Correspondence re: McGraw Hill Encyclopedia of Science and Technology, articles on glacial geology. 1958

Thwaites, F. T. (Fredrik Turville), 1883-1961
[s.l.]: [s.n.], 1958

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McGRAW-HILL ENCYCLOPEDIA OF SCIENCE AND TECHNOLOGY

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10 Elliewood Avenue, Charlottesville, Virginia

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The McGraw-Hill Encyclopedia of Science and Technology is to be an eleven-volume compendium of the scientific and technological knowledge of today. It will cover the essentials of science and technology in a way that will make it of interest and value both to the layman and to the scientist and engineer. The encyclopedia will be kept up to date by running revision; a yearbook will be produced. The highest professional and editorial standards will be maintained in the production of the encyclopedia. This much-needed synthesis of scientific and engineering knowledge is designed to help scientists, engineers, and educators in their day-to-day activities, and to stimulate the interest of young men and women and encourage them to make science or engineering their life's work. In view of the emphasis being placed on these fields today, the encyclopedia may well become one of the most important publishing projects of our time.

Organization

The first step in the production of the encyclopedia was the naming of an Editorial Advisory Board of noted scientists and engineers (see list on previous page). The Board established the broad patterns for the encyclopedia, including scope, readability level, and depth of coverage. It also classified all scientific and engineering knowledge into fifty-nine fields or disciplines, such as electrical engineering, meteorology, solid state physics, organic chemistry, and physiology.

The Board then selected distinguished authorities to serve as consulting editors in these various fields (see list above). The enthusiastic acceptance of the authorities so designated constituted an overwhelming endorsement of the encyclopedia project.

Each consulting editor works with the encyclopedia staff in planning a series of articles that will fully cover his area of responsibility. He recommends outstanding authorities in his field to write these articles. The staff editors in the encyclopedia office then write to the recommended authorities and ask them to undertake preparation of the articles that will cover their special areas of interest.

The Contributor's Responsibility

After a contributor has agreed to write an encyclopedia article, the staff editor supplies him with details of the assignment including article wordage and, to some extent, article content. He will be given a Contributor's Guide which explains how to prepare articles, and sample articles that will serve as examples to be followed for style and method of presentation. In addition, the contributor will be supplied with a list of the titles of all articles planned for his field. The lists are prepared in organization-chart style, a method of presentation which offers a quick over-all view of the field. From these lists the contributor can readily determine what his articles should cover and what material will be covered in articles prepared by other contributors. The written material will be supplemented with illustrations. An encyclopedia art staff will prepare finished drawings from your sketches, letter drawings and photographs, and help you in any way they can to obtain good illustrative material.

It is expected that the encyclopedia will become a standard reference work in science and technology. Scientists, engineers, educators, and students will turn to it in the years to come to read its authoritative articles. Each article writer, therefore, has the unique opporunity to make a lasting contribution to the reference literature in his field. With a thousand or more authorities making such contributions, there is no question but that the encyclopedia will become *the* standard reference work in the fields it covers.

1-10-58 2M

McGRAW-HILL ENCYCLOPEDIA
OF SCIENCE AND TECHNOLOGY

CONTRIBUTOR'S GUIDE

TO PREPARING ENCYCLOPEDIA ARTICLES

10 Elliewood Avenue, Charlottesville, Virginia   *5M 2-3-58*

CONTRIBUTOR'S GUIDE

McGRAW-HILL ENCYCLOPEDIA OF SCIENCE AND TECHNOLOGY

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Contributor's Guide to Preparing Encyclopedia Articles

Compiled by the staff of the McGraw-Hill Encyclopedia of Science and Technology to provide encyclopedia contributors with technical information on the preparation of encyclopedia articles.

In planning this guide to the preparation of articles for the McGraw-Hill Encyclopedia of Science and Technology, we have tried to anticipate, and to answer, all the questions that our contributors are likely to have. Do not hesitate to write us, however, if after reading this booklet you are still in doubt about any of the procedures to be followed. We shall be glad to help you in any way that we can.

Planning Your Contribution

Although there is no one ideal way to prepare an article, the suggestions listed below, and illustrated in the sample articles we will send you, may serve as a general guide.

1. *Be Concise.* Since the encyclopedia is to cover the fundamentals of science and engineering in a few thousand pages, all articles are obviously subject to rigid limitations of space. They must be compressed to essentials, but nothing of basic importance can be omitted. Thus you will have to tell a great deal about your subject in relatively few words—a severe test of writing skill. For precision, clarity, and conciseness, use concrete nouns, active verbs, and simple, direct sentences. Make every word count.

2. *Keep Your Audience in Mind.* Try to anticipate the questions of your readers—scientists, engineers, and students—and to include the basic information that they will expect to find. Most articles should be written for comprehension at the college-undergraduate level; but even where the subject matter requires a more advanced treatment, the presentation should be as simple as the topic permits. Wherever possible, articles should follow a progressive development—from the general to the specific, from the simple to the complex. Accuracy in all matters—dates, names, places, terms, definitions—is, of course, essential.

3. *Define Your Titles.* Most articles should begin with a simple definition of the title and the specific sense in which it is used. Refer to the sample articles for examples.

4. *Keep Historical and Biographical Data to a Minimum.* Some historical and biographical information may be included in

articles where it is necessary for adequate coverage of the subject matter, but no article should be primarily concerned with such material. Generally speaking, the encyclopedia will deal only with strictly scientific and technological matter; we are publishing an encyclopedia *of* science and technology, not an encyclopedia *about* science and technology.

5. *Avoid Repetition.* Each article should be complete in itself but should, insofar as possible, avoid duplicating material covered in other articles. Our editors are responsible for correlating articles by various authors, but they need your cooperation. To show you how your articles fit into the over-all plan, we shall send you charts outlining the field of which your contribution forms a part and indicating the general relationship between the topics to be covered. These should help you decide what to include in your own articles and what to leave for related articles. Wherever possible, instead of repeating material to be covered elsewhere, simply supply a cross reference to the articles that the reader may consult for supplementary information. Indicate cross references by typing the key words or phrases in capitals at the end of the article or section as "see" or "see also" references. See the sample articles.

Remember that the importance of the subject does not always determine the length of the article. The general topic "Electrical Engineering," for example, may be covered in a relatively short article with cross references to detailed treatments of specific aspects of the subject.

6. *Include the Latest Developments.* Many branches of science are moving ahead so rapidly that articles dealing with them may become somewhat dated before the encyclopedia is printed. Please help us make the coverage of your field as up to date as possible by (*a*) warning us that changes are taking place and (*b*) submitting revisions of your articles as new developments occur (up to typesetting time). Avoid such expressions as "the most recent discovery," "the present time," and "the last few years." Give specific dates where appropriate.

Preparing Your Manuscript

You will be our final authority for the technical accuracy of your articles. Your initials will appear at the end of each article you have written, and the names and affiliations of all contributors will be listed in the front of Volume 1. If our staff editors have to make extensive changes in your articles for any reason—to meet space requirements, say, or to correlate them with other articles—a copy of the revised manuscript will be submitted to you for review.

Editorial Style. A consistent, logical system of handling such details as spelling, punctuation, abbreviation, capitalization, and hyphenation will be followed in all articles. If a single style is adopted throughout, the reader will not be confused by needless variations. In general, we plan to standardize on the forms recommended by established authorities—for example, Webster's *New International Dictionary,* unabridged, for routine spelling, capitalization, and hyphenation, and Blakiston's *New Gould Medical Dictionary* for medical terms. We recognize, however, that the accepted style for certain terms may vary from discipline to discipline, and we ask you to guide us in usages peculiar to your field. We shall be glad to follow your recommendations on technical terms if you wish to adopt a generally accepted scientific or trade style that differs from the one given in Webster's. Please call our attention to such deliberate variations.

Copyrights and Permissions. If you find it necessary to use copyrighted material, please secure written permission from the copyright holder and send it to us with your manuscript. Pattern your request for permission after the sample letter shown on page 8.

Headings. You may wish to supply headings to show the various subtopics covered in your article. Possible subheadings, marked by the symbol (+), are listed for many of the articles shown on the charts. These are merely suggestions, however; they neither limit the topics to be covered in an article nor indicate their relative importance. Please ignore them, revise them, or add other subheadings as you see fit.

Bibliographies. If you feel that the reader should be directed to a more detailed treatment of your subject than can be included in the encyclopedia, provide a bibliography. The bibliography is part of the article and its wordage should be included in the article wordage assignment. Send the bibliography to us with the article of which it is a part. Do not send the article at one time and the bibliography at another. Since we will have at least 10,000 articles in the encyclopedia, we must avoid such complications as trying to handle parts of articles. Avoid repeating citations in articles that are cross-referenced to each other. List only a few of the most important and readily accessible publications, preferably those that include extensive bibliographies. Be sure to list your own works if they are pertinent. Do not list journals, periodicals, out-of-print books, or foreign-language publications unless they are indispensable. References should generally include the author's last name and first initials, the book title, the name of the publisher (short form), and the place and date of publication, but note exceptions shown below. *Be sure that all information is correct; our editorial staff will not check these items.* Sample citations follow:

A. Hollaender (ed.), "Radiation Biology," vol. 2, p. 305, McGraw-Hill, New York, 1955.

H. D. Smyth, "Atomic Energy for Military Purposes," Princeton University Press, 1957. (Do not repeat place name with university presses.)

F. W. McBryde and P. D. Thomas, Equal-area Projections for World Statistical Maps, *U. S. Coast and Geodetic Survey Spec. Pub.* 245, 1956.

B. I. Spinrad et al., Reactivity Changes and Reactivity Lifetime of Fixed Fuel Elements in Thermal Reactors, *Proc. Int. Conf. on Peaceful Uses of Atomic Energy* 5:125.

G. P. Wadsworth and J. G. Bryan, *U. S. Air Force, Air Weather Service Tech. Rept.* 105-38, 1957.

Typing. We shall supply special paper on which your article should be typed. Please use double spacing to allow room for the editor's marks. Make a carbon copy, which may be on plain paper, for your files. A separate sheet should be used for each article, even a very short one.

A place is provided at the top of the special paper for the article title, contributor's name, and page number. The vertical lines on the paper give us a way of estimating the number of

words in the article and the number of printed lines it will require. Align your copy with the left-hand vertical line, indenting the first line of each paragraph 2 spaces inside this line. If your typewriter has pica type, 10 letters to the inch, run the copy to the right-hand vertical line marked "Pica." If the type is elite, 12 letters to the inch, run the copy to the line marked "Elite." Lines may be a few letters long or short; our estimate is based on the average.

Show italics by a single typewritten underline, boldface by a wavy underline in ink. Major headings should be indented 4 spaces, marked for boldface (wavy underline), and run in at the beginning of the paragraph. Subheadings, if you wish to use them, should be indented 6 spaces and marked for italics with a typewritten underline. These also should be run in at the beginning of the paragraph.

It is extremely important to present symbols and equations legibly, accurately, and consistently. Be especially careful to indicate such devices as superscripts and subscripts, Greek and script letters, and any other special characters clearly. Identify them in a marginal notation if there is any possibility of misinterpretation. Chemical structural formulas must be drawn with the greatest care.

Illustrations

Photographs and drawings will comprise about a fifth of the encyclopedia, and each contributor should supply us with the illustrative material that his articles require.

Selection. Select only the clearest and most valuable illustrations for your article, those that best supplement the details emphasized in the text. If a picture or diagram clarifies your presentation, by all means use it; but do not include an illustration merely because it is striking. If you have two or more illustrations in an article, number them and indicate by numbers the illustration locations in the text.

Location. Please indicate on the manuscript where each illustration should be placed. When the printed pages are made up, the illustration will be inserted as near to the related text as possible.

Sources. Manufacturers and distributors often have excel-

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It is understood, of course, that acknowledgment of the source of this material will be made in the encyclopedia.

Your prompt consideration of this request will be greatly appreciated. A release form is given below for your convenience. The duplicate is for your files.

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(signed) ....

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Sample letter requesting permission to use copyrighted material

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Original Illustrations. You may have photographs or line drawings that can be adapted for use, or you may be able to make rough pencil sketches from which a professional artist can prepare acceptable copy. If you wish to have drawings prepared under your personal supervision, please write us about this in detail before starting work.

Colored Illustrations. Since color printing involves multiple plates, special presswork, special handling, and increased production costs, we shall try to avoid the use of color wherever possible. If you feel that your article needs colored illustrations, please write us about this before you begin work.

Size. The reproductions prepared from the drawings and photographs you submit will generally be much smaller than the originals. Ideally, a drawing should be suitable for two-to-one reduction; that is, the original should be twice the size planned for the reproduction. Most illustrations in the encyclopedia will be one or two columns wide. The maximum width for a single-column illustration is $2\frac{13}{16}$ inches; for a double-column illustration, $5\frac{13}{16}$ inches. Thus, you should plan to make most of your drawings either $5\frac{5}{8}$ or $11\frac{5}{8}$ wide. To save space, we shall use single-column or smaller illustrations wherever feasible. Foldouts will not be used.

Lettering. Final lettering should be left to our art editor, for it should match both the editorial and the lettering style set for the encyclopedia. Simply indicate on a transparent overlay the captions and labels you want, or you may write them in pencil on tracing cloth (see "Handling," below). Make the overlay of good tracing paper or tracing cloth. If arrows are used to point out certain details, be sure to place them accurately.

If lettering already appears on the photographs or drawings you supply, do not try to remove it. We shall make any changes that are necessary.

Handling. Do not write on the face of a photograph, for the slightest crease, crack, mark, or indentation on the print may show up in reproduction. Trace arrows, numbers, or letters very lightly on a tracing paper or cloth overlay, being careful not to mar the surface of the photograph. Then lift the overlay and go over the lines firmly. If you wish to show only part of a photograph, indicate on the overlay the part of the photograph that is to be reproduced.

Do not use paper clips on illustrations. They make marks which will reproduce when the illustrations are printed.

Retouched photographs and drawings should be handled with special care. Retouching is done with water-soluble paint that is likely to flake off. Fingerprints show up on such material and cannot be removed.

Large drawings should be rolled, not folded. Photographs must be kept flat.

Identification. Since we shall receive thousands of illustrations, it is important that each one be identified with the author's name and the name of the article to which it belongs. Put this information in the upper right-hand corner of a drawing (above the illustration) and on the back of a photograph. Write lightly on the back of the photograph to avoid indentations. As an alternative, you can add this information to the legend you attach to each illustration (see "Legends," below).

If you have several illustrations, number them in order and use the numbers on your legend list (see "Legends," below).

Legends. The legends, or descriptions to be printed below illustrations, should be typed in list form, double-spaced. Make three copies. Attach the original to the article. Cut up the first carbon and rubber cement each legend to its illustration. This

assures proper correlation of legends and illustrations. Keep the second carbon for your file. Be sure to follow the style of the manuscript in spelling and in other details and to give credit, wherever needed, to the source supplying the illustration.

Mailing

Please send your manuscript and illustrative material to us by registered first-class mail or by express. When mailing photographs, protect them with cardboard and mark on the outside of the envelope: "Caution. Photographs. Please do not fold."

Deadlines

If the encyclopedia is to be published on schedule, the efforts of all contributors, advisers, editors, and others involved in its preparation must be carefully integrated. This means that each contributor must meet the deadline assigned to him. If one person falls behind, publication may be delayed—a threat to the timeliness of the entire project.

SUPPLEMENT TO

CONTRIBUTOR'S GUIDE

McGRAW-HILL ENCYCLOPEDIA OF SCIENCE AND TECHNOLOGY

March 19, 1958

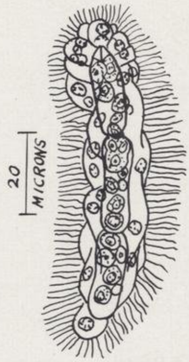
Use of Scales on Illustrations

To make the encyclopedia more useful as well as more uniform, we have decided to include scales on all biological illustrations, as well as on photomicrographs of metals, thin sections of rocks, etc. We feel that scales will be more useful and much less ambiguous than indications of magnification such as X 450 or ½ actual size. Scales placed directly on the drawing have an additional advantage in that they do not lose significance when the illustration is reduced for reproduction.

Scales should indicate size in the metric system and may be in microns, millimeters, centimeters, or meters, depending on the size of the object shown. (See examples below.)

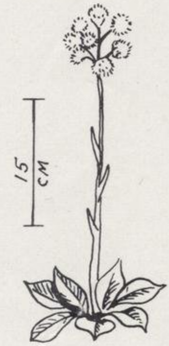
If you have already submitted illustrations which are not scaled or which have magnification indicated, copies of these drawings are enclosed. We would appreciate your adding an appropriate scale to these copies and returning them to us.

EXAMPLES



Young stem nematogen of Dicyemida shultzianum

White cast iron



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~~Whitcomb drawlin~~

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3921

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Please address replies to:
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Charlottesville, Virginia
P. O. Box 3757
University Station
Phone 3-5144

September 26, 1958
Charlottesville, Virginia

Professor Fredrick T. Thwaites
41 North Roby Road
Madison 5, Wisconsin

Dear Dr. Thwaites:

In your book Outline of Glacial Geology there is a photograph showing Varved clay of a glacial lake (Plate I, Figure 3).

We would like to use this photograph, or one showing similar phenomena, with the article on varve (100 words) by Dr. J. Marvin Weller.

Can you supply the photograph that was used, or a similar one, and grant permission to use it? We will, of course, give the necessary credit.

Also, photographs to illustrate the series of articles on glaciated terranes are desired.

Very truly yours,

Neil A. Benfer

Neil A. Benfer
Staff Editor, Earth Sciences

NAB/cgc

Mr. Neil A. Benform
McGraw -Hill Book Co.,
Charlottesville, Virginia

Dear Mr. Benfer:

In reply to yours of 26 Sept.,
took some days until I was able to go to the
of the State Geological Survey in Science hall
took over the old photographs which I took
when I was working in the field. I am now reti

I was able to find photographs of many featur
but not of drift plains which are not common in th
state. I took photographs of them while working
Illinois especially in the year 1939. They must
have copies at the Geological Survey office in Na
Resources Bldg., Urbana, Illinois

I am enclosing list of those I am sending. Al
the pictures with four figure numbers belong to the
State of Wisconsin, Wisconsin Geological Survey. Some
have been used in copyrighted books but you have
permission to use them again. I also have some air
photographs of a drumlin and an esker which I am
not including. They were not taken by me and have
been used in a copyrighted text I forget which.
The air photographs in the "Outline" were furnished by
the Wisconsin Highway Commission. My copies were sent t
the Journal of Photogrammetry in Washington for use

and not returned.

Please return all those which belong to the Survey.

From personal collection, return not necessary.

1. Cross section of a drumlin showing beds of silty sand which were damp.

2. Outwash plain between rock hills

3. Cross section of very bouldery esker

4. Very rough topography of the Kettle Moraine where gravels were deposited against stagnant ice

Photographs from collection of Wisconsin Geological Survey. Please be sure to return when through with them

3623 Granite boulder in swamp.

3706 Drumlin rising from outwash plain

3894 Pit in outwash showing level x topography and horizontal bedding

3921 Drumlin

3934 Esker showing bouldery material (eskers are hard to photograph from the ground. Air photos are better)

3977 Varved clay of glacial lake. The layers are interpreted as annual deposits, coarser material in summer when ice melted fast. The fine winter layers are dark. New London, Wis.

4481 Very ruggdd endmoraine Langlade County, Wisconsin

4545 Pitted outwash showing topography which is deceptively like that of endmoraine. Lake in kettle. Langlade County, Wisconsin

4546 Same as above. Note even skyline between kettles.

23 June, 1958

Mr. Niel A. Benfer,
McGraw"Hill Book Co.,
10 Elliewood Abe.,
Charlottesville, Virginia

Dear Sir:

As per my agreement I am sending you enclosed what I have prepared on the subjects in glacial Geology asigned to me. I hope they are prepared all right for although the paper sent appears to be for photolithographing I did not take the time t make all corrections in a way suitable for that method.

I may have run over thw words assigned because although did a lot of counting I did not know just how you count figure and just how you want references given, that is in what form.

I refered freely to my lithoprinted book on glacial geolo although it does not seem to be well known in the east. It contains fairly extensive lists of references. Although printed by Edwards Brothers I sell this myself at the address given above. I ventrure to suggest that you may not have all technical terms used for some I employ are not recognized by R. F. Flint. Such terms are underlined when first used in my book.

If there are vital corrections I will try to make them.

Sincerely yours,

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Please address replies to:
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P. O. Box 3757
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Phone 3-5144

April 17, 1958

Mr. Fredrick T. Thwaites
41 North Roby Road
Madison 5, Wisconsin

Dear Mr. Thwaites:

You may have seen the announcement that the McGraw-Hill Book Company will publish an Encyclopedia of Science and Technology. This encyclopedia - in eleven volumes - will cover the essentials of the pure and applied sciences and engineering in a way that will make it an outstanding reference source for scientists, engineers, educators, and others in their day-to-day activities. The highest professional and editorial standards will be maintained in the production of this encyclopedia.

The enclosed brochure gives a brief description of the encyclopedia and discusses the contributor's role in its preparation. Note especially the members of the advisory board and the roster of consulting editors. You were recommended by the consulting editor in surficial and historical geology, Dr. Kirtley F. Mather, as an authority to write the articles listed on the enclosed form. These will total 2700 words.

We would like to add your name to our growing list of outstanding specialists who are making contributions to this encyclopedia. We trust you will signify your agreement by signing the form in the space provided and returning it to us in the enclosed envelope. (A duplicate copy is provided for your file.) Details of the assignment will be forwarded to you upon receipt of your confirmation. Please let us know how soon you will be able to complete the articles after receiving the specific details (for example, two weeks, four weeks, two months, etc.).

Very truly yours,

Neil A. Benfer

Neil A. Benfer
Staff Editor, Earth Sciences

NAB:jcs

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Phone 3-5144

April 23, 1958

Professor Fredrick T. Thwaites
41 North Roby Road
Madison 5, Wisconsin

Dear Professor Thwaites:

We are very happy that you have accepted the invitation to contribute to the McGraw-Hill Encyclopedia of Science and Technology. We hope that the matters discussed in this letter and the enclosures will be of aid as you plan and write.

Enclosure 1, the contributor's guide, is provided to answer questions about preparation of manuscript and related materials. Enclosure 2 contains information pertinent to your particular contribution and its relation to other articles in the Encyclopedia. Manuscript paper also is enclosed; and a post card to inform us that you have received the materials.

We intend to limit our editing. Except for certain details of encyclopedia-article form and style, most editing will be concerned with possible overlap or inconsistencies in relation to other articles. We strongly urge that tables and illustrations be used to strengthen the articles. These materials will receive our careful attention. If you have any questions, please write to me and I will try to answer them.

Very truly yours,

Neil A. Benfer

Neil A. Benfer
Staff Editor, Earth Sciences

NAB:jcs

McGRAW-HILL ENCYCLOPEDIA OF SCIENCE AND TECHNOLOGY

Contributor's Assignment Form

Contributor Mr. Fredrick T. Thwaites
41 North Roby Road
Madison 5, Wisconsin

Date April 18, 1958

Recommended by Dr. Kirtley F. Mather

Consulting Editor in surficial and historical geology

To write the following articles:

Article Title	Assigned Wordage
✓ glaciated terranes	1600
✓ cirque	100
✓ drumlin	100
✓ esker	100
✓ Finger Lakes	100
✓ fiord	400 †
✓ Matterhorn	100
✓ kame	100
✓ moraine	100

Total number of articles 9 Total assigned wordage 2700

Payment will be at the rate of three cents per assigned word. McGraw-Hill will have the right to obtain copyright to the article or articles mentioned in this agreement in its own name as proprietor and shall have all rights of the copyright owner therein.

Neil A. Benfer
Neil A. Benfer
Staff Editor, Earth Sciences

Contributor's Signature ____________

Date ____________

Articles will be submitted in ________ weeks.

GLACIATED TERRANE. A glaciated terrane was once covered by glacial ice which can be classified as: (1) mountain or valley glaciation where the high ridges and peaks projected through the ice, and (2) continental glaciation where ice spread out over a large area of relatively low relief and concealed almost all the surface. Since mountain glaciers in many places spread out over adjacent lowlands in piedmont glaciers, the line of division is not abdolutely definite and sharp. That glacial ice extended beyond its present limits is demonstrated by: (1) scratches (striae) on bed rock and loose rocks which are exactly like those observed in and around existing glaciers; (2) rock fragments of all sizes, many of them striaeted, which are unlike adjacent bedrock (erratics), Some of them occur higher than their probable bedrock sources unlike material transported by streams; (3) unconsolidated deposits unstratified and unassorted which contain erratics (till) Many of them too large to have been transported by any other agency than glacial ice. and Much of the material derived from the mechanical breaking up of unweathered bedrock and not from chemical alteration; (4) drainage features unlike those due to normal stream work including streams out of harmony with the nature of the bedrock, waterfalls, and rapids as well as lakes; (5) basins completely rimmed with bed rock, which are far larger than basins due to weathering and lack the smooth boundaries of depressions caused by earth movements; (6) a margin of glacial deposits slopes, unlike the border of deposits due to water; (7) topographic features (see figure) which were built and not worn like those due to stream work. These include streamlined hills, ridges, and depressions which are clearly constructional rather than destructional forms, not explicable by any other process than glaciation. (8) coarse stream deposits which occur where water is now impossible showing that a solid obstruction has been removed without leaving any trace of erosion; (9) in mountain valleys a longitudinal profile of the bedrock surface which is irregular with alternating rock basins and abnormally steep intervals unrelated to the chemical nature of the bedrock; (10) in Mountains valleys which are wider, straighter with steeper sides than is normal for the stream erosion of similar rock; (11) in many valleys of glaciated mountains stream junctions are not accordant and very steep rapids or falls occur (hanging valleys); (12) depressions with unusually steep sides (cirques) occur either at the heads of mountain valleys or on mountainsides. See figures

The practical application of the above criteria is fraught with many pitfalls. It is rare to find all or even a majority of them in the same area unless it has been covered by ice rather recently. As the time since glaciation increases the criteria become harder and harder to discover. Common errors in application include (1) confusion of striae and scratches due to faulting (slickensides) particulary on loose rocks; (2) Destruction of striae by weathering for even in rather young drift a cover of till is necessary for preservation of striae which are rather rare on exposed rock ledges; (3) It is difficult to demonstrate that some loose rocks are true erratics; (4) lanslides and creep of unconsolidated mateial yield deposits which are deceptivly like till; (5) Some unglaciated rock hills are deceptively like drumlins; (6) Hanging valleys are in places due to other agency than glacial erosion; (7) Erratics may be transported by floating ice. making in many places the border of glaciation very uncertain; (8) Mass movement on hillsides plus weathering can make discovery of errats most difficult. It is small wonder that opinions of existance of glaciation in certain localities differs with the personal bias of the geologist who observes the evidence.

North America. Much work on glacial geology has been done in North America This has been greatly aided by the air photographs which are available for most of this continent, even the Canadian wilderness. Ice of continental extent survives in Greenland and there are extensive ice caps in some of the Artic Islands. The Canadian shield of crystalline bedrock is largely thin drift with some eskers, many lakes and much lake sediment from waters impounded by the continental glacier In lateglacial time the sea rose higher onto the land than it now does and many areas were submerged. In southern Ontario and the prairie provinces drift is thicker with moraines and drumlins. The mountains of Labrador fail to display striae but may have been an early center for glacial accumulation. One theory is that ice spread west from them with the moisture brought by westerly winds. The western mountains were largely buried by ice but the spectacular glacial topography is largely the result of later local glaciers which excavated extensive cirques. In the United States the glacial drift is thick on sedimentary bed rock particularly in the region south and southwest of the Great Lakes. The bottoms of all the Lakes except one extend below sea level and drilling shows that they are rock basins excated by ice erosion from the weaker sediments especially shales and evaporties. Glacial drift of several distinct ages has been discriminated in the Mississippi Valley. The young drift of the north is called Wisconsin. In its type locality and throughout its extent its glacial topography is clearly marked with large rugged moraines and pitted outwash pl ains, eskers and vast fields of drumlins. Some of the most striking lake districts are in pitted outwash. The lakes there have more rounded outlines than do those of either thin drift or endmoraines. In the area of crystalline bedrock in Wisconsin and New England the till is very bouldery. This reflects the fact that such rock breaks into large fragments and does not indicate any special kind of glaciation. In southwestern Wisconsin there is a considerable area of rugged rock topography in which no erratics have been discovered except for those brought from outside by lake or stream waters. This is called the Driftless Area and is generally thought to have never been glaciated. The exact boundary of glaciation around this area is indefinite except on the east side which is an endmoraine of Wisconsin drift. On the other sides the drift thins out gradually and the fact that water stood in front of the glacier makes tracing very uncertain. Even in the recognized glaciated terrane the drift is so thin over considerable areas that the rock topography was not smoothed or obliterated in the slightest. Although it is possible that an early glacial drift was entirely removed by erosion it is generally accepted that the area escaped glaciation by reason of the lee side protection of the higher crystalline rock upland of Michigan and northern Wisconsin. One of the most spectacular glacial features of Wisconsin is the famous Kettle Interlobate Moraine which was caused by division of the ice into lobes one of them following the Green Bay lowland the other the Lake Michigan Basin. The Kettle Moraine is the accumulation chiefly of gravel in the angle between thse two lobes as the margins melted back . It is not two opposed endmoraines. The topography is extremly rugged sith kettles, ridges between them, and moulin kames of gravel. To the south in Illinois the moraines become less conspicious for the till has a high content of clay. The intevening areas are till plains due partly to the fluidity of the till when first desposited and also to buried lake clays. In the till plain of Wisconsin age postglacial erosion is confined to the major stream valleys. South of the Wisconsin drift whose margin is marked by a moraine is a ~~similar~~ drift plain of the Illinoian drift which is more eroded and weathered. West of Mississippi River in Iowa the amount of erosion of the drift plain increases abruptly along a definite line and we have to the west the Kansan drift which is much older. With the same relief, material , and climate the difference can only be ascribed to a longer postglacial time. This checks with the occurrence of the soil profile of the Illinoian drift ~~a short distance~~ below the surface of the Kansan. In this region of clay till the endmoraines are inconpicious or absent. In Iowa an older soil profile is buried beneath the Kansan. This is the Nebraskan drift whose surface occurence if any is fdifficult to distingusih largely ~~partly~~ on account of its age and probably deep erosion. The glacial features of Minnesota are for the most part similar to those of Wisconsin. To the west the clay content of the till increases and moraines are less conspicious. In North Dakota the region around the salt lake s of the Devils Lake ~~region~~ are an exception ~~and are rugged~~. Continental drift ~~merges with~~ that from the Rocky Mountains not far from the foothills. Scenic features like glacial cirques, lakes and waterfalls decrease gradually toward the south in the Rockies from those of Glacier National Park near the Canadian border to high volcanoes of Mexico. ~~San Francisco Mountain in Arizona~~ There is more extensive present and Pleistocene glaciation in the ranges along the Pacific coast. Glacial features also decrease southward from the magnificent ~~seni~~ fiords of Alaska to the small cirques near Los Angeles. The coast of Puget Sound strongly resembles fiords in both outline and depth of water but the material of the shore is glacial drift mainly stratified. It is more like a pitted outwash plain which has been invaded by the ocean. Some kettles are freshwater lakes. The Yosemite Valley of California is world famous for its high fslls from hanging valleys. Study by Matthes shows that it has been widened and deepened by glacial erosion of fractured bedrock but the different levels of hanging valleys record successive tilts of the Sierras up on the northeast rather than glacial erosion alone thus connecting the tectonic theory of valleys with glacial erosion. Valleys with such cliff sides are rare in the Sierras for they occur only where the structure of the bedrock is favorable. Inland from the Coast Range of Alaska the continental climate was too dry for extensive glaciation Crater Lake Oregon records a mountain which disappeared since its glaciation.

Europe. Although much work has been done on the glaciation of Europe for a long time there does not appear to be any fairly detailed maps of large areas. This lack is explicable by the many political divisions and bitter rivalries of that continent. The glacial succession of the Alps was first worked out and the Günz, Mindel, Riss and Würm glaciations were distinguished. The relative importance of mountain centers of ice accumulation appears greater than in North America. The British Isles were covered by piedmont glaciers from local centers. The center from which ice overspread the lowlands of Germany and Russia was the Scandanavian mountains. Farther east, the Urals appear to have been important. Over most of the lowlands drift of only three distinct ages seems to have been distinguished. The young drift exhibits land forms similar to those of the United States. The coast of Norway has many striking fiords.

Asia. The glaciation of Asia is much less known than of Europe. Continental ice, probably from the Urals, covered northwestern Siberia but its extent has been disputed. Elsewhere the glaciation was of the mountain-piedmont type. The dry continental climate was unfavorable for extensive glaciation.

Other areas. Antarctica is covered by the largest continental glacier of the present time. Earlier, some local glaciers were present in Australia, New Zealand, and some of the higher Pacific islands. In South America there was no continental ice but the high peaks of the Andes and, in particular the southern end of that range, were covered with local accumulations of ice. Southern Chili and Argentina were eroded into fiords. Local glaciation has also been reported on high peaks in Africa.

References. Antevs, Ernst, Maps of the Pleistocene glaciations: Geol. Soc. Am. Bull., vol. 40, Pp. 631-720, 1929

Flint, R. F., Glacial map of North America: Geol. Soc. Am. Spec. Pub. 60, 1945

Flint, R. F., Glacial Geology and the Pleistocne Epoch, 1947

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Thwaites, F. T., Outline of Glacial Geology, 1957

FIORD, a narrow deep, steep-sided marine bay found ~~mainly~~ in Alaska, British Columbia, Labrador, Greenland, Norway, Patagonia, Chili, New Zealand Depth of water is generally least at the entrance from the ocean; a maxium of 4000 feet is recorded. Although most fiords lead down to the ocean some run parallel to the coast. The pat tern of development may be either dendritic or rectangular. Many tributary valleys ~~either~~ ~~hang~~ ~~or have submerged~~ hanging junctions. Along the long axis depth of water is very irregular. Some islands occur. ~~Faults~~ have been ascribed to sinking of a ~~normally~~ eroded coast forming drowned valleys, to faulting and to glacial erosion. Since all occur in glaciated territory the last must have a part in their formation. Localization of such erosion is related to preglacial valleys which formed the ice into relatively narrow tongues. Although the sides of many fiords display glacially striated and polished bedrock it is much more probable that only a part of the bedrock wqs reduced to powder by glacial grinding. Plucking of large masses of rock beneath thick ice is a much more rapid process of erosion for it requires far less energy. This process is possible only where the glacier was thick enough to permit pressure melting and reefreezing of ice around rock fragments which had previously been fractured by earth movement. The rectangular pattern of many fiords is related to regional structure including faulting and thus ties in the tectonic theory of fault control with the hypothesis of glacial erosion. The islands in fiords are the localities of minimum fracturing and hence little erosion. Change of level of the land ~~is present~~ in many localities but is not important under this theory. Coasts which superficially resemble fiords such as the northeast side of the Adriatic Sea and Maine have shallow bays unlike true fiords. Although the formation of fiords requires narrow tongues of glacial ice the mountainous topography of the land beneath the glaciers of Greenland and Scandanavia lends itself to such concentration. Study by Matthes of Yozemite Valley, California which does not contain a lake ~~also led to~~ the hypothesis of glacial plucking of fractured rock. The high waterfalls from hanging tributaries tell of widening and deepening of a preglacial valley by glacial plucking but the several levels of the falls demonstrate successive tiltings of the land up to the northeast which acclerated erosion of downslope streams producing hanging valleys outside the glaciated district. The same explantion doubtless applies to other regions of localized glacial erosion along lines of fracturing of the bedrock.

References: Thwaites, F. T., Outline of glacial geology, pp. 9-10, 99-100, 111-112, 127, 1957;

Holmes, C. D., Glacial erosion in a dissected plateau: Am. Jour. Sci., vol. 233, pp. 217-232, 1937;

Matthes, F. E., Geological history of the Yosemite Valley: U. S. Geol. Survey, Prof. paper 160, 1930;

Gregory, J. W., The nature and origin of fiords, 1913

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Enclosure 2 to NAB McGraw-Hill Encyclopedia letter of April 24.

- glaciated terranes [2] (~~B~~ - ~~2,000~~ 1,600)
  - cirque (~~A~~) 100
  - drift, glacial (~~x~~ +)
  - drumlin (~~A~~) 100
  - esker (~~A~~) 100
  - Finger Lakes (~~A~~) 100
  - fiord (~~C~~) 400
  - hanging valley (~~x~~ +)
  - horn peak (+)
    - Matterhorn (~~A~~) 100
  - kame (~~A~~) 100
  - knob and kettle topography (~~x~~ +)
  - moraine (~~A~~) 100
  - nunatak (~~x~~ +)
  - outwash plain (~~x~~ +)
  - paternoster lakes (~~x~~ +)
  - Pleistocene glaciation (*) Dr. Flint.
  - roche-moutonnees (~~x~~ +)
  - till (*)[3] also loess (*)[3]
  - valley train (~~x~~ +)
  - and others aspects (+)

(Portion of geomorphology article title chart.)

2. Includes mountain, valley, and continental glacial features. Glaciers will be treated under hydrology (geophysics) and Pleistocene glaciation under historical geology.

3. Article on sedimentary petrology chart.

x = cross reference
+ = possible subheading or just content item
* = any pertinent aspects of the topic may be covered in the article but detailed treatment of the subject will be considered elsewhere in the encyclopedia

The content of the article as outlined should be regarded only as partial and suggestive to the contributor. Items may be dropped if not considered pertinent or added if they were omitted. Contributor determines sequence of treatment and subheads that should be used.

You may desire to make short, definition type articles out of such entries as kame, esker, etc. and x-reference them back to glaciated terranes article, applying the balance of unused wordage in that article. All illustrations can then be grouped together with the glaciated terranes article which will include the details of formation of the landforms. also

memo • McGRAW-HILL ENCYCLOPEDIA OF SCIENCE AND TECHNOLOGY

from:
10 Elliewood Ave.
Charlottesville, Va.

to:
Article Contributors

The enclosed manuscripts are an attempt to comply with requests for sample articles to illustrate the writing style and level of presentation of the Encyclopedia. Samples of this sort, however, can illustrate only a few of the problems that will be encountered by our contributors. As a result, we would like to take this opportunity to re-emphasize some of our editorial aims. The Encyclopedia is intended as a reference for the scientist, the engineer, and the scientifically oriented layman, to fields outside *their specialties. The word "outside" is the key to our objective. Each article should be written for as large an audience as possible; under no circumstances should it be written for the specialist. An article on even the most esoteric subject should include an introductory paragraph that will be understandable to the lay reader—that will at least relate the topic of the article to his realm of experience.*

We realize that the task of writing for the non-specialist is an extremely difficult one, but we think you will agree that the objective of increasing the availability of scientific knowledge is so important that it warrants our best efforts and yours.

Elite | Pica

Definition: Answers the question, "What is it?"

Additional information on, "What is it?"

Answers question, "Why is this important?"

SPOT TEST ANALYSIS, a technique used in qualitative chemical analysis to test for the presence or absence of certain substances. Tests are performed by placing a drop or particle of the unknown substance on a support, and by adding a drop or a few drops of reagent. The unknown is identified by the appearance of a characteristic color reaction. The technique is readily adapted to field testing applications. It may be used to detect both ionic and organic substances. The advantages of the technique are simplicity, speed, and sensitivity. See qualitative chemical analysis.

After introducing the subject, the article becomes more detailed.

The support is chosen to permit easy detection of color changes during the test. Spot plate, watch glass, ash-free filter paper, or spot test paper--a thick and strongly absorbent paper--may be used. The spot plate is best made of colorless transparent glass so that it may be placed upon colored paper. The color of the paper should contrast with that of the expected reaction product.

Substances that may interfere with the test are sometimes separated by a method based upon the different rates of migration of the unknown and the interfering substances through paper. Usually, however, separations are avoided by using sequestering, or masking, agents. These convert the interfering substances into compounds that do not affect the tests and consequently need not be removed. The compounds are sometimes precipitates, but are most often complexes.

Article Title Spot Test Analysis Contributor John A. Jones

Page 2 of 2 Pages Field Analytical Chemistry Staff Ed. CDO Date Rec'd May 1, 1958

Elite Pica

The specificity of spot tests is improved by using sequestering agents (which lower the concentration of the interfering substances) and by controlling the pH of the solutions. J.A.J.

Bibliography--F. Feigl, "Spot Tests," 2 vols., Elsevier (Van Nostrand), New York, 1954.

Note use of bibliography to refer reader to source of additional information

This is an article on a specialized topic within the general field of qualitative chemical analysis. Few readers with little knowledge of chemistry would be expected to refer to it. As a result, only a few sentences at the beginning of the article are devoted to the general reader. The bulk of the article is aimed at the novice chemist. None of it, however, is written for the expert in qualitative chemical analysis.

Article Title Anthrax Contributor Dr. John A. Jones

Page 1 of 3 Pages Field Medical Microbiology Staff Ed. DNL Date Rec'd May 5, 1958

> Answers questions "What is it?" and "What causes it?"

ANTHRAX, an infectious disease, primarily of animals. Man may be secondarily infected. It is caused by *Bacillus anthracis*, a rod-shaped bacterium. In animals, the disease, known as splenic fever, occurs when spores of *Bacillus anthracis* are eaten with contaminated forage. In man, the disease is contracted by contact with infected animals or animal products such as bone meal, meat, hide, and fur.

> Tells why subject is important.

The disease occurs in nearly every country in the world. From 1945 to 1955 there were 3,447 outbreaks in animals in 39 states of the United States, with losses of 17,604 head of livestock.

> Note use of illustration to supplement verbal description.

ILLUSTRATION: PHOTOMICROGRAPH OF BACILLUS ANTHRACIS

> After general introduction, article now begins to present detail.

The causative organism, *Bacillus anthracis*, is a Gram-positive, rod-shaped bacillus 3 to 8 microns in length by 1 to 1.2 microns in diameter, and belongs to the family Bacillaceae. It occurs in infected animals as chains of 2 to 8 bacilli surrounded by a large capsule, but when grown on artificial media the capsule is lost and the chains contain more bacilli. Under conditions unfavorable for growth, the bacilli form small, ellipsoidal spores which are very resistant to temperature extremes and to dehydration. The spores, which remain capable of growth for a period of about twelve years, are ingested by animals grazing on pasture land. After the organism invades a host, polyglutamic acid in its capsule and an extracellular toxin, which produces edema, combat the host defense mechanism. The toxin can later

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kill the host by producing secondary shock.

Note use of subheads to indicate content

Note definition of "septicemia"

Anthrax in animals (splenic fever). The most susceptible animals are herbivora especially cattle, sheep, pigs, horses, and goats. Usually a septicemia, or blood poisoning, occurs. The effects vary from a sudden apoplectic attack (with death occurring a few minutes after the appearance of the first symptoms) to a subacute but eventually fatal illness manifested by fever, an enlarged spleen, and frequently by intestinal disturbances. Sometimes local manifestations, which are less often fatal, occur. For example, in cattle and horses circumscribed cutaneous carbuncles may appear, and in swine similar lesions are commonly found in the throat.

Anthrax in man occurs almost exclusively among personnel in contact with animals or animal products. It takes three main forms: malignant pustule, pulmonary anthrax, and intestinal anthrax.

Note that secondary subheads follow organization indicated by introductory paragraph

Malignant pustule (cutaneous anthrax), the most common form, results from contamination of the skin. An area of inflammation forms and necroses in the center. The center becomes brown, purplish, or black, and is surrounded by an area of edema and by vesicles containing yellow fluid. There is no true pus and little pain. Fatality is low and occurs only if generalized septicemia ensues.

Pulmonary anthrax (wool-sorters disease) is caused by the inhalation of dust containing spores.

Intestinal anthrax may follow the eating of

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infected food.

The last two types of anthrax are rare, but almost invariably fatal. Treatment is difficult because of the short period of time between onset of symptoms and death.

Immunization, diagnosis, and therapy. Live spores of attenuated virulence form an effective vaccine for cattle and other animals. A cell-free protective vaccine, suitable for use in man, has been produced. This vaccine is a sterile filtrate from a culture of *Bacillus anthracis* grown in a chemically defined medium with controlled incubation time and temperature.

The disease is diagnosed by microscopic identification of bacteria in the blood and by the Ascoli thermoprecipitin test. In the Ascoli test, a precipitate forms when a boiled saline extract of infected tissue is added to a suitable immune serum.

If used early, penicillin and streptomycin cure anthrax. See toxin, bacterial; gram stain; infectious disease transmission; bacillaceae. J.A.J.

Bibliography--"The Yearbook of Agriculture 1956 (Animal Diseases)," U. S. Dept. of Agriculture, Washington, D. C., 1956; G. S. Wilson and A. A. Miles, "Topley and Wilson's Principles of Bacteriology and Immunity," Williams & Wilkins, 1955.

Note inclusion of Bibliography for possible further reference

The above is an example of a general information article. The first paragraph gives a brief discussion of the topic. Subsequent paragraphs go into much greater detail. But at no time does the discussion use unnecessary technical terms.

400 words allowed

Fiord. ~~A fiord is~~ a deep narrow steep-sided bay ~~with deep water~~ arm of the sea found where valley glaciers once existed or still exist, as in Alaska, Labrador, Greenland, Norway, Patagonia. Chili. Similar valleys inland contain lakes (All Finger Lakes). The depth of water is variable ~~but mainly very great~~, up to 4000 feet recorded; At the mouth there is shallower water. The origin of fiords has been much debated but most agree that they are not simple drowned valleys. The irregular depth is due to glacial erosion controlled by structural weakness of the bedrock plus irregular deposits. Similar coast outlines in unglaciated regions or areas of continental glaciers do not have the depth of fiords. Theories of fiord formation now generally accepted ~~by the majority of geologists~~ involve erosion at the bottoms of valley glaciers which once filled ~~the~~ preexisting former valleys. Important erosion ~~must be~~ is probably by plucking of large masses of rock rather than by grinding to powder. Hence zones of preexisting shattering by joints appear to to be ~~the~~ a vital controlling factor. Some fiord valleys parallel the coast and show little relation to preglacial valleys. Thus there is a tectonic control of fiord topography although they are not due directly to earth movement: which theory was once advocated by some. See Finger Lakes. See Thwaites Outline of glacial geology

15 lines

~~Approaching~~ the Pacific Coast evidences of mountain or valley glacistion are better ~~and better~~ developed bec use of the greater supply kof ,oisture. Somr of the higher volcenit peaks laike Mt. Rainer are still largely covered by ice which once extended much farter down the slopes are shown by the form of the valleys. Crater Lake in Oregon, evidently was formed later than most of the glacial deposits for the ~~lake~~ caldera trancated valley deposits of glacial origin which could only have originated on a now-vanished higher cone. In California the spectacular hing vallyes with waterfalls of the Y9semite Valley are world famous. Detailed study shows however, that not all of the features ~~are~~ due to the erosion of mountan glaicers for successive westward tilts of the Sierra range had a large part in deepening the valleys of streams which flowed down the slope. Such picturesque valleys are rare for the condition requisite for ~~such~~ glacial erosion are confined to valleys along lines of shattering of the bedrock. The irregular shoreline of Puget Sound is not due to glacial erosion but was cuased by deep kettles of a pitted outwash plain ~~later~~ invaded by the sea. North from the United States porper fiords due to great amount of glacial erosion are very prominet and in Alaska many still contain glaciers. There is little or no evidence of glaciation in much of the interior of Alaska.

East from the Great Lakes region the original relief of the preglacial lanscape was high and the drift deposits are therefore less conspicious than in Wisconsin and Michigan. Northern New York and Ontario along the ~~southern~~ shores of Lake Erie and Ontario show prominet drumlins. Throught the Appalchian Plateaul and forms of glacial origin are very mqnor and ~~largely~~ confined to valleys. Some of the glacial drift of this region is so thin that controversy ~~reigned~~ for a long time between whether or not it is an early glacial deposit much eroded or ~~simply~~ a thin margin of the first glacial advance. The drift is now regarded as ~~largely~~ very old. Long Island and the New England islands exhibits prominent moraines and pitted and unpitted outwash

In New England glacial f eatrues are not swell developed although many lakes are present. The bouldery soils reflect the nature of the bed rock which furnished many large fragments ~~and~~ not the kind of glaciation. Even the highest peaks

Thus occured the great observed variation in the topography of glaciated terranes. Scattered erratics might have come from floating ice in marginal lakes. In Illinois and Iowa variation in amount of postglacial erosion of the drift plains can only be accounted for by difference in the length of postglacial time becaue material, original slope, total availabble relief, vegetation and climate are essentially the same. There is marked difference between the very slightly dissected plains of the Wisconsin glaciation, the moderately eroded plain of the Illinoian drift, and the submaturely dissected plain of the Kansan drift of Iowa. Within these marginal areas of clay till moraines formed by halts of the ice margin are relatively inconspicious so gentle are their slopes. In Wisconsin and much of Minnesota and Michigan land forms of glacial and glacio-aqueous origin are prominet features of the landscape. The great Kettle Moraine an interlobate deposit between the Michigan and Green Bay lobes of the Wisconsin drift is largely gravel and is famous for ~~the~~ steep slopes with many enclosed kettles many of them due to melting of isolated ice masses. ~~Fillings of~~ holes which melted through the decaying glacier ~~are~~ gravel ~~and~~ are termed moulin kames. Locally they make a landscape similar to one of recent vulcanism for the conical hills resemble the form of small cinder cones. The great fields of drumlins of Wisconsin form a striking landscape whose skyline is serrate w hen viewed in the direction of ice movement. ~~Views~~ transverse to that direction ~~are~~ smoother for the drumlin ridges blend in the distance. Adjacent to the Great lakes there is ~~much~~ flat country in part the beds of marginal glacial lakes and in part drift plains where glacial till overlies older lake clays from which it ~~gained~~ a high content of clay. In western Minnesota and the Dakotas the surface features are smooher than in Wisconin for the till appears to have a high content of clay. Enclosed depressions are noted howwever incuding the series of salt lakes of the Devils Lake region of North Dakota. The northern mountains show prominet cirques ~~although~~ surviving glaciers are small. ~~Going~~ south along the Rocky Mountain s cirues become less and less conspicious. Some are present on Pikes Peak, Colorado San Francisco Mountain, Arizona and some of the higher volcanic peaks of Mexico.

The appearance of a glaciated terrane depends upon several factors: (1) nature of the glacial deposit, (2) thickness of drift, (3) relief of preglacial surface, and (5) time since glaciation. If the drift contains much clay and silt little assorted sand and gravel results. Slump of the wet material leads to low slopes ~~leaving~~ drift plains which are well developed in Illinois and Iowa. Drift with a large content of ~~pebbles~~ and sand ~~forms~~ steeper slopes with marked glacial features such as moraines and drumlins. If the total original drift deposit was thick the drainage was disrupted with lakes a nd stream diversions ~~through~~ across rock ridges. Such features are rare or absent in regions of a thin deposit. The relief of the original surface before glaciation is very important. It depends largely on the kind of bed rock and the location of major drainage lines. Where the drift failed to bury the rock hills steep slopes favor erosion of the drift both by ~~water~~ wash and mass movement. Such erosion is relatively rapid compared with the headward growth of stream valleys into a drift plain. Weak sandstone bedrock ~~also~~ favors postglacial erosion and removal of the drift. Time is only one factor in determining the amount of ~~preglacial~~ postglacial erosion. ~~From the above it follows that there is wide variation in the present landscape of glaciated terranes.~~ Further confusion is prevent where there was more than one ice advance. The later glaciation may have deposited drift above earlier drift ~~deposit~~s which may include ~~those o~~f glacial lakes. ~~Possibly~~ The high clay content of some drifts is due more to older lake clays than to shale bedrock. Asid from some endmoraines and lrge drumlins prominent hills are almost all due to bedrock control and not to glacial dirft accumulation. In drift pains rock hills rise like islands from a sea Drift acculation is greatest inpreglacial valleys. At the other end of the series some glaciated trrane shows only cscatterd eratis on a topography whooly controoed by bedrock.

Thus the great observed variation in the topography of glaciated terrane. Scattered erratics might come from floating ice in a marginal lake. In Illinois and Iowa variation in degree of erosion of drift plains can be accounted for by variation of time since glaciation. Comparison of other areas can be misleading. 688

show that they were glaciated by the presence of erratics on the summits. Local glaciers were present at various times during the history of glaciation. In Canada the highlands of Labrador are regarded by some as the location of the earliest glaciers. Glaciation spread to the west under the influence of westerly winds which brought moisture. Much of the Precambrian area of Canada is thin drift except for the lake deposits of the "clay belt."

In Europe and Asia glacial maps of the type made in The United States do not exist for political divisions have prevented large scale surveys. The first area to the studied was the Alps and the area to the north. Here four spearate glaciation were early distinguished, Guenz, Mindel, Riss and Wurm. Efforts have been made to distinguish this sucession in other regions not all of them sucessful. The glaciation of Great Britian was by local glaciers. The continental drift of Europe and western Asia may have orginated and terminated in the Scandanavian mountains The area of Precambrian rocks is largely thin drift with abundant boulders. In the areas of sedimentary bed rock drift plains, moraines and outwash chanels are abundant. Around the Baltic Sea there is much clay which was deposited in glacial lakes or brackish water. The study of the inferred annual layers or varves gained much publicity through the work of DeGeer in Sweden who attempted to ascertain the age of glaciation in years by correlating the sucession of such layers. The extent of glaciation in Siberia is little known a nd is subject to dispute. Much was mountain glaciation.

In the southern hemispher the glaciers of the southern Andes were once much more extensive than they no w are. Some mountain glaciation is reported from Australia and New Zealand still has some glaciers.

Glaciated terranes. Land which has been glaciated ~~in the past~~ ~~bothboth~~ consists both of mountain valleys and ~~of~~ plains. ~~The~~ Evidence that glacial ice once covered these terranes consits of: (1) scratches (striae) [on bedrock] like those ~~found near~~ [of such origin at many] existing glaciers, (2) fragments of rock [many scratched, which are] unlike the local bed rock ~~which~~ could only have been transported by glacial ice, in ~~many~~ [some] places from a bedrock source lower than their present location, (3) diversion of drainage by deposits ~~of~~ [made by] glaciers, (4) excavation of basins in the bed rock far larger than those due to other causes, (5) a sloping margin of the glacially transported deposits unlike the shore of a body of water. (6) ~~Nature of the~~ Glacial deposits, ~~with~~ much of them unsorted and [which] contain ground-up fresh bed rock. (7) Topography of ~~the~~ glacial deposits which ~~is~~ constructional ~~and~~ cannot be accounted for by erosion. (8) coarse occurence of water deposits ~~in locations~~ where no [running] water is now possible. Geologists have differed in [the] relative importance of these criteria and on account of possible [errors] ~~confusing evidence~~, such as mistaking striae for slickensides on a fault, it is rarely possible to depend upon any single one of them for a definite conclusion. With increase of time since glaciation many loose their value. For instance striae are destroyed by weathering ~~and frost action~~ and transported boulers (erratics) are not ~~as~~ easily recognized in many localities. ~~This is the case~~ where ~~the~~ both the erratic and the local bed rock are of the same [kind] nature. For this reason opinion has varied on existance of former glaciers over wide areas. Large boulders may also be tranported on ice bergs in standing water. Where all erratics are small they could have been transported by [running] water Only where the glaciation was not too long ago is evidence ~~always~~ decisive. In such localities the final result of glaciation was to smooth the country, decrease the relief and leave enclosed depressions many of them containing lakes.

~~but~~ it is ~~clear~~ that the northwestern part was ice-covered ~~mainly by ice~~ from the ~~although it~~ was continuous with the continental glacier Ural Mountains. The glaciers of the other mountain chains covered considerable areas. The dry continental climate prevented extensive glaciation. Glaciation was present in the mountains ~~to the~~ south of Siberia and on the highlands of Australia ~~and New Guinea~~.

Other continents. Antarctica still preserves its ice, the largest continental glacier extant. ~~Some~~ A few of the Pacific islands which have high peaks show glacial drift The southern part of the Andes in South America were heavily glaciated by valley glaciers which left the striking fiord coast. High volcanic peaks to the north still have ~~ice~~ glaciers. African Mountains ~~as well~~ showed considerable glaciation even under the equator. New Zealand displays glaciers and a fiord coast in one of the islands.

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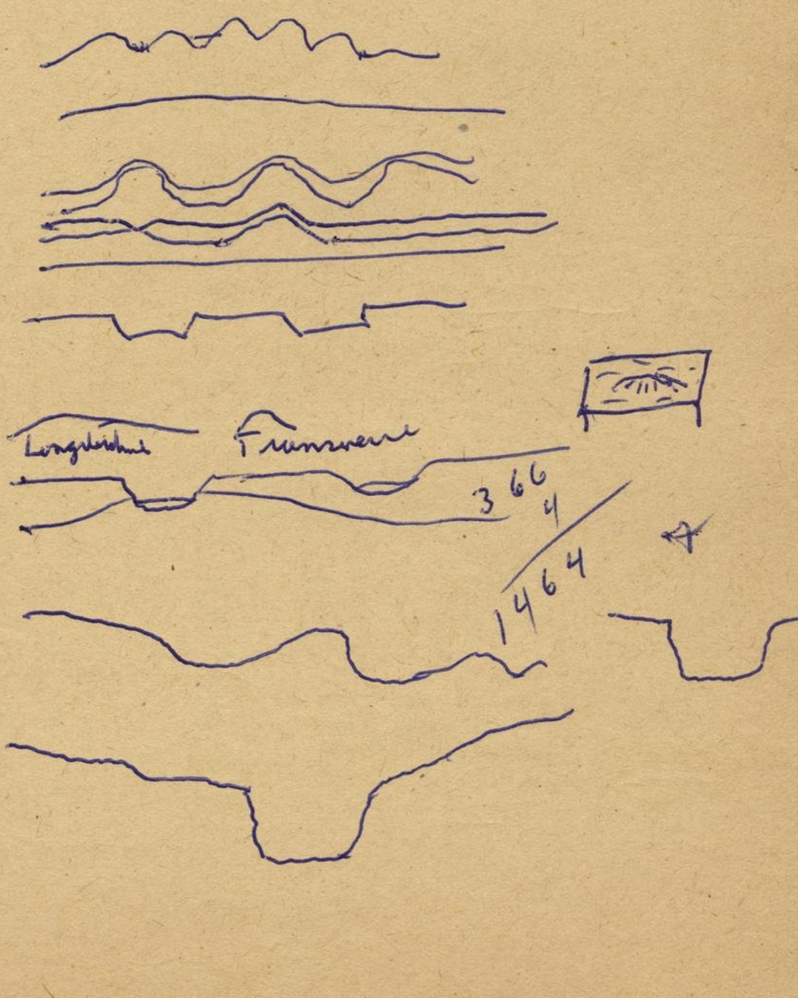
Diagram

1 Terminal moraine - stony
2 " " clay
3 ground " stony
Till plain
4
5 outwash plain - flat
pitted
6
7 drumlin
8 Eroded drift plain
9 glaciated mountain valley
10 hanging valley



North of Wisconsin the glacial geology of the vicinity of Lake Superior is not known in detail becauce of the heavy forest cover which makes even the interpretation of air photographs very difficult. The glacial features of Minnesota are for the most part similar to those of Wisconsin with abundant well developed moraines, drumlins and outwash plains. Toward the west specially in the Dakotas moraines have a higher content of clay and are less conspicious. An exception is the vicinity of the famous salt lskes of the Devils Lake region, North Dakota. There the moraines are high and rugged. In the Rocky Mountains glacial erosion features such as cirques are very conspicious in the north for instance in Glacier National Park and on the volcanic peaks along the Cascades and Sierras. Glacial features become progressively less and less developed in going south into Mexico The Yosemite Valley, California is world-famous for its waterfalls from hanging valleys. Studies by Matthes showed, however, that although there was much glacial erosion controlled by jointing of the granitic bedrock glaciation was not the sole agency. Successive tilts of the range up to the east accelerated the streams which flowed down slope and caused some of the hanging conditions. Such valleys are rare for they occur only where the bedrock is well fractured. In Alaska glaciation was confined to the coast and to local valley glaciers which formed wonderful fiords. Inland the climate was too dry for extensive glaciers.

Europe. Although the glaciation of Europe has been studied for many years the political divisions with accompanying rivalries has prohibited all general studies and no maps like thoes of North America exist. The continental ice sheet appears to have origninated in the Scandanavian highlands from which ice spread over the lowlands of Germany and Russia. Drift of at least three distinct ages has been found . Moraines and outwash plains are abundant in the younger drift. The glaciation of the Alps was first worked out and four glaciations were distinguised in decreasing age; Günz, Mindel, Riss and Würm. Many have tried to distinguish this succession all over the world. Glaciation of the British Isles was almost wholly from local centers in the highlands. Scandanavian ice was unimportant.

Asia. Extent of continental glaciation in Asia is not very well known. In Siberia.

The skyline of drumlin areas is markedly serrate when viewed in the direction of ice flow. Eskers, ridges of gravel and sand, are common in ~~occupy much of~~ the lowlands between drumlins

In southwestern Wisconsin a considerable area of rugged rock ~~controlled~~ topography has long been believed to have been unglaciated for no erratics were ~~have been~~ discovered outside of ~~xtreamxtrxn~~ outwash and lake deposits derived from a nerby young drift ~~glaciated territory~~. It is called the Driftless Area. Tracing ~~of~~ the exact boundary is difficult for where the drift was fairly old erosion has removed most of it, partiularly where the bedrock is incoherent sandstone. Only the east boundary where the drift is quite young is clearcut.

Over much of the marginal ~~of the~~ drift the landscape is not unlike that of the ~~apparently~~ unglaciated region, for the glacial deposits are so thin and ~~parranctly~~ never did smooth out the country like they did in thicker drift.

~~Reference Thwaites "Outline of Glacial Geology, 1957 pp 99-100, 127~~

Insert on p 3

recognized. Much of the region is thinly drift covered over crystalline rocks; but lakes are abundant. Even the highest peaks have been glaciated as proved by the discovery of erratics on their summits. Cirques tell of local glaciers which may have existed since the continental ice. Eskers are prominent in Maine. Endmoraines of the continental ice are almost entirely confined to the coastal islands of the Cape Cod region. Westward through the Applachian Platea and Adirondacks drift deposits are largely confined to the valleys by reason of the high relief of the bedrock surface. The famous Finger Lakes much resemble fiords and it is generally accepted that their depth can only be explained by glacial erosion. West of the plateau the Great Lakes are rock basins clearly due to glacial erosion where the bedrck is especially vulerable to that process. South of the the thikkness of glacial drift is considerable and moraines and till plains are well developed. Southwest of the Great Lakes the drift is very thick. Much of Illinois was almost flat before gt postglacial erosion by streams. The young, or Wisconsin, drift area is only slightly eroded along the streams. Next older, the Illinoian drift to the south is much more deeply weathered nd is moderately dissected so that remnants of the original surface are preserved only on the divides. Its endmoraines are inconspicious. West of Mississippi River in Iowa the drift surface is submaturely dissectd. With similar drift material, bedrock, relief, and climate this can only be accounted for by greater age, the Kansan drift. A buried soil zone at the top of this drift proved the conclusion. Beneath the Kansan drift with its deeply weathered soil profile lies another buried soil zone, the top of a much older drift, the Nebraskan. The extent of the Nebraskan drift at the surface is not positively demonstrated for we must recognize that postglacial erosion is conditioned upon other things than time alone. North of the belt of pre-Wisconsin drift Wisconsin is the tyoe locality for the youg drift and displays a wonderul variety of glacial features. Vast fields of drumlins and the famous Kettle Moraine at the junction of two ice lobes deserve mention. As in New England the drift on crystalline rocks contains many large boulders, a result of the type of bedrock which breaks in large masses and not a characteristic of a particular kind of glaciation.

It is relatively uncommon to find all or even the majority of the above criteria over any large area except where glaciation has been quite recent. In application criteria difficulty is largely in proportion to the time since occupation by the ice There are many pitfalls in the practical application which may lead to error. Striae are destroyed by weathering and even in rather young glaciations require several feet of drift to protect them from destruction. They are rare on most exposed rock outcrops unless very recent. It is not easy to prove that certain rocks are really erratics. Slickensides due to faulting are readily confused with striae particularly on loose stones. Topography due to solution of the bedrock is striking like that of glacial deposits. Boulders may be transported on icebergs mixture of material; Landslides and creep give confusing phenomena in movement of rocks and topography. It is small wonder that opinions differ in many areas depending on the personal bias of the geologist who studied it. As the age of the drift increases erosion and weathering, which destroy much of the evidence, render conclusions increasingly difficult. Where the topography has been not surveyed accurately deposits of marginal lakes make mapping of the glacial boundary most uncertain.

North America. In North America much of the glaciated terrane has been surveyed in fair detail and maps of large arezs are available. Continental ice persists to the present day in Greenland and some of the adjacent islands still have considerable ice caps. Canada has been photographed from the air and in spite of wilderness conditions the glacial deposits are known relatively well. Much of the Precambrian hard rock area has thin drift cover and lakes are abundant. Some of the mountains of Labrador now show no striae, one theory is that the continental glacial originated on them and spread westward because of the supply of moisture from westerly winds. Local glaciers existed in these mountains since the continental ice disappeared, The coast displays many fiords. The western Mountains of Canada appear to have been once nearly or quite buried by ice but the topography displays only the work of local glaciers some of which still persist. In the United States there is a large development of deposits by glaciers which were older than the last or Wisconsin glaciation.

In New England, however, only the young Wisconsin drift has been definitely

GLACIATED TERRANE. A glaciated terrane ~~has~~ was once ~~been~~ covered by glacial ice ~~although little or none is present today~~. Division is made into (1) areas of mountain or valley glaciation where many of the high ridges and peaks projected through the ice ~~at its maximum extent~~ and (2) continental glaciation where the ice ~~spead~~ spread out over ~~a~~ large areas of relatively low relief and concealed almost all of the land ~~features~~ shapes ~~when it was of maximum size and extent.~~

Evidence that glaciers once covered these areas were once glaciated ~~To prove that an area was once glaciated~~ is demonstrated by: (1) scratches or striae on bed rock like those seen near existing glaciers, (2) Rock fragments of all sizes, many striated, and many too large to permit of transportation by any other agency than a glacier. Many of these transported rocks or erratics are unlike adjacent bed rock and some are now found at a higher elevation than the probable source bedrock. ~~(3) Those unlike adjacent bedrock are called erratics.~~ (3) Loose material containing erratics with no sorting or stratification indicates glacial transportation. Much of this material was derived from fresh bedrock, not weathered. (Till) (4) Abnormal ~~unusual~~ features of ~~the~~ drainage including diversion through rock ridges, waterfalls, and lakes ~~which demonstrate~~ show that glacial deposition ~~which~~ disturbed a normal drainage system, (5) basins ~~in the bedrock~~ completely rimmed with bedrock which are far larger than bedrock depressions due to weathering and which lack the abrupt and regular margins of depressions due to earth movements. (6) Where clearly ~~marked~~ traceable, the margin of the glacial deposits slopes at a ~~marked~~ considerable angle and does not resemble the ~~margin~~ edge of deposits due to any other agency than glacial ice. ~~It is relatively~~ (7) Depressions and other constructional features in the topography of glacial deposits which can~~not~~ be explained neither by normal stream erosion nor by solution of the bedrock. See figure (8) the presence of coarse water-transported deposits in places where running water is not ~~present or~~ possible at the present. (9) in mountain valleys an irregular longitudinal profile of the bed rock with enclosed basins, separated by abnormally steep ~~sections~~ intervals with no adequate cause in the nature of the bedrock, (10) valleys which are wider and straighter than is ~~normal~~ common in the same type of bedrock, and which have much steeper sides than is ~~common~~ normal. (11) valleys ~~mit~~ many of whose tributaries do not join accordantly (hanging valleys). (12) Cirques / ... of erosion by local glaciers. The accompanying figure illustrates in idealized form some of the characteristic land forms of glaciated terrane.

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FIORD, a narrow, deep, steep-sided marine bay found mainly in Alaska, British Columbia, Labrador, Greenland, Norway, Patagonia, Chili, New Zealand. The depth of water varies greatly with a maximum of 4000 feet recorded; it is commonly less at the entrance from the ocean than farther up the fiords. Some fiords parallel the coastline instead of indenting it. Many tributary valleys hang above the main fiord, or show unbalanced junctions. The origin of fiords has been ~~much~~ debated. Theories include (1) ~~range from simply~~ drowned land valleys, (2) faulting, and (3) ~~or~~ glacial excavation of preexisting ~~older~~ stream valleys. Fiords of typical form are located in regions where there either are or have been valley glaciers some ~~many~~ of them later than ~~the~~ continental ice. The key to the problem is the relation of both stream and glacial erosion to fracturing of the bed rock. Glacial erosion, particularly, is much affected by the ability to remove bedrock in large masses rather than grind it to powder. Hence there is a direct relationship to the tectonic pattern of faults which is ~~showing that there~~ is a related ~~relation~~ to regional structure. In regions where valley glaciers did not reach the ocean there are deep lakes which are ~~represent~~ the inland results ~~distribution~~ of the same conditions. ~~See Finger Lakes~~

See Thwaites "Outline of Glacial Geology"; ~~Flint, Glacial Geology and the Pleistocene Epoch, 1947; Glacial and Pleistocene Geology, 1957~~: Gregory, J. W., The nature and origin of fiords, 1913

Islands in fiords are ~~represent~~ localities where there was insufficient fracturing of the bedrock to permit extensive glacial erosion. That there has ~~also~~ been change of level of the land with respect to the sea in fiord regions is unimportant to ~~in~~ the theory of origin. ~~of fiords~~ Fiord coasts are some of the most picturesque in the world and the more accesible ones are much visited. Their presence near to the surviving continental glacier of Greenland ~~is not an indication of origin through its agency alone, but rather~~ is the result of later valley glaciers plus ~~and~~ offshoots of the continental glacier in the mountainous ~~such rough~~ topography. Some fiords show extensive glacial polishing of the sides but this does not demonstrate that glacial abrasion although important was the dominant process. The relation to rock fracturing was also discovered ~~demonstrated~~ by Matthes in Yosemite Valley, California which does not contain a lake. See Finger Lakes 367

Erosion by plucking without reducting to powder is conditioned not only on fracturing of the bedrock but also on thick enough ice to permit pressure melting and refreezing to loosen large fragments. 399

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Kame- Any hill of stratified or sorted glacial drift regardless of origin. Some attempt to limit the term to small hills of coarse poorly-sorted gravel in endmoraines. Some kames are deltas with inclined bedding showing deposition in standing water. Hills between the kettles of pitted outwash have also been called kames. The material of these is much finer than in true kames. Eroded outwash has been erroneously called kames. 69 "moulin kames" are the gravel fillings of holes melted in stagnant ice 81

KAME, a hill of poorly stratified and assorted glacial drift for the most part in or near endmoraine or interlobate moraine. They must have been deposited in holes or crevices within the glacier in part under standing water as shown by inclined stratification. Melting of supporting ice disturbed the bedding. The term kame has not been applied uniformly in the past. Hills of pitted outwash, stream was deposited by streams around and over isolated masses of ice were called kames by some. Moulin kames are conical gravel deposits in filled holes in the decaying glacier. Hills of eroded outwash were once called kames too

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KAME, a hill of poorly stratified and assorted glacial drift in or near an endmoraine or interlobate moraine. Such hills were deposited in holes or crevices within the glacier, in part under standing water as shown by inclined bedding. In many places melting of supporting ice disturbed the layers. The term kame has neen applied to hills either of eroded glacial outwash or within pitted outwash which was deposited by streams around and above isolated ice masses. Moulin kames are striking conical fillings of holes melted through the last of the glacier. See Thwaites "Outline of Glacial Geology" 1957

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Esker: Ridge of ~~stream deposits mainly~~ poorly-sorted gravel and sand, ~~found~~ in a glaciated region. Eskers ~~may~~ reach a length of many miles and ~~many of them~~ are higher at the terminus than at the source. They are best developed in ground moraine areas. Complexities ~~in topography~~ consist of multiple ridges, adjacent knolls of stream deposits, ~~either kames or outwash~~, ~~breaks or interruptions~~. The material varies ~~greatly~~ al~~ong the course~~, ~~but~~ Eskers ~~are in many places~~ the only source of gravel ~~for long distances~~. Eskers are deposits of glacial streams which flowed between ice walls but whether or not the channels were ~~roofed by ice is not~~ certain. ~~Many must have been~~ formed when the ice was ~~in its last stages and~~ stagnant. The uphill course can be accounted for by tunnel deposition in some places

ESKER, ridge of poorly sorted gravel and sand ~~in glaciated region~~. Length from 150 miles ~~down with~~ many ~~interruptions or~~ gaps. Trend in roughly in direction of glacial movement. Terminus may be higher than source. Best developed in ground moraine, mainly on low ground but may cross low ridges. ~~Material varies greatly in short distances~~. Complexities include multiple ridges, adjacent knolls of stream deposits. Origin is a stream of glacial meltwater between ice walls, possibly in part a tunnel. ~~Irregularities~~ show that ice was stagnant ~~during deposition~~ Some ~~geologist~~ regard eskers as elongated deltas ~~formed in a crevasse~~.

Should not be confused with crevasse fillings in outwash

100

Finger Lakes ~~are~~ long narrow comparatively stright lakes best developed in the north border of the Appalachian Plateau in northwest New York . Depth of water in some extends below sea level. This and the sharp contrast with the flowing contours of the adjacent uplands strongly suggests glacial deepening partly by concentrated ice flow and partly because of the thickness of the ice. which permitted erosion by plucking. This origin ~~was~~ much debated and ~~apparently~~ other factors may have cooperated in ~~and led to~~ localization ~~of~~ glacial erosion. The lakes much resemble fiords. 7

Some tributary valleys hang high above the lake bottoms

Depth of drift in the lakes is unknown 102 85

FINGER LAKES, long narrow, comparatively straight lakes, best deveoped in the north edge of the Appalachian Plateau in western New York. These lakes strikingly resemble fiords of glaciated coasts. ~~In several~~ The bottoms of some are below sea level. This fact and the sharp contrast with the flowing contours of the adjacent uplands strongly suggests that pre~~rising~~ glacial or interglacial valleys were deepened by glacial erosion. The concentration of ice flow in the valleys plus plucking under ~~the~~ thick ice ~~have been appealed to in order to~~ apparently account for the ~~local concentration of~~ ice erosion in the bottoms of valleys. Some tributary valleys hang hundreds of feet above the lakes. Depth of drift is ~~the valleys of the lakes is~~ unknown. 55 60 100

FINGER LAKES, ~~LONG~~ long narrow, comparatively straight lakes, best developed in the north edge of the Appalachian Platea in western New York. These lakes strikingly resemble fiords(See fiord) The bottoms of some are below sea level. This fact and the sharp contrast with the flowing slopes of adjacent uplands strongly suggest that pre~~existing~~glacial or interglacial valleys were deepened by glacial erosion of the bottoms leaving many tributary valleys hanging. The localization of such erosion is due both to concentration of glacial flow and to the thickness of the ice in the valleys which caused plucking of the bedrock. The depth of drift in the lake bottoms is unknown. Reference: Thwaites, Outline of Glacial Geology, pp 21-22, 113, 1957.

Matterhorn- ~~term applied to a~~ mountain similar in form and origin to the famous Matterhorn in Switzerland. Such an isolated streep-sided peak is a residual ~~beteen glacial cirques, a place~~ where cirque erosion ~~of head walls~~ removed more gently sloping mountains, leaving a very abrupt surviving peak. See cirque, arrete.

MATTERHORN, a high isolated peak with ~~very abrupt~~ unusually steep sides located in southern part of Switzerland near Zermatt. Also called Mont Cervin and Monte Silvio. The name has been ~~applied to~~ used as a type designation for other mountain peaks of the same form and origin, namely headwall erosion ~~by~~ glaciers ~~in~~ cirques leaving a residual mass of rock ~~through~~ after junction of the heads of the cirques. See cirque. This process of ice erosion is called sapping and forms very steep rock slopes in marked contrast to the smoother slopes of unglaciated mountains. See Thwaites "Outline of Glacial Geology", 1957

MATTERHORN, a high isolated peak with unusually steep sides in southern Switzerland near Zermatt. Also called Mont Cervin and Monte Silvio. The name, sometimes shortened to horn has been applied as a type to other mountain peaks of the same origin, namely the erosion of the heads ~~walls~~ of adjoining cirques by sapping so that portions of the intevening walls are removed leaving residual peaks which are unique in their abrupt sides. The contrast of such peaks with the adjacent unglaciated mountain sides in testimony to the nature of glacial erosion. See cirque. Reference: Thwaites, F. T., Outline of Glacial Geology, pp. 7-8. 111-112, 1957

KAME, a hill of poorly stratified and assorted glacial drift in or near an endmoraine or interlobate moraine. The deposits were formed in holes or cracks of the glacier, in part under standing water as shown by inclined bedding. Melting of supporting ice margins disturbed the bedding. The term kame has been used loosely and applied to hills due ~~either~~ to stream erosion of outwash, ~~or~~ to pitted outwash, or to all deltas. ~~of all kinds~~. Moulin kames are striking gravel fillings of holes melted through stagnant ice. Reference: Thwaites, F. T., Outline of Glacial Geology, pp. 39, 116, 1957

100

Moraine- ~~term generally applied to all~~ glacial drift particularly that deposited by a continental glacier. "Terminal" or "end moraines" ~~were~~ accumulated at the border of a glacier either continental or valley. The term "ground moraine" was applied to smooth to level drift accumulations inside of the endmoraine on the old theory that the deposits were laid down under the ice rather than by its final melting. End moraines are ridges or series of minor ridges with enclosed depressions between them. Moraines of valley glaciers are ridges. Medial moraines are due to the union ~~junction~~ of two valley glaciers, ~~where the valleys unite~~

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MORAINE, glacial drift deposited ~~either~~ at the end, ~~or~~ side ~~of a glacier~~ or under the glacier ~~ice or all over the glaciated area~~. Subdivided into terminal or end moraines deposited at the margin ~~terminus~~ of the glacier during a period of balance between movement and wastage. Ground moraine, ~~which covers~~ drift over large areas was once thought to have been wholly ~~all~~ deposited under the ice. It is more probable that it was ~~largely~~ laid down when the last ice melted. End or terminal moraines are ridges whereas ground moraine is a mantle ~~sheet~~ of drift ~~much of~~ which owes its topographic form to older drift deposits or to the bed rock beneath.

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MORAINE, ~~glacial~~ drift deposited at the end, side or under a glacier ~~the ice~~. Moraines are divided into terminal or end~~moraine~~ formed at the margin of the ice, ground formed when the ice melted, interlobate between adjacent lobes, lateral on the sides of a valley glacier, and medial due to junction of two valley ~~mountain~~ glaciers. Origin of end moraines involves moving ice whose margin was nearly stationary bec ause of balance between motion ~~movement~~ and wastage. The material of moraines is chiefly till although some stratified materials occur particularly in endmoraines. Endmoraines are ridges, many of them complex, parallel to ice border. Ground moraine owes most of its form to preexsting topography.

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horseshoe

Reference: Thwaites, F. T., Outline of Glacial Geology, pp. 39-43, 1957

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Drumlin. A stream-lined hill either wholly of glacial material or covering a rock core. The long axis is parallel to the motion of the last ice advance of the area. The end toward the ice is relatively abrupt whereas the other end or tail is long and pointed. Some drumlins show complexities, later drift on top, fusion with neighbors. Drumlins were formed by moving ice of considerable thickness. Most of the material is unsorted till although some water deposits may occur. That drumlins were built by ice, not worn by ice, is the opinion of most geologists.

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DRUMLIN, a streamlined hill either all glacial drift or drift which covers either a rock hill or a mass of older drift. The long axis parallels the direction of ice movement. The end toward the ice source is relatively abrupt and the tail is longer and sharper. Some drumlins show complexities such as later drift on the top, fusion with neighbors, multiple crests, and so forth. Material is largely glacial till although some stratified layers are found. Most geologists favor the idea that drumlins were built by moving ice of considerable thickness rather than eroded by ice from older drift.

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DRUMLIN, a stream-lined hill of glacial drift which may conceal inside a rock hill or hill of a previous glaciation; the long axis is parallel to the ice motion. The end toward the ice source is relatively steep, the tail more gentle. Complexities include later drift above, fusion with neighboring drumlins, multiple crests, multiple tails. The drift is chiefly till with minor layers of silt, sand, and gravel. Most geologists favor the theory that drumlins were built by moving ice of some considerable thickness, not eroded from older drift.

References: Thwaites, F.T., Outline of Glacial Geology, pp. 44-45, 116, 1957

Fairchild, H.L., Drumlins of central western New York; New York State Mus. Bull 111, 1907

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ESKER, a ridge ~~or series of ridges~~ of poorly-sorted glacial gravel and sand which ~~is~~ variable in short distances. Eskers trend ~~in general~~ parallel to the direction of ice flow and the terminus is ~~in many~~ higher than the source. Eskers are best developed in ground moraine, ~~mainly on low ground~~. Some cerss low ridges. Complexities ~~of eskers~~ include multiple ridges, bordering troughs, and adjacent knolls of stream deposits. They should not be confused with crevasse fillings the deposits of outwash between ~~adjacent~~ ice blocks. Eskers were deposited by streams of glacial meltwater with ice walls and possibly roofs ~~in some instances.~~ ~~The~~ Irregularities of course indicate stagnant ice.

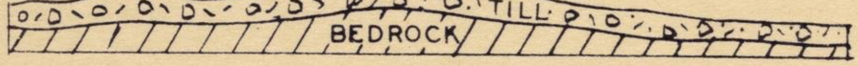
References: Thwaites, F. T., Outline of Glacial Geology; Flint, R. F., Eskers and crevasse fill9ngs: Sm. Jour. Sci., vol. 215, pp. 410-416, 1928

ESKER, a ridge ~~with gaps~~ of poorly-sorted glacial gravel and sand which varies abruptly. The trend averages parallel to ice movement and the terminus may be higher than the source. Eskers are ~~commonest~~ in low ground moraine but ~~may~~ cross low ridges. Thie form is complicated by multiple ridges, gaps, adjacent depressions, and knolls of similar material. ~~True~~ eskers should be distinguished from crevasse fillins which ~~were~~ are glacial outwash between ice blocks. Eskers oriingated in streams of glacial meltwater ~~with~~ ice walls and localy ~~roofs~~. ~~Irregularities~~ demonstrate that the ice was stagnant. Reference: Thwaites, F. T., Outline of Glacial Geology, pp. 52-54, 117; 1957 Flint, R. F., Eskers and crevasse fillings: Am. Jour. Sci., vol. 215, pp. 410-416, 1928

Cirque. A basin-like depression in side of a mountain not necessarily at head of a normal valley. The side toward the mountain is very steep and cliffed. Most Geologists ascribe erosion of these forms to frost breaking in the crack or bergschrund at head of a glacier which either does or did occupy the cirque. The bottom of the cirque may be on bed rock or glacial deposits and many contain lakes often called trams. The lake may be either a basin in bed rock or enclosed by a moraine of glacial deposits. Cirques are abundant in glaciated mountains and indicate work of local glaciers. They are not formed by large continental glaciers although they have been formed in such areas of continental glaciers by local glaciers either preceeding or following in age. The process of erosion which kept the head wall steep is often termed sapping. Water which runs into the bergschrund at the head of the glacier freezes and makes it possible for the ice to remove material from the bottom of the steep slope. The bottom of a cirque shows effects of glacial grinding of the bed rock.

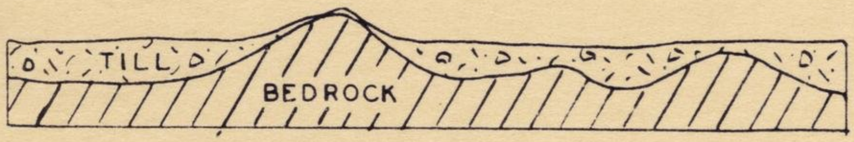
CIRQUE. A half basin-like depression in a mountain side or at the head of a valley. The side toward the mountain or headwall is very steep or cliff. Erosion of this abnormal slope required a different process than occurs in stream erosion. The bedrock was broken into fragments and removed by glacial motion. The breaking was due to frost action due to the freezing of water which descended into the crack (bergschrund) at the division between the ice and rock. This process is called (sapping). Below this steep headwall glacial grinding may excavate a basin which after the ice all melts may contain a lake or (tarn). Cirques are the product of local glaciers but occur in some regions of continental glaciation where there were local valley or mountainside glaciers before or after the larger ice sheet. Thwaites F. T., Outline of Glacial Geology, pp. 7-8, 111-112, 1957

END MORAINE, STONY

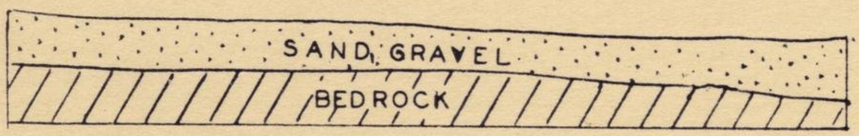


END MORAINE, CLAY

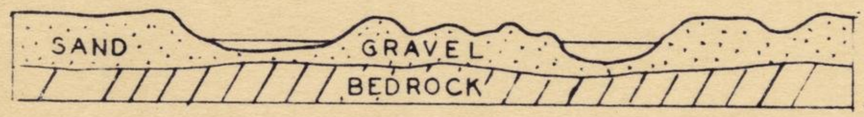
GROUND MORAINE



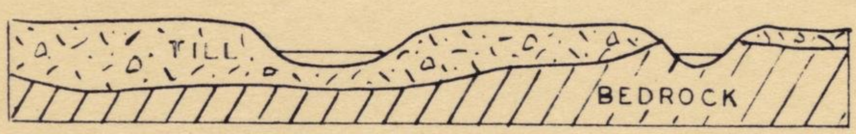
TILL PLAIN



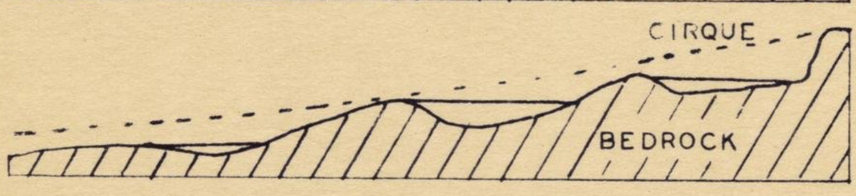
OUTWASH PLAIN



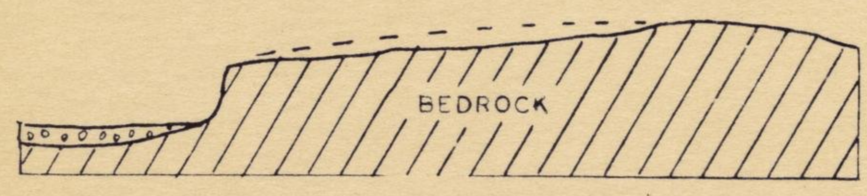
OUTWASH, PITTED



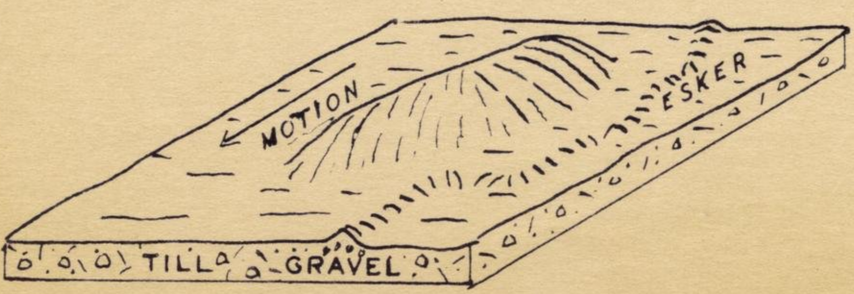
TILL PLAIN, ERODED



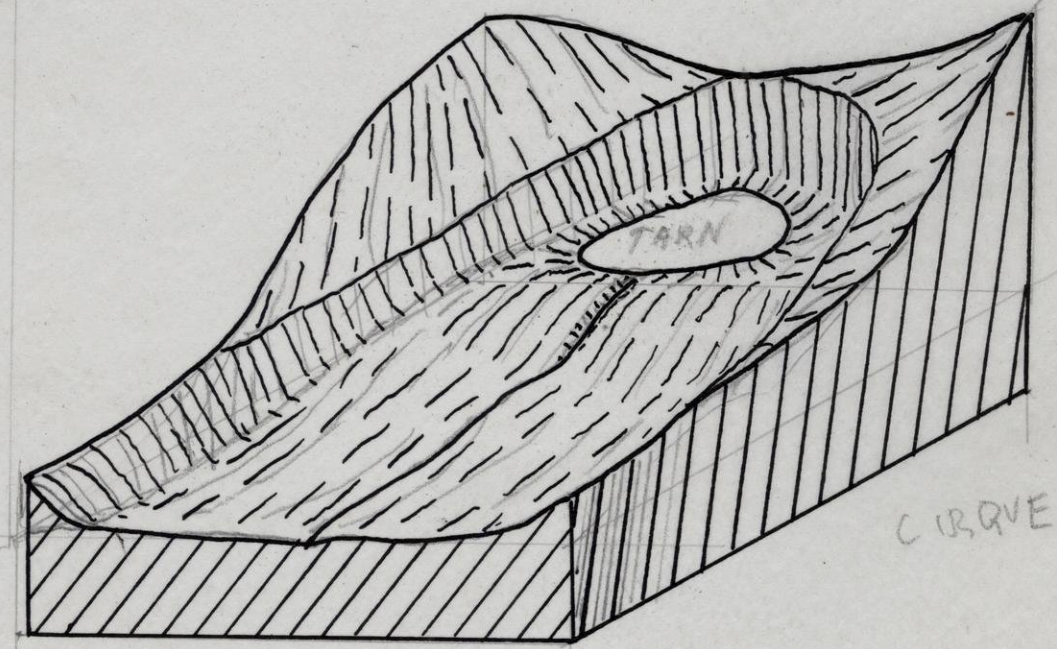
MOUNTAIN VALLEY, CIRQUE



HANGING VALLEY



DRUMLIN, ESKER


TARN
CIRQUE