ent not only on its shape but on how rounded the edges are. If a boulder breaks, the value for the roundness has one-half the value it had before it broke. For example, if the roundness before breaking was 0.7, after breaking the value would be 0.35. However, the roundness values are only given to one significant figure so the new value is 0.4.

Roundness

Usually as a boulder becomes rounded to values greater than 0.5, it breaks as a result of collisions. Then the process of rounding starts again. Beyond a certain distance from its source, there is a dynamic equilibrium between breakage and roundness with a mean roundness of 0.5. For boulders to reach this state of equilibrium at the base of a glacier, a distance of some 15 to 20 miles is required.

Breakage

Boulders fall into one of three categories of breakage:

Relatively fresh surface breakage no. 2 and 9. Find one of the three others. _____

Worn surface breakage no. 5 and 27. Find one of the two others? _____

No indication of breakage, no. 3, 4 and 10. Find one of the three others? _____

Roundness of the boulders

Look at the boulders for evidence of grinding and crushing by the glacier. In order to determine the degree of abrasion; use the visual scale of roundness.

Boulder no. 3 has a roundness of 0.6. What are the roundness values of boulders no. 8 _____ and 12 _____?

In the case of a fresh break, a boulder’s roundness value is obtained by dividing the value of roundness before breaking by two and rounding up to the nearest tenth.

For example, boulder no. 2 has a roundness of 0.3. No. 9 has a roundness of 0.4. What are the roundness values of no. 26 _____ and no. 33 _____?

Do all boulders show the same degree of surface changes?

Estimating the relative distance of transportation

By evaluating the relative roundness, breakage and shape of the boulders we should be able to estimate the relative distance each rock type has traveled from its source. Note that pegmatite boulders (no’s. 2, 3, 9, 11, 17, 24, 26, 36, 39, 41, and 44) are very inconsistent in their degree of roundness, extent of breakage and shape. Roundness, for example, varies from 0.1 to 0.6. This would lead us to conclude that there is a wide range of transport distances for pegmatite boulders. This is reasonable because pegmatite is associated with all types of basement rocks.

Based on shape, breakage, roundness and number of boulders, evaluate the relative distance to the sources for the following rock types.

Basalt

Boulder No.	Shape	Roundness
13		
28		
40		

Augen Gneiss

Boulder No.	Shape	Roundness
33		
34		
43		

Lineated Leucogranite

Boulder No.	Shape	Roundness
5		
10		
30		
37		

Biotite Granite and Gneiss

Boulder No.	Shape	Roundness
1		
6		
8		
12		
14		
15		
16		
18		
19		
20		
21		
23		
25		
27		
31		
32		
35		
38		
42		

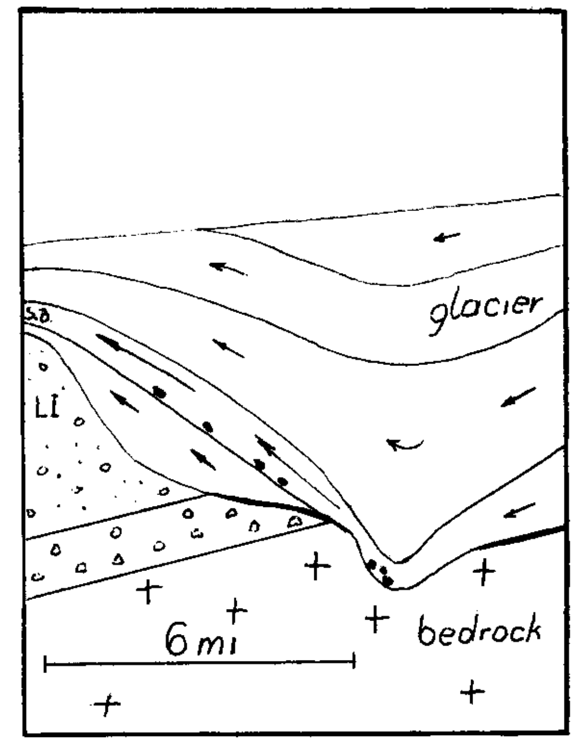
Subglacial transportation

The angular shape and low degree of roundness and large number of boulders of the biotite granite and gneiss and suggest that they traveled the shortest distance, perhaps not even at the base of the glacier. An angular form is hard to preserve in a basal glacial environment of constant grinding, even for distances shorter than 6 miles the closest possible source of basement rocks. One possible explanation is that some of these boulders were transported within the glacier and not at its base.

Distance Traveled by Boulders Near the Earth & Space Sciences Building

Waldemar Pacholik

Summer 1999



CREATED FOR THE
EARTH SCIENCE RESEARCH PROJECT

State University of New York
Stony Brook

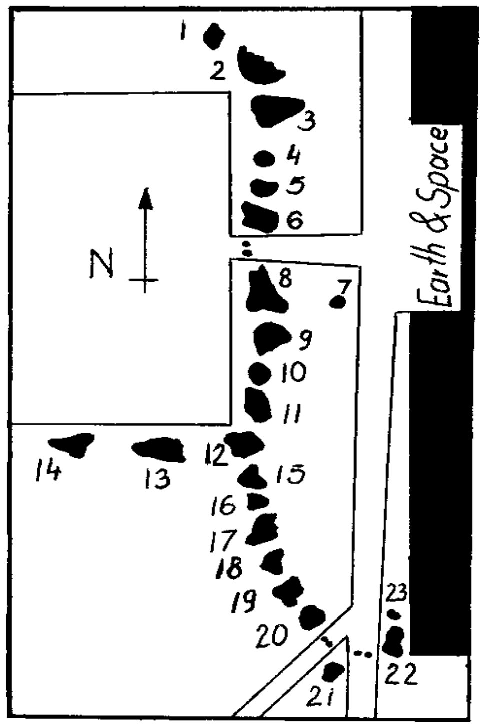


Fig. 1 Arrangement and shapes of boulders along paths on west side of ESS building near small parking as of the summer of 1999. These boulders are occasionally moved around by the campus maintenance crews, so their arrangement may be somewhat different at the time you are viewing them.

Introduction

Studies of the distribution and sources of rock types, suggest that most boulder size rocks at the base of a glacier travel only some 20 miles before they are destroyed by crushing and abrasion. This does not mean that some boulders did not travel much further. It is just means that if there is a continuous source of boulders in a glaciers path, those boulders that traveled a longer distance make up only a small percentage of the boulders. Also not all boulders travel at the base of the glacier. Some may be placed in the ice above the base and as a result are transported with little crushing or abrasion. An analysis of boulders on the Stony Brook University campus suggests that while some of these boulders may have traveled some 30 to 40 miles from their source (Pacholik, 1999), many came from the basement rocks underlying Long Island Sound. The closest place that basement rocks would have been exposed during glaciation is about 6 miles to the north.

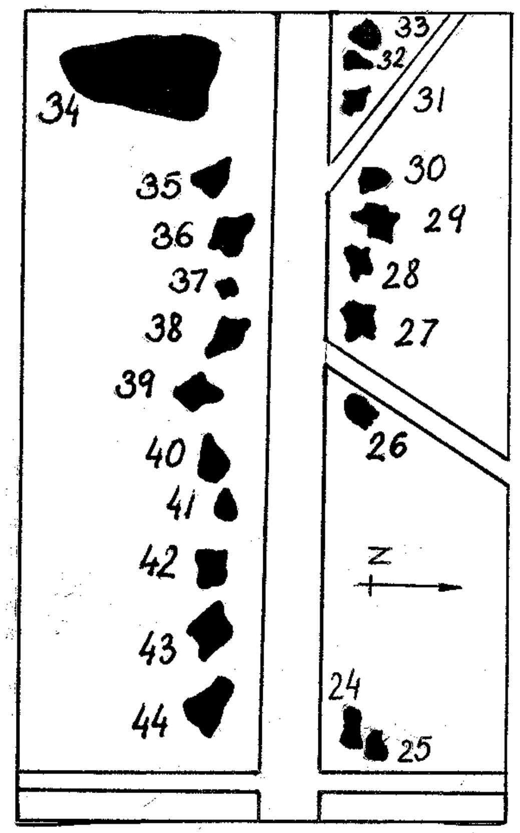
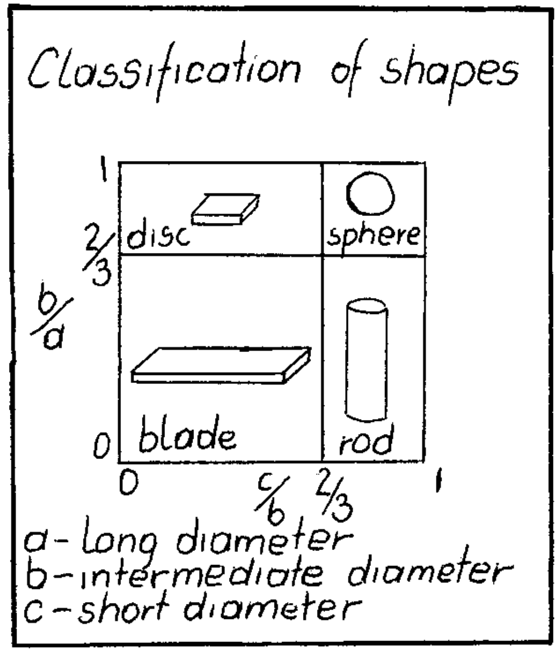


Fig. 2 Arrangement and shapes of boulders along paths to large parking lot southwest of ESS Building as of the summer of 1999. These boulders are occasionally moved around by the campus maintenance crews, so their arrangement may be somewhat different at the time you are viewing them.



Boulders on the Western Side of the ESS Building

These boulders, found during construction of the buildings on campus, were plucked by glaciers from the bedrock of Long Island Sound and Connecticut and deposited on the Stony Brook Campus. Rock particles of all sizes are concentrated at the bottom of a glacier. This material is known as till. This densely packed material about a meter or two thick is kept in constant motion at the base of the ice. The rocks are abraded and broken in this grinding machine. As the boulders are transported, their size, shape and degree of roundness change. Our hypothesis is that the least rounded boulders traveled the shortest distance. You will determine whether different boulder types have different degrees of roundness. If so, you can evaluate the relative distances that the different boulder types traveled.

Types of rocks

We first need to characterize the different types of rocks in our population. The majority of boulders consist of

biotite granite, no. 8 and 12; _____
biotite gneiss, no. 25; and _____
pegmatite no. 2 and no. 9. _____
Find at least one other example of each these rock types placing their numbers in the spaces above.
In addition, we can find three boulders of basalt, like no. 13. Find at least one of the other two. _____
There are three samples of augen gneiss no. 33. Please find at least one of the other two. _____
There are also three boulders of foliated and lineated leucogranite. No. 5 is one. Find at least one of the other two. _____
The least abundant rock is medium grained, strongly foliated and lineated gneiss no. 22 and 29.

Shape

What shape will be the most abundant after many miles of grinding? Most boulders originally are plucked from the basement with their shape dependent on the fractures in the rock. These boulders will usually have angular edges. Their overall shapes could be similar to spheres, blades, rods or discs. As they travel they become more spherical (look at no. 5, 10, 16, 36, 37, and 41). Krumbein has set up a visual scale of roundness with values from 0 to 1.0. The roundness of a boulder is depend-