.	Ice	= glace.
Soft hail	= Grésil.	Ice limit	= Limite des glaces.
Silver thaw	= Verglas.	Ice breaker	= Brise glace.
Thaw	= Dégel.		