

University of Wisconsin-Extension  
GEOLOGICAL AND NATURAL HISTORY SURVEY  
3817 Mineral Point Road  
Madison, Wisconsin 53705

James Robertson, State Geologist and Director

A WEATHERING STUDY OF THE UNIVERSITY BUILDINGS

by

Burton E. Karges

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CIVIL WORKS ADMINISTRATION

PROJECT 79.42

A Weathering Study of the University Buildings.

Conducted by Burton E. Karges under the direction of

Mr. E. P. Bean.

The hours spent on this project total 120, in January and February, 1934.

The following is a brief summary of a study made to determine the causes and extent of the weathering in the university buildings. Special attention has been given to the buildings constructed of Madison sandstone; however, the Library, Chemistry Building, and Memorial Union are also included.

As the author has not had any architectural training, some of the suggestions may not be of any great value. I believe that the following suggestions should be kept in mind at all times when designing plans for future buildings where the Madison sandstone is used as a facing stone.

1. The Madison sandstone and Bedford stone should never be used as a foundation stone or be placed lower than two feet above the level of the ground.

2. All belt courses whether of Madison sandstone or terra cotta should either be set flush with the wall or extended at least four inches beyond the outermost points of the wall below lint, in spite of a groove, (which is absolutely essential on all projecting stone) drip water stain and weather the stone below the belt course.

3. Waterproof mortar should be specified for all belt courses and the joints above and below the belt courses.

4. The construction of wide projecting belt courses of the Madison sandstone is not recommended.

5. The construction of ornamental balconies such as are seen in Barnard and Lathrop Halls is to be discouraged.

6. The use of projecting cap-stones over windows is not recommended.

7. Wide cornices such as those on Barnard, Tripp, and Adams Halls protect the Madison sandstone and their further use is strongly advocated.

8. The use of bush-hammered stone is encouraged over the use of smooth-cut stone because it is less susceptible to weathering and the effects of weathering are much less noticeable.

9. Stone with silt filled worm tubes should be condemned. While it will no doubt be hard to tell in the fresh stone, blocks which contain silty laminations, patches, or lenses should likewise be condemned.

The following paragraphs give a brief resume of the weathering in the buildings studied. The page references at the conclusion of each paragraph refer to the notes which accompany this report.

1. North Hall. North Hall was constructed in 1861; considering its age most of the stone in its walls is in excellent condition. The most weathered portions of the building are: (1) The foundation stone where capillary water aided by freezing and thawing has in many places caused weathering to depths of  $3/4$  to 1 inch. (2) The under sides of the window sills are not protected by a groove so that water runs back and attacks the wall below the sills. (3) An area at the southwest corner of the building has been considerably weathered presumably by water from a defective down spout. pp. 1-5.

2. South Hall. The weathering in South Hall is very similar to that of North Hall. The most serious decay is found in the foundation stone below the lower belt course. Other weathered areas are found beneath the ungrooved window sills. Considering the age of the building the stone is for the most part in a very satisfactory condition. pp. 5-11.

3. Geology Building. In the lower courses of this building there has been considerable spalling. Areas beneath the window sills on the south side of the building have been attacked by water working back into the wall from the under sides of the sills. This is not seen on the north side of the building; this shows the more frequent freezing and thawing on the sunny side of the building. Of the belt courses the two projecting courses near the top of the wall show the most serious decay and discoloration. The further use of belt courses of this type is not recommended. The outward convex belt course between the basement and first floor is badly decayed but has been adequately patched with mortar which is standing up very well. pp. 11-20.

4. Adams Recreation Building. In the older north wing of the Administration Building serious decay is seen in the foundation courses and in the upper stones of the vestibule. Zones beneath the window sills and scattered blocks in the walls are also affected to depths up to  $1/4$  inch. In spite of the younger age of the south wing, weathered areas are noted below the window sills and in scattered blocks containing silty patches. pp. 20-25.

5. Barnard Hall. Because of the wide cornice and the careful selection of stone, there is very little evidence of weathering in this building. Aside from the projecting stone balconies there is no serious decay here. pp. 25-31.

6. Lathrop Hall. Serious decay is seen in the lower courses and in areas below the large window sills and below the panel sills in which these windows are set. Much of this weathering below the sills may be attributed to the lack of an adequate groove and to the weathering out of the mortar in the sills. Weathering is common on the under side of the projecting balconies and below several of the projecting belt courses. The use of waterproof mortar would lessen the speed of decay in the balconies and would probably eliminate weathering in the belt courses. pp. 31-44.

7. Buato Hall. Most of the stone in the walls of Buato Hall is weathered to some extent. This seems due to the use of more smoothly cut stone than the usual bush-hammered blocks and to the poor construction of cornices and eaves which has allowed water from above to run over the wall. The buff Madison has

been stained below the belt course and ornamental blocks of the Lake Superior red sandstone. pp. 44-54.

8. Bascom Hall. In the newer portions of Bascom Hall, window sills are well grooved and so far the stone is in excellent condition. In the older part, serious decay due to capillary water drawn up from the soil which is in most cases in direct contact with the stone is to be noted. The belt courses show abundant pitting where silty spots occur and spalling on the under side of projecting belt courses and beneath the window sills is almost universal. pp. 55-79.

9. Mechanical Engineering Building. The Mechanical Engineering Building has been so recently constructed that there is no decay of the stone. Discoloration is noted below several of the belt courses. This is due to the dirty water working down from the upper side of these projecting belt courses. A further setting out of the lower belt courses where this staining is most pronounced would no doubt have eliminated this discoloration. The greater portion of the Madison sandstone wall is in contact with the soil and weathering from capillary water is to be expected in the future. pp. 78-82.

10. Field House. The belt course eight feet above the ground is not sufficiently set out but what projecting stones in the wall below intercept dirty water dripping off this belt course and are stained and discolored. The metal caps over the door frames add to this discoloration. There is a three to six foot zone of serious efflorescence and discoloration just below the terra cotta belt courses in the gables at the north and south ends of the building. This may be due to water working through the wall from the roof or to water running onto the wall from the belt courses. There are several serious cracks extending from the foundation to the base of the windows and in some cases from the top of the windows to the top of the wall; two of these are almost 1/2 inch wide and should be patched at once. pp. 83-91.

11. Dinatory. The walls of the Dinatory are at present in an excellent condition throughout. Numerous large irregularly shaped blocks have been placed in a vertical position in the wall; there can be little doubt but that these blocks will yield more rapidly to weathering. This practice is to be discouraged. pp. 91-93.

12. Tripp Hall. The wide cornice, the use of brick in the window sills, and a concrete foundation 8 to 24 inches above the level of the ground have rendered the stone immune to the most common types of weathering seen in the Madison sandstone buildings on the Hill. The practice of placing large blocks in vertical position in the wall should not have been carried out here, though as yet there is essentially no weathering in the stone. pp. 94-95.

13. Adams Hall. The remarks made for Tripp Hall also apply here; in addition serious fault is to be found with the mortar used in this building. This is especially noticeable on the north side, and on the west side the decay has been so serious that all joints have had to be patched. At present patching is necessary in the north wall, and before long all of the original mortar that has not already been patched will have to be pointed. pp. 97-104.

14. Chemistry Building. The old western portion of the Chemistry Building is built of sand line brick. This brick is not standing up well. Disintegration and spalling are especially noticeable in the lower portion of the wall. Higher up in the wall over large areas the outer glaze of this brick has been



broken through and a grain by grain disintegration is slowly going on. For any but the most temporary construction, sand lime brick should never be used. In the newer portions of the building, the belt courses are somewhat stained. Deep weathering is seen in the western half of the south side just above ground level. The Bedford limestone used in the main entrance is frequently cross-bedded and under side projecting stones are decayed to depths averaging  $1/4$  inch. Pp. 105-112.

15. Chadbourne Hall. The weathering in this building is especially severe in the foundation courses on the north side. Areas less deeply and less extensively weathered are seen below many of the window sills; weathered stones near down spouts are very common. Pp. 113-119.

16. Library. The Library is faced with Bedford collitic limestone which is on the whole in good condition. On the east side pitting, due, it seems, to chemical rather than physical weathering in the second and third courses from the ground, is noticeable. The depth penetrated by this weathering is rarely greater than  $1/8$  inch, but it is especially unsightly because the white stone of the weathered portions makes a decided contrast with the predominating gray stone of the building. Discoloration is noted on the outer edge of the projecting cornice near the top of the wall. Efflorescence is seen below this layer, just above the ground, and in a few scattered patches in other portions of the outer face. In most of the stone the narrow ridges between these grooves have been slightly attacked. Pp. 119-126.

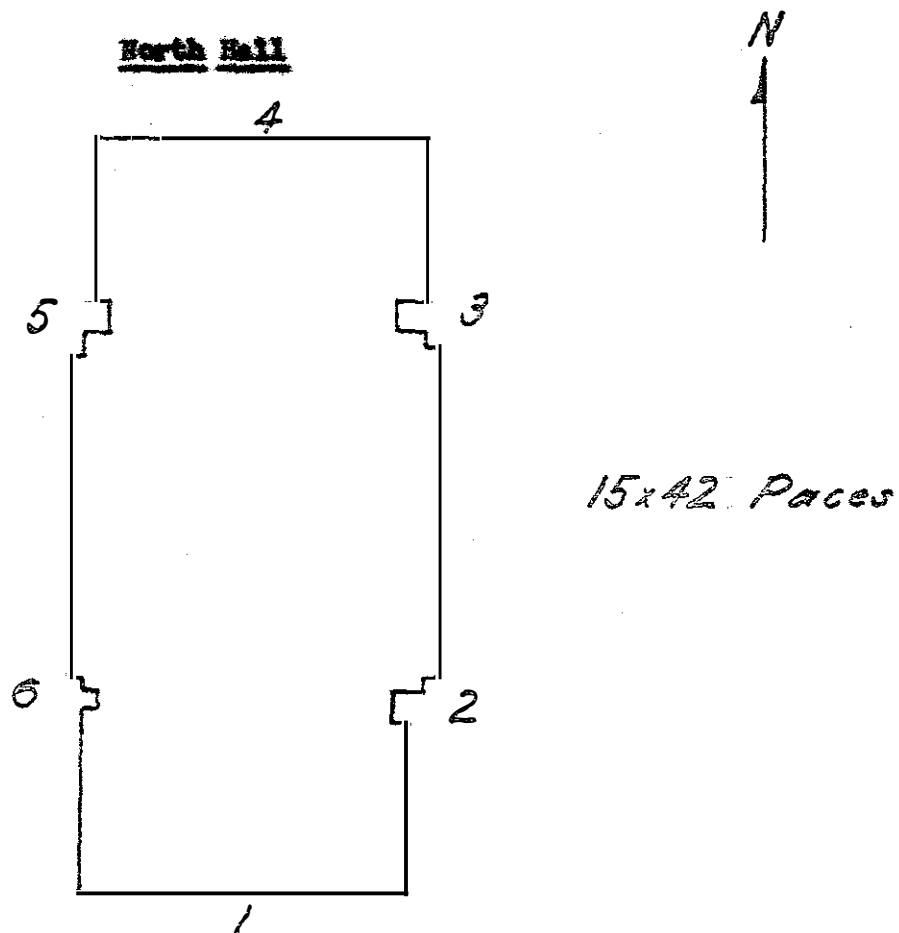
17. Memorial Union. Aside from rather abundant efflorescence in the ornately cut belt course just below the terra cotta cornice, and discoloration below the belt course at the base of the second floor, the Bedford limestone in this building is in excellent condition. The grooved Madison sandstone is standing up very well, but the same cannot be said for the smooth cut Madison which shows small areas that have required patching. Unevenness of texture seems more susceptible to attack than those in grooved or bush-hammered blocks of the Madison. For this reason the further use of smooth cut Madison is not recommended. The steps of the main entrance are of lower Magnesian dolomite from Minnesota. The numerous chips up to 2 inches in diameter which have weathered out attest to the mediocre quality of this stone. Pp. 127-131.

### North Hall

North Hall is constructed with the Madison sandstone. The blocks used are of irregularly sized roughly square blocks. They have been tooled to shape rather than sawed, except at corners and around windows where squared blocks with bedding vertical are used exclusively.

No particular effort seems to have been made to place the stone with the bedding in horizontal position.

The Madison is in direct contact with the soil so that water can be drawn up into the wall. However  $3\frac{1}{2}$  feet above ground level on the east side, but practically at ground level on the west, a dense fine-grained belt of Madison 8 inches thick has been laid and this has served effectively in keeping down capillary water.



In general the stone is in good condition. Exceptions are found in the lower  $3\frac{1}{2}$  feet, under the windows, and beside the SW eave trough. What weathering there is, is due chiefly to poor placing of the stone both in relation to the position of the bedding planes and in positions where it is easily attacked by water.

#### Location 1 (South Side)

Below the belt course -- large blocks make up the foundation. The blocks are in almost every instance placed with the bedding in vertical position and have been freely attacked by weathering. 90% of the rock has been weathered and in 70% of the area the depth affected is from  $\frac{1}{2}$  to  $1\frac{1}{2}$  inches. In most cases the damage has been done by spalling off due to weaker layers inside; some, however, is just a grain by grain disintegration as the loss of cement and freezing and thawing have gone on. Fine grained silty stone is the most affected.

Above this heavy layer weathering is conspicuous beneath the window sills, where it extends to a depth of  $\frac{1}{4}$  to  $1/5$  of an inch (or perhaps even a little more), and on the lower half of the south side of the SW corner. This looks as if it were due to a defective down spout.

An area 12 feet high and 2-3 feet wide is affected here to a depth of  $\frac{1}{4}$  to  $\frac{3}{4}$  of an inch. Beds laid both vertically and horizontally are affected.

With the exceptions noted above, plus several bad cracks between windows, and rare stones high in the wall which are considerably weathered because of their position or original poor quality, the south wall is in good shape.

#### Location 2.

Weathering is confined chiefly to the  $3\frac{1}{2}$  feet below the belt course;

65% of stone, especially in the lower half, is affected to a depth of  $\frac{1}{2}$  to  $1\frac{1}{2}$  inches due to some reasons and agencies as in Location 1. Weathering from  $\frac{1}{4}$  to  $\frac{3}{4}$  of an inch deep is rather common in the first foot below window sills. In the angle in the wall just north of the door sawed corner stones are placed with bedding vertical and weaker beds are weathering out in lower half of building from depths of  $\frac{1}{4}$  -  $\frac{3}{4}$  an inch. With these exceptions and very rare scattered blocks, this wall is in good condition.

#### Location 3.

The north end of the east side of this building is so very similar to the south end (Location 2) that a separate description is unnecessary. These things are to be noted. 1. The crack between the north tier of windows is wide and serious. 2. Not only are the sawed stones of the angle weathered as those in Location 2, but also several of the sawed blocks around the windows and one around the door are spalling off thin sheets because they have been placed with bedding vertical.

#### Location 4.

Below the belt course 40% of stone weathered from  $\frac{1}{4}$  -  $\frac{3}{4}$  of an inch, some spalling but mostly a gradual grain by grain wasting away. This has been aided, I think, by a green scum which looks like a fungus growth.

On the whole the wall above the curb is in better condition than any other part of the building. There are some cracks between the windows and below the windows; in each case the stone is discolored and weathered from  $\frac{1}{4}$  -  $\frac{3}{4}$  of an inch deep. Also some of the sawed stones set in the corners have been weathered to a depth of  $\frac{1}{4}$  of an inch. However this has not been a spalling with subsequent exposure of weaker layers; it has been just a slow gradual weathering and a firm face is still exposed to the elements.

#### Location 5.

Here the base of the belt course is level with the ground and weathering

which is confined in the main to the area 18 inches to 3 feet above the top of this belt course is due to splash water and to water drawn up by capillarity from melting snow on the top of the belt course. 35% of this 18 to 24 inch band is affected to a depth of  $\frac{1}{2}$  an inch, but in 6 or 8 blocks to a depth of 1 inch. Both horizontally and vertically bedded stones are affected, but the horizontally bedded are affected to a greater depth, especially along poorly cemented laminations.

Below the windows, weathering and discoloration are marked; the average depth of decay is estimated at  $\frac{1}{2}$  an inch. The small curbs above the windows in the central part of this location do more harm than good in protecting the stone, for snow lodges there and as it melts, the water is drawn up by capillarity to do effective weathering in the stone.

Sawn blocks around windows and corners are slightly weathered, but still present a firm surface.

No efflorescence.

Discoloration only under windows and around fire escape.

#### Location 8.

Weathering most marked in lower 18 inches just above the belt course. 35% affected to a depth of  $\frac{1}{2}$  inch or more; in about a dozen blocks the depth reaches an inch. The texture of the more weathered stone is very fine grained and appears very silty. Weathering proceeds by means of the spalling of thin sheets. These sheets spall parallel to the wall, and the relation of the bedding planes is of little consequence.

Areas under windows are discolored and weathered to a depth of  $\frac{1}{4}$  -  $\frac{1}{2}$  an inch.

The area between the SE corner of the building and the southernmost tier of windows is weathered from top to bottom to a depth ranging from  $\frac{1}{4}$

to  $\frac{1}{2}$  an inch, but with a few blocks affected to  $\frac{3}{4}$  of an inch. All the stones except a few more red and more coarse grained are weathered. This weathering which is a combination of small pieces spalling and a leaching of the cement seems due to a defective down spout.

One or two of the sawed blocks in the angle are beginning to spall quite noticeably.

### South Hall

South Hall was constructed in 1855. The excellent condition of most of the stone speaks well for the lasting qualities of the Madison sandstone for building purposes. This building is the same size and shape as that of North Hall; so no sketch map is presented. The location numbers correspond.

The sandstone has been placed in the wall with no particular care to have the bedding planes in horizontal position; the sawed blocks which are placed at the corners and around the doors and windows almost always have their bedding vertical.

The stone is in blocks roughly square and, in general, of larger size and more smoothly finished than are the blocks in North Hall.

As in North Hall there is a belt course 8 inches thick  $2\frac{1}{2}$  feet above ground level on the east side and at ground level on the west side of the building. This belt course appears to be Trenton dolomite. It is, except on the west side, effective in preventing the flow of capillary water in the wall above it. This belt course projects from the wall and is not grooved on its under side.

### Location 1. South end.

The foundation stone below the belt course is Madison sandstone. It is laid up in even courses 8-10 inches thick and unlike North Hall, the beds have been laid in horizontal position and as a result have withstood

weathering action much better. While 60% of the rock shows slight grain by grain weathering to a maximum depth of  $\frac{1}{2}$  an inch, the more serious spalling off is seen in less than 10% of the surface. This spalling is confined to beds laid in vertical position and is most marked in the blocks which have numerous silt-filled worm tubes.

Above the belting course, weathering and discoloration are seen below several of the windows. The depth of weathering ranges from  $\frac{1}{4}$  to  $\frac{1}{2}$  an inch and is causing noticeable spalling in several of the vertically placed stones. A groove on the lower side of the projecting sills would no doubt have eliminated much of this weathering.

On the south side of the southeast corner, a band varying from  $2\frac{1}{2}$  to  $4\frac{1}{2}$  feet in width is weathered from the top to the bottom of the wall. The depth of the disintegration ranges from  $\frac{1}{4}$  to  $\frac{1}{2}$  an inch, but in several cases spalling has taken place and the depth of weathering has reached  $\frac{3}{4}$  of an inch. This spalling is seen in the vertically laid beds and is much more conspicuous in the tool smooth blocks than in the squared blocks of the corner. This is no doubt due to the greater ease with which the water could penetrate to the weaker more silty layers on the rougher surface of the tooled stone. This weathering band is conspicuous because of its lighter yellow buff color. Even mortar is gone in places. This perhaps to defective down conduit.

With these exceptions, the south wall is in splendid condition; the wall is almost entirely unweathered and the nearly 80 year old marks of the stone mason on the blocks are still well defined.

#### Location 2, East Wall, south half.

Weathering is confined mainly to the area below the belt course. Here 80% of the stone is weathered to a depth ranging between  $\frac{1}{4}$  and 1 inch. In two or three bad cases decay has gone back over two inches in the stone.



The type of weathering is mainly a spalling off? in thin sheets. This no doubt is mainly due to freezing and thawing, for horizontally laid beds are as badly affected as the few vertically laid beds. The stone has been tooled with a bulge between the mortar joints thus:



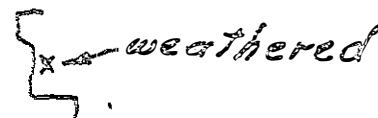
The under side of this bulge (x) is especially affected.

Beds which have been weathered worst are of finer grain and higher silt content.

Beds with silty splashes and with silt filled worm tubes are the least resistant.

Below the windows weathered areas are common but not universal. The area affected does not extend over a foot below the sill and in only two or three cases is the estimated depth over  $\frac{3}{8}$  of an inch. In the instances low enough to be seen clearly, the deepest weathering has been due to spalling from interior weak layers of vertically laid blocks.

The large sawed blocks over the door and about half of those over the windows in the north half of this location are beginning to spall slightly; as yet the depth penetrated is less than  $\frac{1}{4}$  of an inch. This weathering seems to be due to the projections at the top of these stones.



With these exceptions the wall is in excellent condition; only half of the windows have cracks below them.

#### Location 3, North $\frac{1}{2}$ of East Side.

Conditions in Location 3 are so similar to those in Location 2 that a separate description is not necessary. Below the belt course the area affected by weathering is 35-40% of the total. Of this, it is estimated, that in less than 15% has the weathering exceeded  $\frac{1}{2}$  an inch. The causes and effects are

described under 2.

Location 3 is well covered with ivy vines and Location 2 is not. In a few blocks it appears as if these vines had been responsible for a very thin weathered zone. The uncertain evidence and slight depth of the weathered zone it may have caused, should not condemn the planting of ivy.

#### Location 4.

Below the belt course the estimated per cent of weathered material is placed at 50%. The depth penetrated usually is less than  $1\frac{1}{3}$  inch and not more than 1 inch.

Below the windows the stone is weathered to a depth up to  $\frac{1}{2}$  an inch. This is usually confined to the first course of stone below the sill.

On the east edge of the north side a weathered band extends with a few interruptions from the base to the top of the wall. This band is less distinct than the one on the SW corner described under Location 1. However many of the blocks here have lost their former shell and are slowly losing sand, mostly grain by grain; spalling is not marked here.

A large mass of ivy in the central portion of the north wall has had no ill effects on the stone.

#### Location 5.

On this side of the building the base of the belt course is at ground level. The area most affected by weathering is the two feet just overlying this belt course. Here 50% of the stone is affected to a depth of  $\frac{1}{4}$  to 1 inch. Depth greater than  $\frac{1}{4}$  an inch are not common and are confined to very fine grained more silty blocks whose position seems to have little influence on the rate of weathering. The more weathered stone is not even in color, texture or cementing; it is blotched, fine-grained light pink sand separated by areas of yellow silt that has practically no cementing material. The author has observed beds of identical type in some of the

quarries near Madison. It has been taken from a bed too low to produce good stone. The weathering has proceeded by spalling parallel to the wall and has affected both vertically and horizontally placed blocks.

As usual areas under the windows are somewhat discolored and weathered up to  $\frac{1}{2}$  an inch in depth.

On the whole this location does not present as firm and unweathered a face as do the previously described areas. This is seen in the slight disintegration of 10-15% of the blocks in the wall and in the sand stone above and below the windows. Half of the sills and about as many of the capping stones above the windows show weather<sup>ing</sup> to a depth estimated at from  $\frac{1}{8}$  to  $\frac{1}{4}$  of an inch. The greater amount of weathering on this side is probably due to the more frequent freezing and thawing on this west exposure.

Some discoloration is seen below where parts of the fire-escape enter the wall.

#### Location 6. South end of west wall.

The weathering effects in the two feet just above the belt course is much less noticeable than in Location 5. Here the percentage of stone affected is estimated at 15-30% and in only two or three blocks has the depth penetrated exceeded  $\frac{3}{8}$  of an inch. The most conspicuous weathering has been a spalling of thin sheets due to silty laminations in vertically laid blocks, and this is the only type of weathering that has gone to any appreciable depth.

Areas under the windows have been somewhat weathered, but with the exception of those on the lower floor where a depth of weathering of half an inch is common, especially in the first course, the upper windows show less weathering beneath them than in any other location.

The sand blocks in 50% of the sills is starting to weather. This seems to be controlled by silty layers in the stone; the depth of decay does

not exceed  $\frac{1}{4}$  of an inch. Portions of the large squared blocks that cap the windows and the door show spalling  $\frac{1}{8}$  -  $\frac{3}{8}$  of an inch deep in half their number. This slight spalling and also discoloration are more marked in those which have a projecting top.

At the south end of the west side the area behind the down spout has taken on a very dark, smokylike color. Between this discolored band and the southernmost tier of windows a weathered zone extends from the base to the top of the building and is made noticeable by its lighter fresher color. The average depth penetrated is estimated at  $\frac{1}{2}$  of an inch. Spalling off to that depth is conspicuous on the squared stone that is vertically laid on top and on the south side of this tier of windows.

Half way up the wall between the fourth and fifth tier of windows (counting from the south end) a similar band extends to the top of the wall. This area is less continuous and less deeply weathered than the area described above. With these exceptions and a slight discoloration below the fire-escape, which, however, does not affect the weathering of the stone, this wall is in good shape.

After a study of North and South Walls, the following suggestions seem to the point.

1. Whenever water gets in contact with the Madison and freezing and thawing take place, the rock decays. To remedy this the following suggestions are made:

- A. The belt course should be at least 5 feet above the ground on all sides.

- B. The belt course and all window sills should be grooved on the under side.

- C. Madison sandstone should not be used for foundations below the

belt courses.

D. Drain pipes should be kept in good condition at all times.

E. Capping stones with a curb or projection over windows weather more readily than flat capping stones set flush with the walls.

### Biology Building.

The Biology Building completed in 1916 is constructed of the Madison sandstone. The sandstone is laid up in regular courses 12 inches in thickness. All the stone has been tooled to give a slightly roughened surface, and a relatively smooth  $\frac{1}{2}$  inch border has been chiseled around each stone. The stone is set in two ways, with the entire face flush with the surface and also (around the ground floor) with a  $1\frac{1}{2}$  inch groove an inch deep at the top of each course.

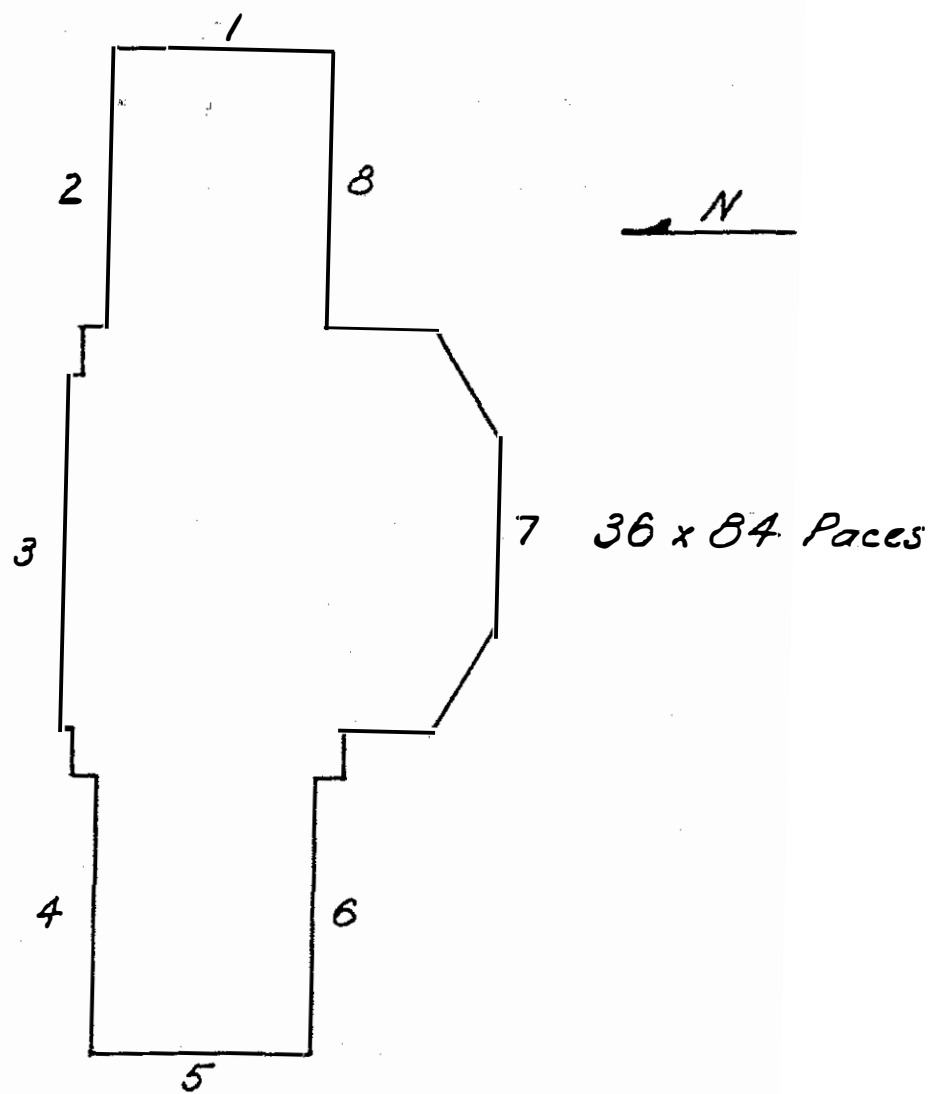
Because of the cut of the stone it is in most cases impossible to see where the bedding planes lie. However at the corners it appears that the Madison has only been used as a facing about 6 inches thick. This thickness and the depth of the courses of twice that would seem to indicate that most of the stone is laid in vertical position.

There is a considerable quantity of cut stone from the Madison which is used around the doors and windows, as well as in ornamentation and in several belt courses.

In general the stone is in excellent condition. Exceptions to this are found mainly on the under side of projecting belt courses of cut stone.

The west end of the building is laid up with cream colored brick, and the greenhouses and other additions prevent a close examination of the stone on the south side.

BIOLOGY BUILDING



Location 1. East End.

At this end the worst weathering is found in the two lower courses.


The Madison is in contact with the ground on the south half, but is somewhat protected from capillary water on the north half by a side walk. Weathering from splash water seems most effective, for in the north half 70% of the stone in the second course is weathered from  $\frac{1}{4}$  to  $\frac{3}{4}$  of an inch. The decay has gone on by spalling and has been due to small pockets of silt which are unsemented. The first course is little affected. On the south half of this and 30% of the lower two courses has spalled off in a similar manner. Aside from this and the exceptions noted below, this wall is in very good condition.

1. Two of the three smooth-out window sills on the first floor are weathering along horizontal silty laminations. This has been patched with mortar in one instance.

2. Three of the four smooth-out columns between the second and third floors show weathering to a depth estimated at  $\frac{1}{4}$  of an inch at their bases.

3. In spite of the grooving the under side of the belt course at the top of the first floor is spalling slightly. The depth penetrated appears to be  $\frac{1}{8}$  to  $\frac{1}{4}$  of an inch.

4. The two projecting belt courses near the top of the building are discolored on their outer side and in spite of the grooving are beginning to spall off on their under side. Depth could not be



estimated from the ground.

Location 2.

The lower courses are protected here by a cement gutter and the stone is unweathered except for a small area (less than 5% of the basement course) on the east end. Here an area 8 feet long and 2 feet high, half of it behind some bushes, has spalled off  $\frac{1}{4}$  to  $\frac{3}{4}$  of an inch. Here again silty layers



have done the damage. The worst block carries numerous small patches of silt which are practically unaccounted.

An unfavorable factor is seen in the numerous and rather wide cracks which parallel the wall and are observed in the recesses occupied by windows. These are shear cracks and indicate either that the facing was not thick enough to support its own weight or there has been a settling of the foundation.

40 % of the outward convex belt course just below the first floor windows has been weathered to an unknown depth and has been patched with mortar. This patching has been very effective and has not weathered out as one would expect it to.

The regular courses in the first floor wall in this location are in excellent condition.

The upper belt course between the first and second floors is slightly discolored and 80% of it is weathered about  $\frac{1}{8}$  of an inch in depth. Just above this there is a zone 18 to 24 inches wide, including the first two regular courses and the window sills in which 40% of the stone has spalled slightly. This is probably due to capillary water working up from the projecting belt course just below.

The course of the second and third floor walls is in excellent condition. The projecting belt course between the third and fourth floors is badly discolored on its outward margin and in spite of the groove the lower portion of this belt course and over half of the course just below are spalling off noticeably.

The fourth floor stone appears in excellent condition. The projecting belt course near the top of the building does not project outward as far as the one just mentioned, but it shows the same weathering effects, although to a slightly less extent.

### Location 3.

In the angles of the wall just east of the entrance steps, in behind the bushes, the greater part of the wall is in contact with the ground so that capillary water could be drawn up. However, weathering here has not been very effective; less than 25% of the blocks in the two lower courses has been affected and the depth penetrated does not exceed  $\frac{3}{8}$  of an inch.

In the central, set out, portion of the building one finds the first course above the cement steps in poor condition. This is a smooth cut course, with small groovings, and 70% of it, especially those blocks nearest the doors, is weathered to a depth of  $\frac{1}{8}$  to  $\frac{3}{4}$  of an inch. These blocks seem to be laid with their bedding in horizontal position; the weathering is due to spalling along more silty laminations. This course is set out  $\frac{3}{4}$  of an inch beyond those just above. No doubt water coming down the faces has entered and attacked this course with greater ease because of this setting out. With this exception all the first floor wall is in excellent condition.

The upper two belt courses between the first and second floors are considerably discolored, having taken on a greenish black coating which may be a fungus growth; aside from the discoloration the stone is but slightly weathered.

The cut stone around the windows and in the columns and the regular courses on the second and third floors is in excellent condition except for the foundation stones of the columns. These have been attacked in every instance, the depth of decay ranging from  $\frac{1}{4}$  to  $\frac{3}{4}$  of an inch. The weathering has caused spalling which is no doubt due to small pockets or layers of silt.

For a description of the weathering in the two projecting belt courses and the fourth wall, refer to the description under Location 2. The same weathering effects are seen here.

#### Location 4.

##### West End of North Side.

The courses of the basement wall on this end of the building are protected from capillary water by a cement gutter. However, 40% of the stone in the lower two courses is very noticeably weathered. It seems likely that some of this is due to splash in this gutter. The very lowest course is but slightly affected; the maximum effects are seen 1 to 2½ feet above the gutter. The depth of decay ranges from 1½ inches downward but fully 70% of the weathered zone is ¾ of an inch deep. The beds here are set in vertical position and the weathering in most cases has been a spalling off due to the presence of silt. This silt occurs mainly in small lenses rather than in definite layers so the spalling removes small pieces and leaves a roughened surface. Blocks with silt filled worm borings are also seriously affected. In a few blocks weathering of a different type is noted. In these the cement has been leached out and as one gently rubs the surface, a quantity of fine grained sand detaches itself and falls to the gutter below. Weathering of this type is not as serious as the spalling, because it goes on less rapidly and it still presents an even and relatively strong surface to the elements.

The remaining courses in the basement wall are in fair condition; the sheer cracks like those noted in Location 2 are much less frequent and are much narrower here. The convex outward belt course between the basement and first floor is discolored but is less extensively weathered than the

same course in Location 3. That decay there is, has been effectively patched with mortar.

The regular courses of the first floor wall are in excellent condition, as are those of the second, third, and fourth floor walls.

The projecting belt course between the first and second floors is somewhat discolored but is not noticeably weathered. The grooving beneath this layer effectively prevents weathering in the building layer just below. Thus:



The large squared blocks which form the sills of the second floor windows show lines of weakness, probably along silty partings, and in most of the sills and in many of the course stones at the same level, small areas have weathered out  $1/8$  -  $2/8$  of an inch.

The condition of the projecting belt courses above the third and fourth floor windows is similar to that described under Location 3.

#### Location 5.

The foundation courses below a 6 inch belt course of Bedford Limestone are of Madison sandstone. All of the wall above is of cream colored brick and is in excellent condition.

The foundation is of 14 inch courses of Madison placed in vertical position. While the sandstone is seen to rest on a cement footing on the southwest corner, soil is in contact with the sandstone in the greater portion of this end of the building.

30% of the stone is decayed to a depth of  $\frac{1}{4}$  to  $\frac{3}{8}$  of an inch due to thin silty lenses parallel to the bedding. There is some weathering in the courses that are in contact with the soil, but the course just below the

limestone belt course is the most seriously affected. This belt course projects out  $1\frac{1}{2}$  inches and has a shallow groove on the lower side, but in spite of this, water has collected on this limestone layer (it extends 15 inches beyond the brick wall above) and has reached and attacked the sandstone below.

#### Location 6.

The lowest course of sandstone in the sub-basement wall is laid on a concrete footing, but the soil comes in contact with the sandstone in the eastern half of the wall. In this eastern half 90% of the lowest course is weathered to a depth of  $1\frac{1}{8}$  -  $5\frac{1}{8}$  of an inch. The western part is, on the other hand, in good condition, and clearly brings out the advantage of keeping the soil away from this stone.

With the exception just noted, the sub-basement and basement walls are in good condition; the convex belt course has been effectively patched with mortar.

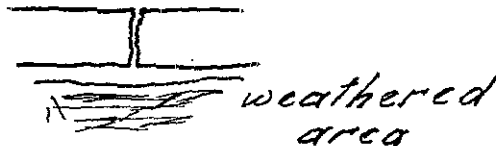
Three of the seven second floor window sills show the beginnings of weathering, and small areas below the third floor window sills have been attacked. These areas do not seem to extend more than 6 inches below the sill. The depth decayed ranges downward from one inch. Otherwise all the wall is in good condition, except the two high up projecting belt courses which show the same features as described before.

#### Location 7.

The regular courses of stone in the Biology auditorium are in good condition. Small spalled areas are seen in the lower two courses.

The most conspicuous decay is seen in the belt courses. In the belt courses between the first and second floors the bulging course is

spalled off from  $1/4$  to  $1/2$  an inch where mortar has weathered out of the joints in the bed just above. 15% of the stone has been decayed.



Sills of several of the second floor windows are spalling slightly along probable silty layers.

The projecting belt course or cornice at the top of the auditorium is weathered and discolored in the manner previously noted for the higher projecting belt courses.

#### Location 8.

Most of the lower portion of the basement wall here is covered by an addition. Where seen, the wall even in the lower courses is in good condition for the soil does not make contact with the sandstone.

Convex belt course is effectively patched with mortar. First floor wall is in very good condition.

The bulging belt course is in good shape except in two small areas below joints which have since been filled up. The course just above is somewhat pitted and just starting to spall slightly.

The second floor window sills and the course stone at the same level have spalled off to a depth up to an inch, but generally below  $1/2$  an inch. 35% of the stone in this course is affected. All the second floor window sills seem to have been taken from the same bed and in their central part they have a weak zone, probably due to silt. The weathering of this zone can be seen in nearly every sill.

The second and third floor walls are in good condition except for small

areas under the window sills where a zone 4-6 inches wide is decayed up to 1 inch deep.

Window sills on the north side of the building do not show this weathered zone beneath as the sills on the south side do.

The projecting belt courses above the third and fourth floors are like those already described.

#### Administration Building

There are two wings in this building, an older north wing and a south wing. I was not able to find the date of construction of this building.

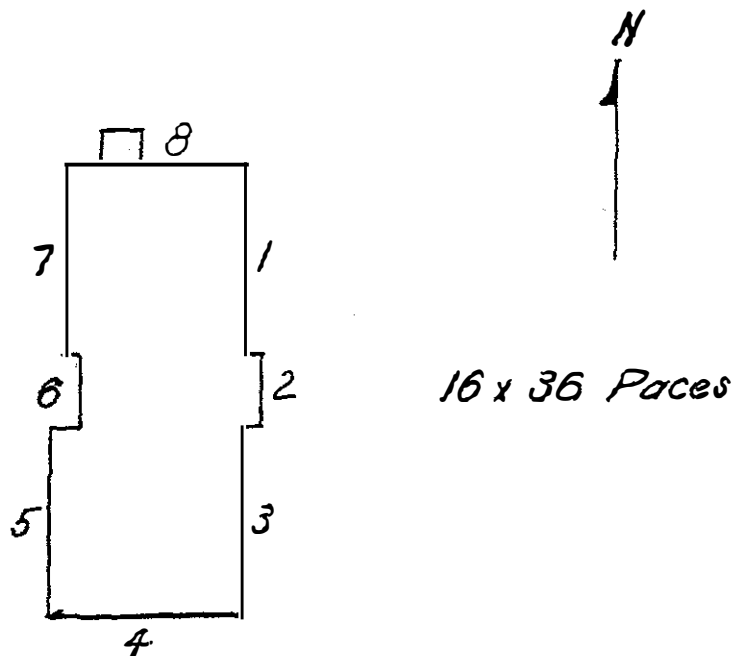
The stone used is the Madison limestone laid up in regular 10 inch courses. The stone is used as a facing about 6 inches thick, and, as far as I can tell, most of the beds are placed in vertical position. This statement cannot be made more positive because the stone is massive and bedding is obscure and the finishing of the stone obliterates the bedding still more.

In the north wing the stone was tooled to a fairly smooth surface, but the  $1\frac{1}{2}$  inch chiseled border on each stone that is seen in the central and southern parts was omitted.

In general the stone in the south wing is in excellent condition, the central part is in fair to good shape, and the north wing is considerably weathered.



Administration Building



Location 1. East Side North Wing.

Below the 7 inch belt course of Madison sandstone, the foundation is made up of a 12 inch course of Madison laid on edge and below this part of another course is exposed before the soil level is reached. Fully 75% of this 12 inch course is badly spalled off to a depth of  $\frac{1}{2}$  to 1 inch. Weathering is in the form of thin sheets spalling off due to silty lenses and is facilitated by capillary water drawn up into the wall. The belt course shows decay in 80% of its length to a depth of  $\frac{1}{4}$  to  $\frac{3}{4}$  of an inch. This is confined to the lower part of this course except in <sup>two</sup> blocks which show numerous worm tubes. These, while not so deeply decayed (only  $\frac{1}{3}$  an inch) are weathered on the whole face. The tubes here are resistant and the silty material weathers from around them.

Above the belt course about 30% of the stone in the wall is weathered to a depth of  $\frac{1}{4}$  -  $\frac{3}{8}$  of an inch. In this 30% are included several

scattered blocks in the wall and an irregularly weathered band, just south of the down spout, which extends from the base to the top of the wall.

Areas under the windows are not especially attacked. However, the cap stone on the lower window, third from the north, is cracked and badly weathered. It should be replaced.

#### Location 2.

This central portion apparently was built in two parts, for half the foundation below the belt course is concrete, while the north half is sandstone; also a vertical crack in the wall suggests a settling of the newer south portion. In the 12 inch foundation course, weathering in the form of spalling of thin sheets has affected 80% of the stone to a depth of half an inch.

The belt course is essentially unweathered. The wall above shows scattered blocks weathered to a depth of  $1/8$  to  $1/4$  of an inch. The cap stone, sill, and several nearby blocks around the north upper window have decayed and spalled off  $1/4$  to  $1/2$  an inch.

#### Location 3.

The lower belt course of Madison rests on a concrete foundation and is essentially unweathered, as are the next three courses above. Above these a 4-inch belt course is set out slightly from the wall and is slightly ( $1/8$  of an inch) weathered in a few places along its lower edge. This belt course is not grooved below.

It is estimated that 8% of the first floor wall is weathered  $1/8$  to  $3/8$  of an inch deep; two or three blocks show a depth of weathering of  $1/8$  to  $3/4$  of an inch. The greater part of this weathered area is found beneath the ungrooved window sills; the remainder is in scattered blocks. Here again the worst decay has taken place in a mottled stone of uneven texture. There

are patches of firmly cemented fine grained light pink sandstone distributed in a matrix that is composed of good stone mingled with bright yellow silt. This silt weathers quickly and releases the other sandstone.

The cap stones over the first floor windows have a projecting ledge at the top and in half the windows the stone below the ledge is beginning to spall off. So far the weathering has not proceeded deeper than  $1/4$  of an inch.

The stone in the second floor wall is in good condition, the areas below the windows are protected by a belt course just below the sills, and no more than three blocks can be seen where the surface has been broken through by weathering.

#### Location 4. South End.

There is very little decay below the second belt course. Blocks under the first floor window sills have weathered  $1/4$  to  $3/4$  of an inch deep in a zone 4 to 8 inches wide below the base of the sills. Weathering is chiefly due to silt filled worm tubes and silty lenses. The only block which has withstood the weathering in this position is one of slightly coarser grain size that is firmly cemented and seems to be low in silt. The rest of the wall is in excellent condition except for about a third of the blocks in the course just below the belt course which separates the first and second floors. Here water working below the belt course has weathered the rock to a depth of  $1/4$  to  $3/8$  of an inch.

The second floor wall is in only fair condition, though the weathering at present is in small pits, the outer shell has been broken through and spalling will take place in several areas before very long.

#### Location 5.

In the courses including and below the second belt course, weathering

has not affected the wall in this location. Areas under the first floor windows are for the most part firm.

15-20% of the stone in the two courses just below the third belt course has weathered to an average depth of  $1/4$  of an inch.

About 12% of the stone in the second floor wall here seems pitted to a similar depth.

#### Location 6.

Weathering is confined chiefly to lower two courses here. The depth of the weathered zone is between  $1/4$  and  $1/2$  an inch and 75% of the stone in these two courses is so affected. The remainder of the wall is in good condition considering its age. A renewing of the mortar in the joints here has aided in the preservation of the stone.

#### Location 7. West Wall. North Wing.

The base of the lowest belt course here is at ground level, but the stone in it is in good condition. In the first two courses above this, 60% of the stone has decayed and spalled off an average depth of  $3/8$  of an inch. This seems due mainly to silty partings. Otherwise the condition of the stone may be classed as good.

#### Location 8.

The two foundation courses below the belt course are laid vertically and 80% of their area is weathered to depths ranging from  $1/4$  to  $1 \frac{1}{4}$  inches. Capillary water drawn up from the soil and spalling due to silty and poorly cemented layers seem to be the chief agent and means of weathering. The belt course is in fair condition and all of the wall above it is in good condition. The areas under the windows are but slightly weathered and there are no blocks in the wall that are in bad shape.

However, such favorable comment does not go for the vestibule on this same side of the building, the upper part of which is weathered to a depth of  $1\frac{1}{2}$  to  $1\frac{3}{4}$  inches. This upper porch or balcony is so weathered that the cut letters giving the name of the building are read only with difficulty. Drainage of the balcony is accomplished by two holes cut in the wall which are fitted with metal troughs. These do not extend far enough out but what the water running out of them strikes the walls below and has contributed to their weathering and discoloration.

#### Barnard Hall.

Barnard Hall was completed in 1912. The facing stone used in its construction is the Madison sandstone, which has been laid up in regular courses 14 inches thick. All the stone used has been roughened slightly with a  $1\frac{1}{4}$  inch chisel, except for a  $1\frac{1}{2}$  inch band around each stone that has been indented an eighth of an inch and smoothed with a toothed chisel.

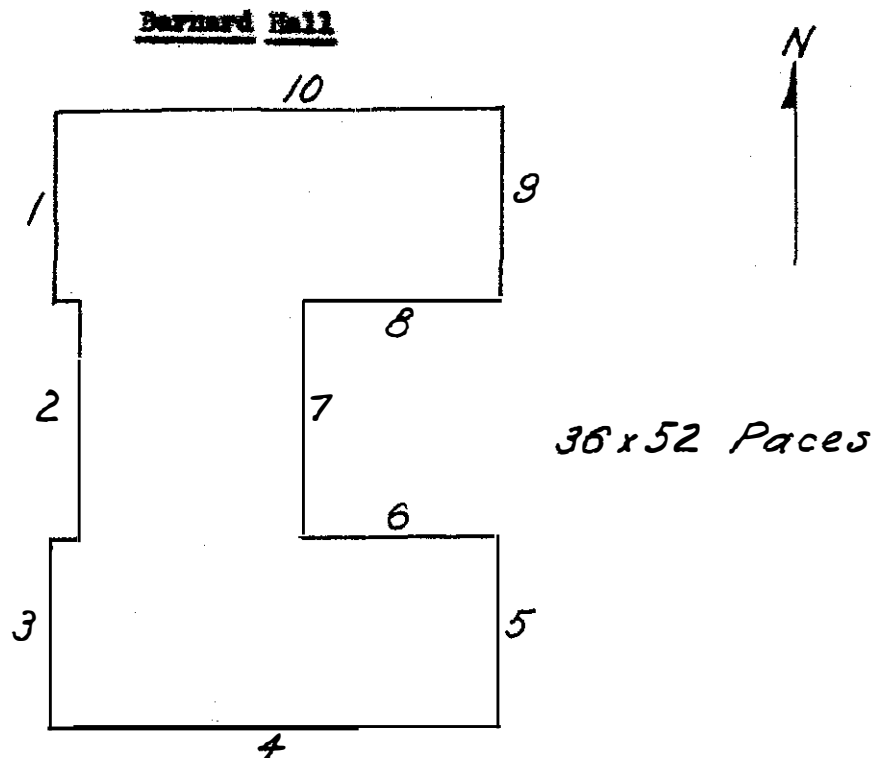
Stone in the first floor wall, on all but the back side, and at all angles in the walls has a  $1\frac{1}{2}$  inch wide 1 inch deep groove just below the joint between courses.

Thus



The building has been carefully built and in general is in excellent condition. The wide cornice has given good protection from drip water and all belt courses and window sills carry a groove on their under side.

It is not possible to state with any certainty how the beds have been laid.

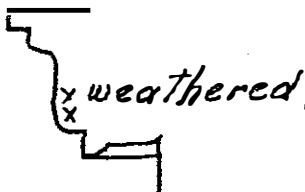


The lower courses are protected from capillary water by a cement gutter. The wall is in excellent condition; even the areas under the window sills are firm and unweathered.

About  $\frac{1}{3}$  of the window sills have decayed to a depth not over  $\frac{1}{8}$  of an inch. The central window between the first and second floors has an ornamental cap stone that projects out 10 inches from the wall and the sill also projects from the wall. Beneath the overhanging part of this cap stone weathering has proceeded to a depth of  $\frac{1}{4}$  of an inch.

This is due to water working down from the shelf above.

The sill is even more affected, being weathered to a depth of  $\frac{1}{2}$  an inch in the lower half of the outer face and on the bottom side. An abundance of silt filled



worm tubes has materially aided this decay.

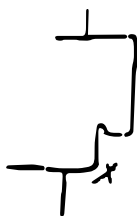
#### Location 2.

The stone in the wall in this location is in excellent condition. Only one stone in the whole area shows any appreciable weathering; that stone has begun to spall off a trifle. The lower courses are protected from capillary water by a cement gutter and walk. A third of the window sills show a slight bit of decay, never over  $1/8$  of an inch; the grooves at the base of the sills seem to be very effective, for the stone under the sills is unweathered.

#### Location 3.

Conditions here are very similar to Location 1. The wall is in excellent shape; the corresponding projecting window cap and sill are similarly weathered. There is a slight crumbling or spalling away on the under side of several of the ordinary sills, and also a few of these show slight decay on their outer surfaces.

The lower courses here again are protected by a concrete gutter. The belt course which is at a level with the first floor here is of Madison sandstone and is purely ornamental. 15-20% of this course is weathered  $1/8$  to  $1/4$  of an inch deep; this is most marked at the corners which are more exposed. Also the thin belt course just below is considerably weathered in spite of the grooving in the layer just above. Here about 40% of the stone is affected to  $1/4$  of an inch. This is a part of the same course.





#### Location 4.

The lower course rests on a concrete footing throughout the greater length of this side and is in excellent condition, as are all the courses until the first belt course is reached. While the outer face of this course is unweathered except for a few blocks where silt filled worm tubes have weathered out  $1/8$  of an inch, the under part of this course (see sketch, Location 3) is weathered to an average depth of  $1/4$  of an inch over 75% of its length. The decay has taken place by spalling due to silty pockets, lenses, and filled worm tubes. Two or three of the smooth cut blocks in the next two courses are decayed to a depth of  $1/8$  of an inch, mainly in silty portions around worm tubes.

The stone on the outer face, and more especially on the under side of the small balcony on the second floor, has spalled off to a depth of  $1/4$  to  $1/2$  an inch. The course of stone in the wall at this same elevation is set out about an inch from the courses above, and in it 25 - 30% of the stone is lighter in color and shows decay not more than  $1/4$  of an inch deep.

The window sills are in good condition except on their under side where 30 - 40% of them show spalling up to  $1/4$  of an inch. For the first time one observes that the areas under the sills have begun to deteriorate. The band is narrow (3 inch maximum) though in some cases the depth penetrated reaches  $1/2$  an inch. 20 - 25% of the first, second, and third floor windows are so affected.

With these minor exceptions the south wall is in good condition.

#### Location 5.

Lower courses rest on concrete footing and are in very good condition up to the first belt course except near the corner near the down spout where

seven or eight blocks show spalling due to silty patches to a depth of  $1/4$  -  $1/2$  of an inch. While these are near the drain pipe, there are none directly in back of the pipe; so it seems doubtful if this decay is due to a defective pipe.

The under portion of the first belt course, as in locations 3 and 4, is weathered here to a depth of  $1/4$  -  $1/2$  an inch over 30% of its length. The outward face of this same course is in satisfactory condition, although somewhat discolored.

The balcony on the second floor shows weathering similar to that described for the balcony in Location 4.

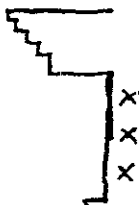
Vines cover so much of this wall that it is impossible to see very much; however, the wall, sills, and areas under the sills all appear to be in very good condition except for a few blocks near the drain pipe above and below the belt course between the third and fourth floors. This dome spout should be examined closely; I think it is in need of repair.

#### Location 6.

With the exception of the first belt course which shows spalling on its lower side and very slight weathering in part of its outward face, and a little spalling on the under side of about a third of the window sills, the wall in this location is in excellent condition.

#### Location 7.

The ornamental group of stones which form the capping over the door and also the second floor balcony are weathered  $1/4$  -  $1/2$  an inch deep. The under side of the projecting ledge is not as much affected as is the vertical face just below. However, in the projecting ledge which caps the second floor window just above the main entrance, the under side of the stone is weathered  $1/4$  to  $1/2$  an inch and further spalling is to be expected. One large smooth cut block



in the belt course just below the windows of the first floor is spalling to a depth of  $\frac{3}{8}$  of an inch on account of silty laminae parallel to the wall. The foundation stones around the doorway are nearly all weathered  $\frac{1}{8}$  to  $\frac{3}{8}$  of an inch from the surface. Splash water falling on the steps probably accounts for this.

Aside from these minor things noted above, the wall here is in excellent condition.

#### Location 8.

Three-fourths of the sills on the first, second, and third floors show some spalling off on their under sides; the depth does not exceed  $\frac{1}{4}$  of an inch. 40% of the sills show a slight amount of disintegration along more silty portions. This is usually about  $\frac{1}{8}$  of an inch deep and never exceeds  $\frac{1}{4}$  of an inch. Below one sill an area 3 inches wide, 12 inches long, and  $\frac{1}{4}$  of an inch deep has disintegrated.

Otherwise the entire wall is in excellent condition.

#### Wall at East End of Court.

The much weathered wall at the east end of the court shows well the weakness of the Madison sandstone when freely exposed to the weather. In this wall it is exceptional to find blocks decayed less than  $\frac{1}{4}$  of an inch deep. In most cases the weathered portion is  $\frac{1}{2}$  to  $\frac{3}{4}$  of an inch deep, and in a few cases areas have been penetrated to a depth of  $1\frac{1}{2}$  inches.

#### Location 9.

Lower course rests on concrete footing and the wall is all in good condition up to the first belt course. In this layer  $\frac{1}{2}$  the length on the inner side is weathered  $\frac{1}{4}$  -  $\frac{3}{4}$  of an inch deep and in the outward face half the blocks have had their more silty laminations (less a  $\frac{1}{3}$  of the area

Besides this lower course already mentioned, weathering is conspicuous

penetrates the stone directly.

of the building, soil has been graded up over this course so that water may of Madison is frequently rather deeply weathered. In the back (North) wall not prevented the flow of capillary water, the lower part of the first course set out 4 inches and forms a shelf where some may lodge, or because it has stone of the Bedford collitic limestone. Either because this limestone is joint between courses. The lowest course is laid on a foundation of one floor course a 1 1/2 inch groove one inch deep has been cut just below the and stories above the first are laid flush out to the wall, but in the first of courses such as are seen at Harvard Hall are used here. The basement sandstone, which is laid up in regular courses 16 inches thick. Two types Lathrop Hall was completed in 1909. The facing stone is the Madison

#### Lathrop Hall.

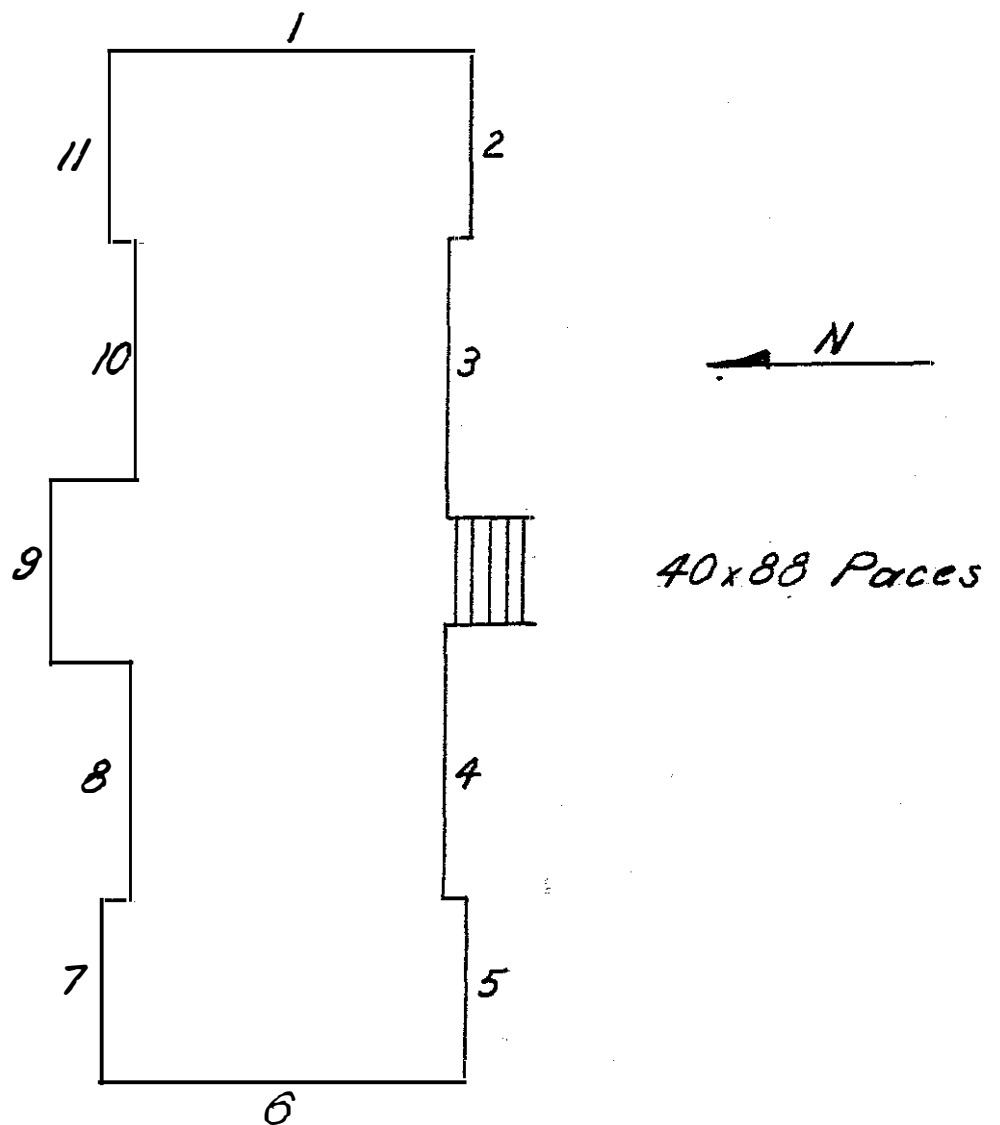
that this wall is in excellent condition seems completely justified. north wall, their area is less than 1% of the total; so the generalization Although there are a few blocks which have spalled off slightly on this

#### Location 10 (North Wall).

these exceptions the stone of this wall is in excellent condition. Two of the sills show slight spalling at their lower corners. With same window has also been attached to a depth of 1/8 to 3/8 of an inch. of the stone accounts for this weathering. The upper 1/2 of the sill of this water from the shell above working down and attacking the most alloy portions window sash just below is weathered to an average depth of 3/8 of an inch. The stone in the lower portion of the second floor balcony and the of each block) weathered out to depth of 1/4 - 1/2 of an inch.

on the under sides of the stone balconies in several of the belt layers and below several of the large window sills and panel sills.

Lathrop Hall.



Location 1. East End.

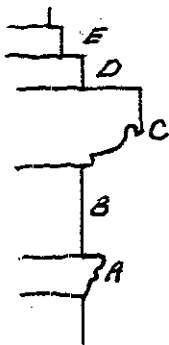
25% of the stone in the lowest course has decayed and is spalling off to depths of  $1/4$  to  $5/8$  of an inch. A casehardened shell is present here. Once this is broken through, the siltier portions weather out and the sheets of the outer shell spall off.

As attention will be frequently drawn to the various belt courses, they are here described in detail.

1. The lowest belt course is a massive one 18-20 inches thick and is set out from the wall about 3 inches. It is located at the base of the first floor.

2. The second belt course consists of five courses. These are from base to top. A- Thin course projecting about 4 inches from wall. B- A 14 inch smooth cut belt set flush with the wall. C- An ornamental belt with a design cut on the outer face, about 12 inches thick and projecting 10 inches beyond the wall. D- A smooth cut belt 10(?) inches thick, projecting 4 inches beyond the wall and E- A similar layer 6 inches thick and projecting 2 inches beyond the wall.

The final belt course is only about 3 feet from the top of the wall and is sufficiently protected by the cornice that little mention of it will be made.



The remainder of the basement wall and the first belt course are in excellent condition. In the next course above there are three or four blocks where light spots appear, indicating that the outer surface is broken through and that spalling may soon begin. I believe these could be

patched with mortar, and such a procedure is recommended. The remainder of the first floor wall is in very good condition. So is belt course 2A. The upper  $1/3$  to  $1/2$  of 2B is weathered  $1/4 - 3/4$  (?) of an inch deep over 60% of its length. Course 2C is weathered on its under side  $1/4 - 1/2$  an inch deep over 40 % of its

length. Places most decayed both here and in the course below are areas around mortar joints, several of which should be patched. Belt 2 D badly decayed along silty lamination to a depth up to 1 (1) inch over 75% of length. 2 E. 25% of blocks show weathering of similar nature up to 1/3 the depth in 2 D.

The under sides of the sills at the base of the set-in panels which contain the large windows are rather uniformly weathered to a depth of 1/4 of an inch. In the course just below, the upper six inches of most of the blocks has spalled off about 1/4 of an inch. Some of this is due to the open joints between the blocks of the sills. These should be retouched with mortar.

The lower portions of the sills themselves have almost all been attacked and have spalled off to a depth of 1/4 - 1/2 an inch. There is less decay in the course just below the sills here than in the course below the panel sills.

First courses above window sills within the panels are decayed up to 3/8 of an inch over 1/2 their area. Keystones in window arches are slightly affected.

The rest of the wall is in good condition.

#### Location 2.

Lower 1/2 of lowest Madison course in over 45% of the length has weathered by spalling due to silty spots and layers to a depth up to 1 inch. Areas below basement windows which are screened are badly discolored, blackened. The wall up to base of second belt layer is in very good condition.

Belt 2 E in its upper half and 2 C in lower portion as well as under side of balcony at same level are weathered to depth of 1/4 - 3/8 of an inch. One cause is open mortar joints which should be retouched. As much as can be seen of 2 D appears badly decayed. 2 E has little or no decay.

The lower portion of panel sill and upper 4 inches of course below are decayed in to 1/4 inch. The rest of the wall, except for five or six blocks which show light spots <sup>where</sup> surface has been broken through, is in good shape.

### Location 3.

38% of the lower half of the base course is weathered as in Location 2. Attempts to patch with mortar have only been partially successful. In half the area tried, it is holding well; in the other half, weathering has gotten in behind and has worked the mortar loose.

Remaining courses up to second belt course in good condition. Belt courses about as before described only smaller depths penetrated. The lower parts of window sills and panel sills are weathered to a depth of  $1/4$  (?) of an inch. 75% of the upper 4 inches of courses just below panel sills is weathered to a depth estimated at  $1/4$  of an inch. Course stone below window sills is affected in less than 10% of a similar area.

The rest of the wall is all right, but there are numerous cracks in the sills and the second and topmost belt courses which have had the mortar weathered out. These should be retouched.

The large balcony over the main entrance to the hall is somewhat decayed on its lower side. The depth is estimated at a maximum of  $1/4$  of an inch. This is less than in some of the other balconies, due no doubt to their greater projection and hence greater protection here. The lower  $1/2$  of the stone posts on the balcony have decayed to a depth of  $1/2$  an inch. The under part of the panel sill and half the length of the course below for 2-4 inches has weathered off  $1/4 - 1/2$ (?) an inch. The capping over the door to the balcony is slightly discolored and somewhat weathered.  $1/2$  the lower part of the sill has spalled off a layer about  $1/2$  an inch thick. The course below is not affected. The remainder of the wall is in good condition.

### Location 4.

70% of the lower  $1/4$  to  $1/2$  of the bottom course of Madison here is weathering, due to spalling off of thin sheets in front of easily attacked silt patches. The depth penetrated ranges from  $1/4$  to  $1 1/2$  inches. Here again the worst offender



is the layer with the mottled color and the <sup>abundant</sup> concentrations of silt.

The remaining stone below the second belt course is in very good condition. Belt course 2 A is weathering on the under side of its projecting upper half. The area affected is 20 - 25% of the total length, and the depth penetrated averages  $1/4$  (1) of an inch. 2 B is much less weathered here than in previous locations on this building. In the upper  $1/3$  of the course, 25% of the total length has been affected but never more than  $1/4$  of an inch deep. The under side of 2 C seems weathered  $1/8$  -  $3/8$  of an inch almost all (85 - 90%) along. Belts 2 D and E are in much better condition than in previous locations on Lathrop Hall. In 2 D three stones are deeply (1 inch  $\pm$ ) weathered along siltyl laminations. The remaining blocks in this belt course and in 2 E have some blocks slightly decayed to a depth of  $1/8$  of an inch. At present this has not gone far enough to produce any spalling off, and the lighter colored areas which hurt the appearance of the building are not seen here.

The lower portions of the panel sills in this location have weathered to a depth of  $1/4$  to  $1/2$  (1) an inch. Just below the upper 3 - 6 inches of the first course of the wall has decayed and spalled off to a depth of  $1/4$  of an inch in 50% of the area mentioned. This is due to water working out around and down from the shelf of the sill just above. It is able to do this in spite of a groove in the sill as shown.



The lower portions of the window sills, whose construction is similar to the panel sills, (see sketch above) are weathered and spalled off to a depth averaging  $1/4$  of an inch in 60% of their length. This weathering as well as a dark discoloration is most noticeable just below joints in the sill stones which have had

the mortar weathered out. These should be repaired. The course stone just below is in good condition.

In the first course of stone above the window sill there are four or five stones (about 25% of the area of the course) which are beginning to show lighter colored areas indicating that the outer surface has been broken through. The depth of penetration could not be learned from the ground. Only small portions in each block have been affected so far.

The remaining portions of the wall are in very good condition.

#### Location 5.

Basement and first floor courses are in good condition; weathering is seen in the lowest course in but two small areas that could be covered with one's hand, and depth decayed is only  $1/8$  of an inch. The mortar in several joints just east of the center line of this location, in and above and below the first belt course needs retouching.

Belt course 2 A is in fair condition. The upper  $1/3$  to  $1/2$  of 2 B has weathered and spalled off up to  $1/4$  of an inch in 60% of its length. The under side of 2 C as well as the under side of the balcony is weathered away to a depth ranging from  $1/4$  -  $3/4$  of an inch. The decay is greatest around open joints where mortar has weathered out. A band near the center of 2 D seems to be a silty layer and in over 75% of this belt's length has weathered out to depth ranging up to  $1 \frac{1}{2}$  (?) inches. This has been rather effectively patched with mortar in one block. There is a possibility that this deeply weathered band may also bear some relation to the projecting ledge just below it, for water and snow would be apt to collect there and be drawn into this layer by capillarity.

$2/3$  of belt 2 E has portions of its stones attacked to depths of  $1/3$  -  $1/4$  (?) of an inch.

All of the under side of the panel sill has spalled off from  $1/4$  -  $5/8$  of an inch, but the course wall below is not affected. The projecting splay stone over the door is discolored but is scarcely weathered at all on its under side. However, the stone just below in the door frame has spalled off to a depth of  $1/2$  an inch along its upper margin.

In the wall itself there are about twelve blocks in scattered locations which are showing light spots, some of which are small, but others of which cover a whole block. These make up only  $5\%$  of the wall, but they do show that the stone is beginning to weaken here. The rest of the wall is in good shape.

#### Location 6.

The lower  $1/3$  -  $2/3$  of the basal Madison course has weathered by spalling due to silt pockets and lenses to a depth ranging from  $1/4$  to  $5/8$  of an inch along  $60\%$  of the length of this west wall. The decay here has taken place so much it was where there is a small thickness (3 - 8 inches) of limestone between the soil and the base of the sandstone, than where the sandstone is in direct contact with the soil. It is possible that there is more abundant splash water in the one place than the other, but it also seems possible that this calcitic limestone foundation is a good sponge for capillary water.

The remainder of the basement and first floor walls are in excellent condition. The 2 A belt course is in good shape, as is 2 B except in two or three small spots below partially opened joints. The lower portion of 2 C has decayed and spalled off over the entire length to depths ranging from  $1/8$  to  $1/2$  an inch.

Approximately  $70\%$  of the blocks in the belt course 2 D have decayed to a depth of  $1/4$  to 1 inch, though depths greater than  $1/2$  an inch are only seen in one very silty block. In several of the blocks silty areas around more resistant

worm tubes are seen to be weathering out. The last belt course has decayed to an average depth of  $1/8$  of an inch over 25% of its length, but no unsightly spalling has occurred.

The panel sills have weathered to  $1/4$  of an inch on their under sides here, but the courses below and the under side of the window sills and the course below them are not affected. All the rest of the wall is in good condition. The stone is less decayed in this location than in any of the previous ones studied on this building.

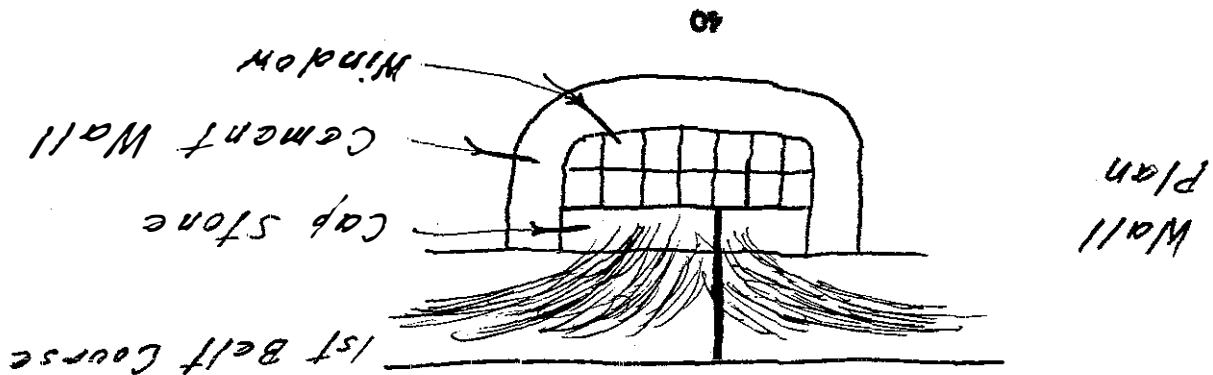
#### Location 7.

Lower courses here are protected from capillary water by the side walk. A third of the area in the massive belt course has weathered  $1/8$  to  $1/4$  of an inch due to silt filled worm tubes. The weathering has been a disintegration of small spots rather than a spalling of larger areas; so the surface, while quite rough, is still rather firm. The first floor wall is in good condition, and the amount and location of the weathered portions in the second belt courses and above is so similar to those described in Location 5 that a separate description is unnecessary.

#### Location 8.

The base of the lower massive belt layer is level with the ground in this location. It and the cap stones of the basement windows just below it have weathered and spalled off to a depth from  $1/4$  to  $3/4$  of an inch. Splash and capillary water working on siltier portions of the stone have accounted for the weathering.

Three of the five flush set window sills of the first floor show small weathered patches where the outer surface has peeled off in front of small silty patches. The depth penetrated does not exceed  $1/8$  of an inch. The remainder of the stone in first floor courses and in lower belt course 2 A



This is sketched below.

In the weathering of the lower course and the basement window capping stones.

As one stands farther back from the wall, a definite splash pattern is seen

the wall, with the exceptions mentioned, is in very good condition.

rather than spalling. Except for very rare scattered blocks slightly weathered,

weathering is due to silty patches but is better described as disintegration

the faces have been attacked to a depth of just less than 1/4 of an inch.

building, one sees the outward faces of the sills beginning to weather. 1/3 of

60% of the stone. The course below is unweathered but for first time in the

In the under part of the window sills weathering 1/4 of an inch deep affects

weathered in 60% of the zone described.

1/2 an inch. The course stone for 4 inches below is slightly (1/8 + inches)

The under sides of the panel sills are completely decayed to a depth of

There is no serious spalling here, though.

shows shallow weathered pits up to 1/8 of an inch deep in 40% of its length.

this 60% some silty laminations have decayed to a depth of about one inch. 2 B

away to an average depth of 1/4 of an inch or slightly less and in one-fourth of

In belt course 2 D, 65% of the length has been weathered and has crumbled

along, but in two blocks near the center the depth ranges up to 3/4 of an inch.

side of 2 C has decayed and spalled to a minimum depth of 1/8 of an inch all

60% of upper 1/2 of 2 B has spalled off from 1/8 to 3/8 of an inch. Under

are in good condition.

The zones of deepest weathering are in crescent shapes. The water falling on the cement walls built around the basement windows (to let in light below the level of the ground) splashes up and attacks the wall.

#### Location 8.

Although the lowest visible course of Madison is at varying elevations in this location, the course nearest the ground is in 60% of the cases considerably weathered by spalling due to salt effloresces. The depth penetrated ranges from  $1/4$  to  $3/4$  of an inch.

The courses of the first floor and the belt course 2 A are in excellent condition. On the east and west sides here the upper  $1/3$  of 2 B has been attacked up to  $1/4$  - of an inch in 60% of its length, but on the north side 80% of the whole area has been weathered  $1/4$  to  $1/2$  an inch. This is especially noticeable under the balcony.

The balcony itself shows conspicuous weathering on its stone posts and in the lower sides of the stones at the ends of the balcony. In these two places the average depth affected is  $1/2$  an inch. On the under side of the main portion, weathering to a depth of  $1/4$  an inch is seen in the ornamental bracing stones and also around the joints between the slabs of the balcony floor.

80% of the stone in 2 B showed weathering from  $1/4$  to  $3/4$  of an inch deep. The weathering is <sup>found</sup> mainly in the central portion of the course and seems to be due to a silty layer. The upper belt course 2 B has not been so vigorously attacked. Not over 80% of the area is decayed, the depth is less than  $1/4$  of an inch, and there has been very little spalling.

The under side of the panel sill has decayed to a depth of  $1/4$  of an inch, as has most of the first course just below it. In this course water running down from the sill has been aided by splash and capillary water from the balcony just below. The frame of the door to the balcony is all in good condition, though the top stone is somewhat discolored.

The window sill is slightly weathered on its outward face and on the under side decay has worked in  $1/4$  of an inch. The remaining wall is in good condition, except for a few light blocks where shallow decay has set in until the highest belt layer just below the roof is encountered. In this belt layer a couple of blocks have spalled to a depth of  $1/4(?)$  of an inch, and three to four blocks in the first course below have weathered out to a depth of  $1/4-1/2$  an inch. This decay is probably due to a defect in the roof, for at present water is dripping from inner portions of the cornice.

On the east and west sides in the location, the walls above the second belt course are in excellent condition.

#### Location 10.

In this location the soil comes in contact with the lowest visible courses of the Madison; so capillary water can be drawn up. However, as the most weathered portions are in a zone 6-18 inches above the ground, it seems likely that splash water is the most important weathering agent. The percentage affected in the zone mentioned is fully 75%, and the depth ranges  $1/4 - 3/4$  of an inch. Stones with silty patches or with silt filled worm tubes are the most easily attacked. Stones above this zone to the second belt course are in excellent condition.

From what can be seen between the vines, the following estimates on the belt courses are made:

2 A - Condition very good

2 B - Upper  $1/3$ , 50% weathered to depth of at least  $1/8$  of an inch.

Under side of 2 C decayed and spalled off to a depth of at least  $1/4$  of an inch over 75% of its length.

60% of 2 D shows decay from  $1/4$  to  $3/4$  of an inch deep. The process has been that of a spalling off due to patches of siltier material. While at

First the author considered the weathering in this belt course to be the weathering of a silty limestone, its curved persistence around the building leads me to believe that unless this stone has all come from the same bed, this weathering, though still due to the presence of silt, must be in a measure attributed to the projecting belt course 2 C just below it. This shell no doubt has furnished water to the bed just above.

20% of the blocks in 2 E show weathering not more than  $1/4$  of an inch in depth.

The under sides of the panel sills are all weathered in  $1/4$  of an inch from the former surface. In the upper  $1/3$  of the course just below these sills 80-90% of the area is weathered to a depth of  $1/4$  of an inch. Only about half of the under sides of the window sills have been weathered. In that 50% the average depth penetrated is estimated at  $3/8$  of an inch.

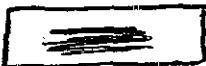
The first course below the window sills is unweathered, and the remainder of the wall is in excellent condition.

#### Location 11.

Only 70% of the wall here is protected by a footing of the Bedford limestone; in the remaining portion the soil is in direct contact with the Madison. 70% of the lowest courses of Madison and 50% of the courses just above it are weathered to a depth ranging from  $1/4$  to  $3/4$  of an inch (the latter depth is rarely seen) due to spalling and disintegration caused by the presence of silty areas. The rest of the basement and first floor courses are in excellent condition.

Belt course 2 A is in good condition also. 2 B is rather heavily covered with vines, but it is estimated that the upper  $1/3$  of this course is weathered over 70% of its length to a depth of  $1/4$  of an inch or less. All of the under side of 2 C is weathered, the depth penetrated ranging in rare cases up to  $1/2$



an inch; most of it is not over  $1/4$  of an inch. The under side of the balcony is in good shape except near joints in the slabs of the floor. In 2 D, 80% of the stone has spalled off, to depths between  $1/4$  and  $3/4$  of an inch. The weathering here as in other locations on this building is most noticeable near the central portion of this layer. 

The belt course 2 E has been weathered to a maximum depth of  $1/4$  of an inch over 40% of its length. Small pits, rather than spalled areas, are the rule here.

All of the underside of the panel sill has weathered and spalled off at least  $1/4$  of an inch, and in the upper  $1/2$  to  $3/4$  of the course just below, all the stone shows the light color of weathered Madison. The average depth of penetration does not appear to be greater than  $1/8$  of an inch.

The window sill in this panel is set flush with the wall and neither the sill nor the course stone just below shows any appreciable decay.

The projecting upper capping stone over the balcony door is slightly discolored but essentially unweathered. However, the smooth cut capping stone just below is decayed  $1/8$  -  $3/8$  of an inch deep in 85% of its face. The remainder of the wall, except for rare scattered blocks very slightly weathered, is in excellent condition.

#### Music Hall.

Music Hall was completed in 1879. The stone used to face the building is the Madison sandstone, but in addition to this a rather coarse grained maroon - colored sandstone similar to that used in the Law Building, is used for ornamental belt courses and columns.

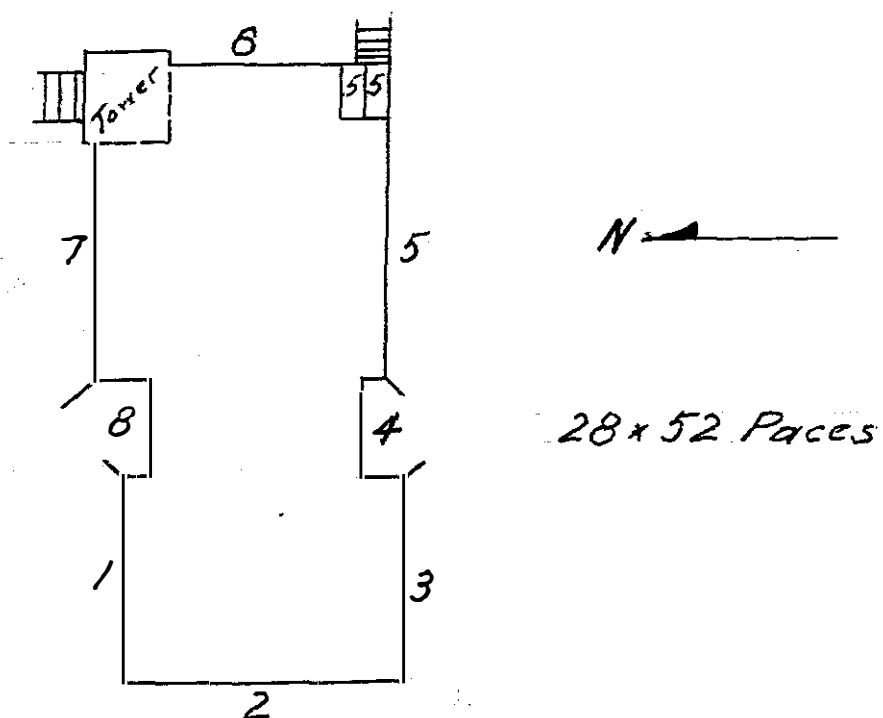
The stone is set flush with the wall throughout; that is, there is no grooving at the joints between courses. The stone is laid up in regular courses 11 inches thick. Each stone has a  $1\ 1/2$  inch wide chiseled border

and the face of the stone, while roughened lightly with a fine toothed chisel, is much smoother than in any of the buildings studied previously.

A dense belt course to stop the flow of capillary water is incorporated in the wall and since the soil is in contact with the sandstone in most cases, there has been considerable weathering due to capillary water.

In general the walls are not in good condition in this building. In the lower courses a large amount of patching with mortar has been necessary. In many cases this has been effective in preventing further decay.

Music Hall.



### Location 1.

The courses below the first belt course in this location have been patched with mortar in about 25-30% of their area. The patching is holding very well. Over half of the remaining stone is weathered  $1/8$  -  $1/4$  of an inch by spalling due to silty splashes.

In the lower belt course, weathering  $1/8$  -  $3/8$  of an inch deep is seen over 80% of its area. In three cases the decay has been serious enough to require patching with mortar. 40% of the course just above is affected to a depth of  $1/8$  -  $1/4$  of an inch.

The remainder of the wall is in good condition except for the three areas mentioned below;

1. There is a band 2 - 3 feet wide from the top to the base of the wall, and including the corner column, at the west end of this location which shows weathering  $1/8$  to  $3/4$  of an inch deep. In the wall the depth is never over  $1/4$  of an inch and very seldom more than  $1/8$  of an inch; but in the column at the corner, depths of  $1/4$  -  $1/2$  an inch are very common.

There has been some patching here which is standing up fairly well.

This weathered zone is deepest in blocks with silty splashes; in other cases, especially on the wall, a grain by grain disintegration has taken place. The weathering here is due to water from above.

2. A triangular area six feet on a side shows weathering to a depth of  $1/8$  -  $1/4$  of an inch in the lower east corner of this location.

3. The outer faces and especially the under sides of 50% of the stones in the ornamental gable have weathered to a depth of  $1/4$  to  $3/4$  of an inch here. This is a very exposed position and this degree of decay is to be expected.

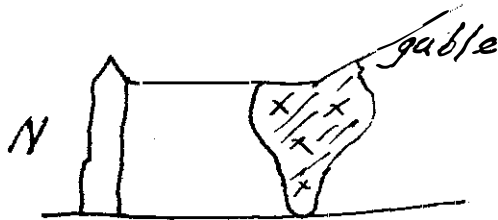
The maroon colored sandstone here is in good condition, but it is imparting a red color to the Madison 1 to 2 inches below it.

Location 2.

25% of the stone below the lower belt course has been patched with mortar and these patches are holding very well. About half of the remaining stone is decayed from  $1/8$  -  $3/4$  of an inch deep. Spalling is worst in the mottled and silt filled worn tube blocks. In the lower belt course 35-40% of the stone is affected to a depth of  $1/8$  -  $3/4$  of an inch.

Fully 80% of the areas in the west sides of the corner columns is weathered away to an average depth of  $3/8$  of an inch.

The largest weathered area on the west wall is located below the joint of the gable and horizontal cornices in the north half of the wall.



The area is roughly funnel shaped, being 12 feet wide at the top, just under the cornice, and tapering down to 5 feet at the top of the first belt course. In this area the spalling of small pieces has been about equal with grain by grain disintegration. The average depth affected is a bit less than  $3/8$  of an inch, but a few stones have been penetrated  $5/8$  of an inch. The red sandstone has also decayed from  $1/8$  -  $3/8$  of an inch. Thin sheets have spalled off, probably due to a leaching of their cementing material. To still further spoil the appearance of the wall, a roughly circular area some 6 feet in diameter is covered with sickly white efflorescence.

Between this area and the north edge of the building, 80% of the course just above the lower belt course is weathered by spalling in front of silty patches to a depth of  $1/8$  -  $5/8$  of an inch. On the southern half of this wall

in a somewhat similar position to that on the north half is another rather large weathered area. See sketch. The depth affected ranges from  $1/8$  -  $5/8$



of an inch and is mainly a disintegration rather than a spalling off of layers. The red sandstone is also affected, and here as in the other a large area <sup>of</sup> red staining 2 or 3 feet below the red blocks, is very common.

### Location 3.

Essentially all of the stone in the lower three and in some cases four lower courses here have been patched with mortar. These patches are holding very well. 10 - 15% of the stone above the repaired portion and the lower belt course is weathered out from  $1/4$  -  $3/4$  of an inch. This weathering is confined almost entirely to a zone west of the westernmost basement window.

This is the lower extension of a weathered band five feet wide (and including the south side of the corner column) which extends from the red belt layer to the ground. In this band spalling of small pieces together with disintegration have penetrated to an average depth of  $1/4$  of an inch. Decay has been due to water from above, mainly from the projecting cap on the column, it seems; and as usual the rocks most badly weathered are those in which the silt is concentrated in small areas rather than distributed evenly throughout the rock.

Weathering in the ornamental gable capping is similar to that described under Location 1.

Except for a few small areas under the first floor windows and the upper half of the eastern corner column where weathering has penetrated  $1/8$  of an inch and  $1/8$  -  $3/8$  of an inch respectively, the remaining portions of this wall are in very good condition.

#### Location 4.

Eastward facing wall: Three areas here show weathering. 1. Near the base where the lower two courses are well patched with mortar but above which the next two courses are decayed to a depth of  $1/4$  to  $1/2$  an inch over 50% of their area. 2. The east face of the corner column where about 60% of the stone is weathered to an average depth of  $1/4$  of an inch. 3. 50% of a zone 6 feet below the cornice has decayed to an average depth of  $1/3$  of an inch. No serious, deep, spalling has occurred here.

Southward facing wall. Due mainly, it seems, to a defective eave and cornice here fully 40% of the rock in this wall has been weathered out to a depth ranging from  $1/8$  -  $3/8$  of an inch. The red sandstone in the pillars and around the door has not been greatly affected except in two especially exposed spots (at the tops and bases of the columns) where similar depth of material has weathered away.

#### Location 5.

Some 20 - 25 % of the stone below the lower belt course has been patched and in most instances these patches are holding very well. The places where it is starting to go are where the patch has not been extended all the way across a course. In these instances weathering attacking the line of contact between the mortar and the sandstone is beginning to get in behind the mortar patches.

40% of the remaining stone below the lowest belt course has been weathered  $1/8$  -  $1/4$  an inch due mainly to weakly or wholly uncemented silty areas. The portions most affected are those just above patched areas and in the columns.

Between the lower belt course and the red sandstone belt course, weathering is observed mainly in the columns. In these 40% of the stone is weathered to depths ranging up to  $3/8$  of an inch. These columns are set out from the wall

and are more exposed to drip water than are other parts of the wall. In three cases weathering of the wall stone is seen close to these columns. These are two areas of about six square feet inside the corner columns and just above the lower belt course, and an area of twelve square feet just east of the second column from the east and just below the red belt course. In these three areas the depth affected is never greater than  $1/4$  of an inch, and the average is somewhat less than  $1/4$  of an inch.

In the zone above the red belt course, 75-80% of the stone is affected to depths ranging between  $1/8$  and  $5/8$  of an inch. The decay is probably due to a defective eave and cornice. Spalling and grain by grain disintegration are about equal in regard to the area affected; but where spalling has taken place, the depth affected is greater. The columns above the red belt course are likewise affected. 50% of the red sandstone has weathered away from  $1/16$  to  $3/16$  of an inch and in places red coloring from this stone extends down nearly two feet on the buff Madison below. However, in most cases, the extent of this staining is not greater than 2 - 3 inches.

In the lower belt course 85% of the stone shows pitted weathering from  $1/8$  -  $1/4$  of an inch deep; in only one stone is spalling noted.

In the south wall of the vestibule, 50% of the stone below the lower belt course has been well pitted, and  $1/3$  of the remainder is in need of patching. For it is decayed to a depth of  $1/2$  -  $3/4$  of an inch. 70% of the lower belt course is weathered from  $1/8$  -  $3/8$  of an inch deep, and just above in the two courses just below the window, weathering has gone on to depth of  $1/8$  -  $1/4$  of an inch over an area of six square feet.

In both the east and southward facing walls above this vestibule, it is estimated that 75% of the wall has weathered away up to  $1/4$  of an inch, due to inadequate protection from water from the roof.

The wall of the stair steps is in good condition, but around the entrances the red sandstone is badly weathered up to a depth of  $1/2$  an inch at the base of the columns and to a lesser degree around the tops of the columns. The masonry here is in good condition except under the lower part of the inner cornice of the gable where an area of two square feet has been weathered  $1/8 - 1/2$  an inch.

#### Location 8.

Below the lower belt course about 25% of the stone, especially on the columns, has been patched with mortar. Most of these patches are holding up very well; a few (less than 15%) are beginning to decay as in Location 5. One third of the remaining stone in this area has decayed and spalled off to depths ranging from  $1/8 - 5/8$  of an inch.

The stone with silty patches is most seriously damaged.

In three places stone has been removed and replaced with new blocks.

In the lower belt course weathering is never deeper than  $1/8$  of an inch, and the outer surface is still firm and in good condition.

Weathering between the lower belt course and the red belt course is found chiefly in three areas: 1. On the columns where, although some effective patching has been done, 30% of the stone still shows weathered areas  $1/8 - 1/2$  an inch deep. 2. In the inner three courses, 10% of the stone has weathered away  $1/8 - 3/8$  of an inch. This is especially noticeable at the ends of, and below the window sills and in the lower scorch corner of the area. 3. In the tower part, 60% of a zone three feet below the red belt course is discolored and weathered from  $1/8 - 1/4$  of an inch in depth.

In the main portion of the building the stone above the red belt course appears to be in good condition.

On the east side of the tower the lowest red belt course is in fair



condition, but in the space between it and the next red belt course, most of the stone is discolored a streaked greenish black and 50 - 25% of the stone is decayed to a depth of  $1/8$  -  $1/4$  of an inch. The most conspicuous areas of weathering are in the corner columns and in the three red blocks placed near the tops of the windows.

The second red belt course seems to catch drip water on its sloping face. It has spalled off thin sheets which would probably aggregate  $1/2$  to 1 inch in thickness.

The 12 inch(?) band of Median that lies between this and the next red belt course has weathered away from  $1/4$  to 1 (?) inch over 50% of its length. The belt course just above has spalled off to a depth of  $1/4$  (?) of an inch over 50% of its length. The tower wall above this point is in good condition except for the underside of the projecting ledge just below the eave. The underside of this ledge and the upper half of the supporting stones just below are decayed to depths estimated at  $1/4$  to  $3/4$  of an inch. This is due to water working down from the shelf above.

#### Location 7.

##### North side of Tower.

Below the lower red belt course weathering is chiefly confined to the corner columns, where 50 - 55% of the stone has decayed to an average depth of  $1/4$  of an inch. The stone with the rec-in designs out in it over the door is discolored and in  $2/3$  of its area it is weathered away up to  $1/4$  of an inch. An area of about 4 square feet just below the first red belt layer and just east of the west corner column has weathered by spalling off. The depth penetrated is about  $1/4$  of an inch. Above this lower red belt layer the pinnacles and amount of the decay are very similar to those described on the east side of the tower. In fact, as much as can be seen of the tower from the ground seems to fit the

detailed description given for the east side very well.

Other than the tower.

The lowest belt course and the courses below it have had 10 - 15% of their area patched with mortar, which is holding up well. A smaller percentage of area is decayed to a depth of from  $1/8$  to  $3/8$  of an inch. A good many of the blocks right down at soil level show little or no weathering here.

Between the lower belt course and the red sandstone belt course, weathering is most conspicuous in the two lower courses, where nearly 40% of the stone is decayed to an average depth of  $1/4$  of an inch. Blocks with the previously described mottled appearance are the most deeply weathered. A band between the tower and the easternmost window, which is from 3 - 5 feet wide, extends throughout the height of the wall. Though depths greater than  $3/8$  of an inch are uncommon here, the fresh light buff color of the wall shows that disintegration and a little thin spalling have been going on here.

The columns are much less weathered than in Location B. In the zone above the red belt course, weathering from  $1/8$  -  $1/4$  of an inch is seen over 50% of the area. This decay along with a little discoloration and efflorescence is most marked around the central columns and in the upper blocks of the window casings between these columns. A zone one to three inches below the red belt course is stained red from the red sandstone just above.

Location B.

Wall facing west. In the lower three courses 75% of the stone has weathered to an average depth of just under  $1/4$  of an inch. The decay is deepest in the lowest course and becomes progressively more shallow in the second and third courses. Capillary water and splash water have been the agents of weathering and the stones with silty patches have been most seriously affected. The remainder of the wall and the corner column, below the red belt course is in good condition with the exception of an area below the fire-escape door sill

of eight square feet where decay has penetrated to a depth of  $1/8$  -  $3/8$  of an inch, due it seems to water running down from the door sill above. (The door sill is set flush with the wall).

Above the red belt course and below the cornice, 45% of the area has weathered away from  $1/8$  to  $1/4$  of an inch both by minute spallings and grain by grain disintegration.

In the corner column a like percentage of the area has been affected, but here the depth penetrated ranges from  $1/8$  to  $3/4$  (?) of an inch.

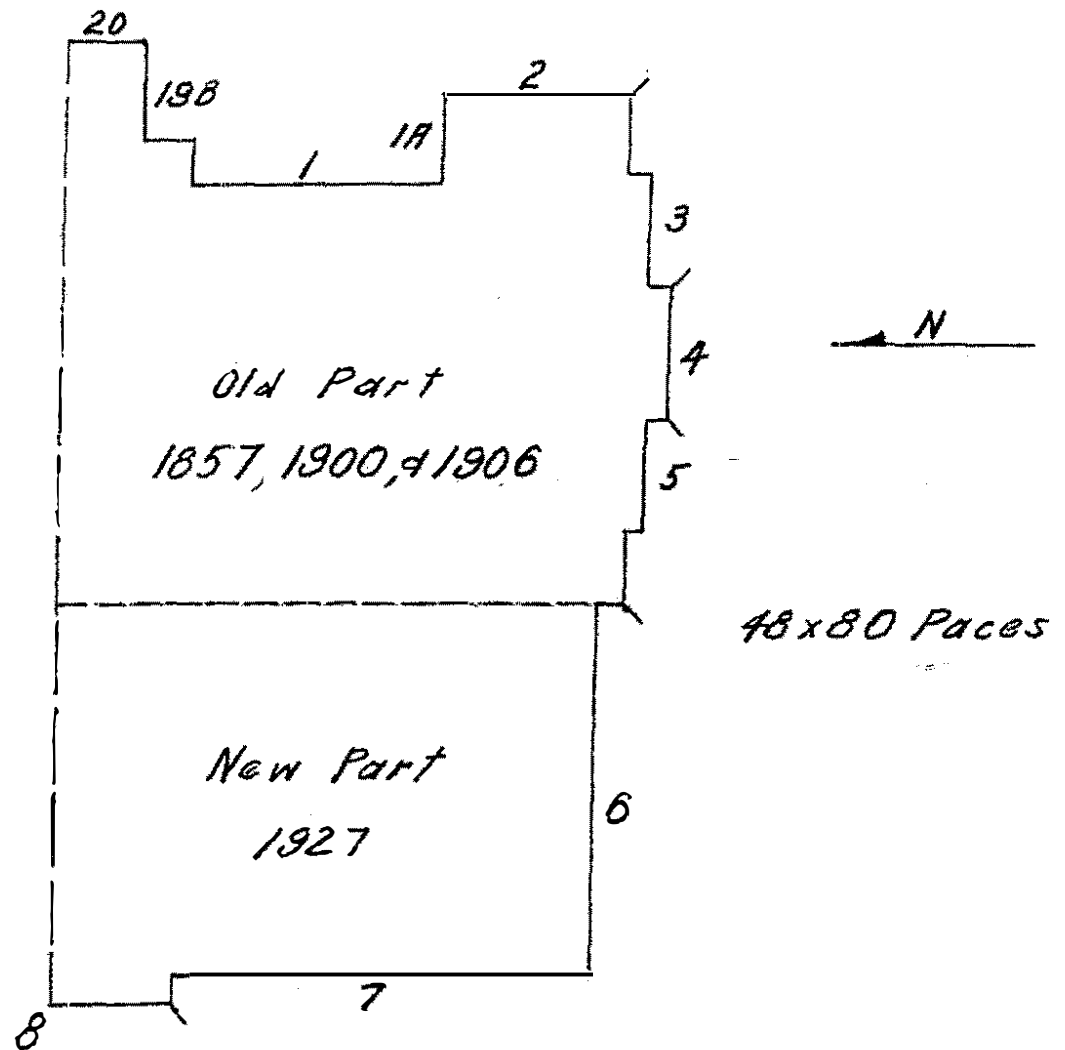
Northward facing wall, Location 3. 40% of the wall below the rather low cornice has weathered from  $1/8$  to  $3/8$  of an inch. The areas most seriously affected are on either side of the large window and seen due to poor jointing in the cornice above.



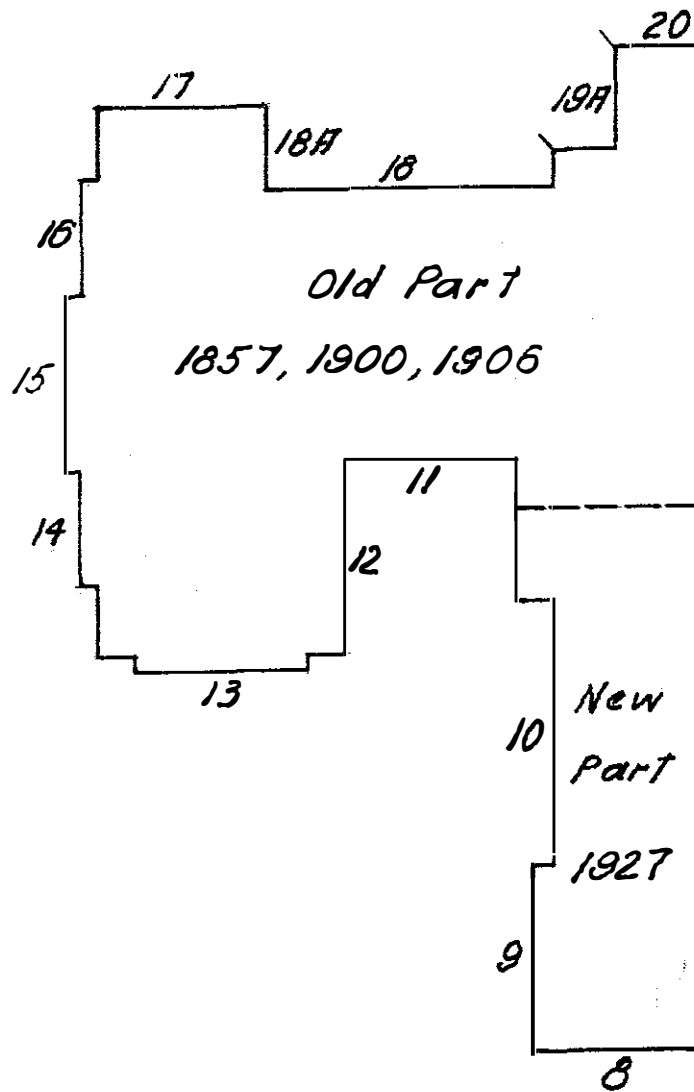
In all the wall the stone is somewhat affected by weathering, but this is expressed in different ways in stones of different textures. The even textured stone in which the silt is evenly distributed, a grain by grain disintegration takes place, which leaves a rather even surface. Where silty areas make an uneven texture, these silt areas weather out to leave a rough surface or else firm rock in front of these silt patches is spalled off; this also tends to leave a rough unpleasant surface.

In the higher wall, both north and eastward facing, the depth of the weathered zone is  $1/8$  -  $1/4$  of an inch. Not over 25% of the area is so affected.

Eastern Hall. South Half.



Bascom Hall. North Half.



N 

56 x 84 Paces

Bascom Hall.

Location 1.

The three lowest courses are smooth cut belt courses, the lower one of which has its base at ground level. The first and third of these have numerous small weathered areas around silt holes, especially where silt has filled worm tubes. The depth penetrated ranges from  $1/8$  to  $3/4$  of an inch, and the area affected is less than 15% of the total.

The remaining course stone and that around the windows on the first floor is in good condition except for a small area around the westernmost window, where spalling to a depth of  $1/8$  to  $3/4$  an inch has taken place in the smooth cut stone of the window casing and the nearby course stone. The reason for this decay other than the presence of silt patches is not clear, but it may be related to the down spout which is nearby in the corner. There is a dark discoloration around this spout, but the wall rock is only slightly decayed.

There are six smooth cut belt courses between the first floor and the base of the second floor windows. Two of these, the upper and the next to the lower project from the wall, and the upper one only has a groove to protect the stone below. All of these belt courses show weathering from  $1/8$  -  $1/2$  an inch deep at their west end near the down spout; but aside from a slight pitting, never exceeding  $1/8$  of an inch, over 50% of their area, the remaining lower four belt courses are in fair to good condition. The upper belt layer has been blackened, but is not much weathered. However, the upper  $1/3$  of the course just below is decayed from  $1/8$  -  $1/4$  of an inch over 25% of its length, due to water that has come from above in spite of the grooving. This decay does not bear any striking relation to the joints in the projecting course above it.

The second floor windows have two capping stones over them, the upper one of which projects 6 - 8 inches from the wall. The projecting layers are unweathered, but are discolored. However, the smooth cut stones just below them

are weathered and small sheets have spalled off of them to a depth of  $1/8$  -  $3/8$  of an inch in 70% of the cases.

The remainder of the second and third floor walls is in good condition, except in the upper  $1/3$  to  $1/2$  of the first course of stone just below the projecting, ungrooved sills of the third floor windows. Here 75% of the stone cited has weathered to a depth ranging from  $1/8$  -  $1/2$  of an inch.

#### Location 1 A.

Lowest course is mainly covered with soil but where it can be seen, capillary water and freezing and thawing have weathered the stone to depths of  $1/2$  to  $3/4$  of an inch.

The two lower belt courses show small shallow ( $1/8$  inch maximum) pits where silty spots have weathered out. 30-35% of the area is so affected.

The first floor course stone is in very good condition, but the underside of the second belt course is weathered all along to a depth of  $1/8$  -  $1/4$  of an inch, due to water from the shelf in the upper part of the same course. 45 - 50% of the upper  $1/3$  to a half of the belt course just below is weathered to a lesser depth for the same reason. Weathering in a similar depth and in a similar zone is seen in 40% of the course just above the upper projecting belt course. All the rest of the wall is in very good condition.

#### Location 2.

The stone below the first belt course is weathered to a depth of  $1/8$  to rarely  $3/4$  of an inch in 15% of the area. The decay is confined to the zone up to 18 inches above the soil and is due to capillary water, which has been especially effective in stones with silt filled worm tubes and silt blotches.

In the lower two belt courses in addition to the pitting similar to that noted in Location 1 A, there is a silty zone one to three inches wide which has decayed to a depth of  $1/8$  -  $3/4$  of an inch in 80% <sup>of the length</sup> of the second, lower, belt course.

The first floor wall, with the exception of the lowest course where 20% (mainly in the window sills) is weathered out to a depth  $1/8 - 1/4$  of an inch, is in very good condition.

The first belt course above is badly weathered. 70% of the course is affected to depths of  $1/8$  to  $3/4$  of an inch and in at least half of this area, the depth penetrated is  $1/2$  an inch. This decay can be attributed to the water which has worked down from the ungrooved projecting belt just above, the under side of which is also decayed  $1/8 - 1/4$  of an inch in depth along 35% of its length.

60% of the next higher belt course is weathered to depths ranging from  $1/4$  to 1 inch. Though half of this is comparatively shallow pitting, the other half is serious spalling along siltier portions and averages  $5/8$  of an inch deep. This is caused by water from the top of the projecting layer below or the wider shelf just above.

The very lowest portions of the columns here are weathered to an average depth of  $3/8$  of an inch.

35% of the upper  $1/3$  of the belt course just below the upper projecting belt course has been weathered by water from above, from  $1/8 - 1/4$  of an inch deep.

The projecting cap stones above the second floor windows are discolored, probably from the accumulations of silt, and 80% of their under sides are weathered away to a depth of  $1/8$  to  $1/4$  (?) of an inch.

80% of the upper half of the course stone below the projecting 3rd floor window sills has weathered to a depth of  $1/8$  to  $1/4$ (?) of an inch.

The remainder of the stone is in good condition.

#### Location 3.

Aside from the two exceptions discussed below, the basement courses in this location are in very good condition. 1. 35% of the stone in the lowest course has been weathered to a depth of  $1/8 - 1/2$  an inch by capillary water



working in the silty areas of the stone. This decay is especially noticeable in the recesses in which the windows are set. 2. In the upper E-4 inches of the course just below the lowest belt course, weathering to a depth of  $1/8 - 1/4$  of an inch has taken place over 25% of the length. This decay is just below the lower belt course, which projects  $1 1/2$  inches beyond the basement wall. The underside does not have a groove. It is clear that water working back under this ledge has caused the weathering.

The description of the two lower belt courses given under location 2 also applies here.

In the lower courses of the first floor wall, 50% of the stone is weathered from  $1/8$  to  $3/4$  of an inch. The greater portion of this decay and all of the deep seams, is seen in the window sills. The rest of the first floor wall is in good condition.

In the belt course just above, the stone in the upper half of the course has weathered to a depth of  $1/8 - 3/8$  of an inch in 50% of its length. This has been due to water coming from the projecting ledge of the course next higher in the wall. While some of this decay is directly under joints in this projecting belt course, the decay is as great in other locations, and the lack of a groove seems more serious here than the lack of water proof mortar in the projecting belt course.

The under side of this projecting belt course has been weathered  $1/8 - 1/4$ (?) of an inch along 50% of its length.

The next two belt courses are in fair condition, although there are some shallow pits that show where slight decay has taken place.

The upper projecting belt course is in good condition, but the upper one-third of the course just below it is weathered  $1/8 - 3/8$  of an inch deep over 50% of its length. The projecting bay stones over the second floor windows are discolored and on their under sides; decay  $1/8 - 1/4$  of an inch deep has affected

80% of the area of these capping stones.

Very nearly all of the upper one-third of the first course of stone below the projecting third floor window sills has weathered away to a depth of  $1/8$  -  $1/4$  of an inch. The remaining stone of the wall is in good condition.

#### Location 4.

20% of the stone in the lowest course has been weathered to an average depth of  $3/8$  of an inch. The soil is in direct contact with the course rock of the wall. The upper regular course of the basement wall has been weathered from  $1/8$  to  $3/8$  of an inch over 70% of its length. This decay is seen mainly in the upper one-half of this course and is clearly due to water working back in from the projecting belt course just above.

The two belt courses between the basement and first floor are somewhat pitted, but deep weathering is confined to one-third of the blocks in the upper course where a band 1 - 3 inches wide is decayed to depths of  $1/2$  -  $3/4$  of an inch.

30% of the blocks in the first course above these two belt courses show deeply weathered pockets. These do not affect but a small part of each block, but the pockets are deep ( $1/2$  -  $3/4$  of an inch).

The central half of top three or four courses of <sup>the</sup> first floor wall and half of the stones in the arches of the window cases have been seriously affected by weathering. The depth of the area mentioned ranges from  $1/8$  to  $3/4$  of an inch.

The belt course just above is also badly decayed. In 80% of its length weathering to a depth of  $1/4$  -  $3/4$  of an inch has taken place. In 40% of the under side of the projecting belt course just above, weathering has attacked to a depth of  $1/8$  -  $1/4$  of an inch. The outer surface of this same belt is pitted, but no spalling has taken place. The next belt course above is in fair

condition, though two blocks show small areas weathered out to depth of  $1/8 - 1/3$  an inch.

There are several dark streaks which have discolored the wall here. This discoloration and the unusually heavy weathering here seem to be due to poor drainage in the large second floor balcony. If projecting belt courses had been grooved, a lot of this decay would probably have been prevented. The columns at the ends of this location are in very good condition. This concludes the description of stone work in this location.

#### Location 5.

15% of the stone up to one foot from ground level is weathered to an average depth of  $3/8$  of an inch in this location. The rest of the basement wall is in very good shape with the exception of a 2 - 3 inch band just below the lowest belt course where 40% of the length of such a band has weathered out to an average depth of  $1/2$  an inch. The cause is the same as that in similarly located areas previously described.

The second belt courses between the basement and first floor are similar to those described under Location 3.

The courses of the first floor wall are in excellent condition.

50% of the upper four inches of the belt course just above has been weathered to a depth of  $1/8 - 3/4$  of an inch.

The projecting belt course next higher is in good condition even on its under side, as are the two courses above it.

The upper projecting belt course is unweathered, but 50% of the upper half of the course just below it has been weathered to an average depth of  $1/4$  of an inch.

Underside of projecting cap stones over the second floor windows is weathered as in Location 3. 50% of a four-inch band below the projecting sills of the third floor windows has decayed and weathered out to an average depth of

1/4 (1) of an inch.

The remainder of the second and third floor walls is in excellent condition.

#### Location 6.

This location is in the new part of Mason Hall completed in 1927. The stone is in excellent condition throughout. The only projecting belt course is located near the top of the wall and the stone below it is protected by a groove. The window sills on the first floor which also are set out from the wall are protected in a like manner. The stones below the basement windows is unweathered, but is somewhat discolored from soot which has collected on the upper side of the rather wide sills.

The only fault that can be found in this location is that on the east end of the area the soil is in contact with the sandstone. So far, however, no bad effects are to be seen.

The western three-fourths of the wall rests on a concrete foundation.

#### Location 7.

All the remarks made about Location 6 apply to the stone in this location. However, two blocks at the base of the wall near the southwest corner of the building show 1/8 - 1/4 of an inch of weathering. This is due, it seems, to the very silty character of the stone.

The sub-basement wall is set smooth in this new portion, but both the basement and first floor walls are grooved just below the horizontal joints between courses.

It should be mentioned that the first floor is the one which is at ground level at the front of the building, and all the way around the building this is considered as the first floor, even though it is above or below ground level in other parts of the building.

#### Location 8.

With the exception of two or three silty stones high up in the wall which

have spalled very slightly, the Madison sandstone is in excellent condition. All projecting sills and coping stones are well grooved.

The Bedford coriolic limestone which forms the columns and ornamental cornice here is not weathered at all. However, a white efflorescence is seen in a large part of the under side of this projecting cornice. This is too high up in the wall to make a positive statement, but this efflorescence seems to come from the stone itself rather than the mortar.

#### Location 9.

In this area the soil is in contact with the lower course of the Madison, and 20% of the lower two courses show slight amount of weathering. The depth penetrated rarely exceeds  $1/8$  of an inch, but a few blocks with silty patches are weathered out to  $1/4$  of an inch.

The walls and sills are in excellent condition here aside from the exception mentioned above.

The wide projecting belt course or cornice between the second and third floors is a little discolored on its under side. There is also quite a little white efflorescence similar to that described under Location 8, to be seen here.

The joints in the Bedford belt course which caps the wall have in several instances (80% of the cases) contributed a dark stain of stain to the Madison 12 - 16 inches below these joints.

#### Location 10.

In this location the Madison rests on a concrete foundation that is just about even with the ground and in the east third of the length the soil has been graded up over the foundation and is in direct contact with the Madison.

A slight amount of decay may be seen in the lowest course. The depth is not greater than  $1/8$  of an inch, and the area affected less than 5% of the west course. This seems to be due to capillary water working in the masonry blocks.

Below the fire-escape there is an area of about six square feet six to eighteen inches above the ground which has been weathered out to an average depth of  $1/4$  of an inch, due to splash water.

The under sides of all of the window sills and the projecting belt course between the second and third floors have good grooves. The outer sides of the sills and this belt course are discolored by soot, but they are unweathered and in excellent condition, as is the rest of the wall.

#### Location 11.

In this location two-thirds of the wall is new, and the small amount of decay will be briefly described; weathering in the older one-third will be treated with Location 12.

In the new portion, even though the old type of construction is matched and the projecting belt courses are not grooved on their under sides (though the first floor window sills are) the wall is in excellent condition except for about four blocks in the lowest course where slight weathering to an average depth of  $1/8$  of an inch has taken place.

#### Location 12.

$15\%$  of the stone in the basement courses has been weathered from  $1/8$  -  $3/4$  of an inch in depth. Much the greater share of this weathering is in the silty blocks of the lower two courses, and it seems to be due to capillary water for the soil is in contact with the sandstone. A minor portion of this weathering is just below the first projecting belt course; here the depth does not exceed  $1/4$  of an inch.

In the three slightly set out belt courses at the base of the first floor, the stone is discolored and  $65\%$  of the stone is weathered from  $1/8$  to rarely  $3/4$  of an inch deep. This is mainly in the form of small pits where silt has weathered out, but spalling is seen on the lower side of the bottom belt course.

in a few scattered blocks in the two upper courses, all filled with worm tubes and silty areas around more resistant worm tubes have rendered the stone susceptible to attack.

The course stone of the first floor wall is in good condition.

The first projecting belt course is pitted to depths of  $1/8 - 1/4$  of an inch over 50% of its length; that is, on the outward face. Not over 10% of the under side is weathered and the maximum depth is less than  $1/4$  of an inch. The belt course just below, which is usually considerably weathered, here shows only a very minor amount (not over 10% of the face) of shallow pitting. 30 % of the third belt course of this group shows pitting and spalling due to salt patches to a depth of  $1/8 - 1/4$  of an inch.

The next course is similarly affected, and the course above that and just below the upper projecting belt course has 50% of its length decayed in a similar manner to the same depth. Strangely enough this is spread over the whole course and is not as it usually is, confined to the upper one-third of the course.

The upper projecting belt course shows  $1/8 - 3/8$  of an inch of decay along 40% of its length. This is most noticeable but is not confined to the lower side.

With the exception of rare scattered blocks, and small weathered zones under four-fifths of the third floor window sills  $1/8 - 1/4$  (1) of an inch deep, the second and third floor walls and are in good condition. The top stones of the windows are set flush with the wall, as they ought to be, and show very little weathering.

A discolored band, seemingly from a defect in the cornice, extends down ten or twelve feet from the top of the wall near the second tier of windows from the south end.

Small (3 - 4 square feet) areas covered with a white efflorescence are to be seen at the west ends of the very lower courses and in the belt course between the first and second floors.

Location 13.

About 30% of the basement wall courses have been weathered here. In the lower two courses where spalling in front of silty patches is common, the depth penetrated averages  $3/8$  of an inch. Except under the fire-escape braces where similar spalling affects the third and fourth courses, the weathering in the layers above the second course is only pitting and a little disintegration whose depth is not greater than  $1/8$  of an inch.

The two lowest belt courses show small pits and bands where more silty portions of the stone have weathered out over 40% of their length. The depth affected ranges from  $1/8$  of an inch in the pits to  $1/4 - 3/4$  of an inch in the bands.

In the first floor wall, weathered areas are seen in  $3/4$  of the window sills; the depth affected is less than  $1/4$  of an inch and in no sill is more than  $1/8$  of the stone weathered.

An area of three feet square below the fire-escape braces is partly discolored and is weathered, due to water running down these braces, to an average depth of  $3/8$  of an inch.

The rest of the first floor wall is in excellent condition.

The upper two to five inches of the belt course just above has weathered out from  $1/8$  to  $1/4$  (?) of an inch over 35% of its length. This weathering is not related to the mortar joints of the projecting belt course above, but to the lack of a groove. The projecting belt course is not weathered on its under side, but several of the blocks show pitting on their outer surface.

The next two belt courses are in fair condition, but the one above them and just below the upper projecting one shows  $1/8 - 3/8$  (?) of an inch weathered out in its upper 3 - 4 inches over 40% of its length. This weathered zone is widest and deepest just below two fire-escape braces. The upper projecting belt course is in fair condition.



The under sides of the projecting cap stones and the smooth cut stones below them over the second floor windows have been weathered from  $1/4 - 1/2$ (?) of an inch in 80% of their area in spite of the fact that the under sides of the projecting stones are grooved.

Beneath all of the ungrooved third floor window sills there is a weathered zone from three to six inches wide where weathering is estimated to average  $3/8$  of an inch in depth.

The remainder of the wall is in good condition, though wherever portions of the fire-scapes are attached to the wall, there is a dark discolored streak below the point of attachment.

#### Location 14.

70% of the lower two courses have show weathering to an average depth of  $1/4$  of an inch. Stones with silty patches are the most seriously decayed. Decay is often deep ( $3/8 - 5/8$  of an inch) on the corner blocks and along side of joints where the mortar has weathered out.

The remaining basement courses are in good condition, as are those in the first floor wall. The two belt courses between are slightly pitted to shallow (not over  $1/8$  of an inch) depths.

The outer face of the lowerprojecting belt course shows pitting  $1/8-1/4$ (?) of an inch deep in 80% of its length, but its under side, though a little discolored, is essentially unweathered. 40% of the smooth cut belt course just below is decayed to an average depth of  $1/8 +$  of an inch, due to water from above.

70% of the belt course upon which the column rest is pitted to depths of  $1/8 - 1/4$  of an inch. Those pits do not affect more than the lower halves of the blocks.

The rest of this wall, excepting minor patches below the upper projecting belt course and small areas on the under sides of the coping stones over the

second floor windows, is in very good condition.

Location 14.

40% of the lowest course and 25% of the second course of stone has been weathered to an average depth of  $\frac{3}{8}$  of an inch in this location, the probable cause of which has been a combination of capillary and splash water.

The lower belt course is in good condition, but the upper one of the two shows frequent pitting, and what is more serious, deeper bands two to three inches wide which have weathered out to depths averaging  $\frac{1}{2}$  an inch in 50% of the length.

The stone of the first floor wall is in excellent shape, but the lower two inches of three-fourths of the window sills has decayed an average of  $\frac{2}{8}$  of an inch.

Of the six belt courses between the first and second floor courses, the lower two and the fourth and sixth from the bottom are in good shape. The third course has a few blocks (not over 15%) which show weathering in the form of spalling of thin sheets to a depth of  $\frac{1}{8}$  -  $\frac{1}{4}$ (?) of an inch. 40% of the upper one-third of the fifth belt course shows spalling and pitted areas (where spalling will soon begin) to a depth of  $\frac{1}{4}$  of an inch. This is due to the lack of a groove in the projecting belt course above.

Projecting sash stones over the second floor windows show decay from  $\frac{1}{8}$  -  $\frac{1}{4}$  of an inch deep in 40% of the area of their under sides.

There is a 4 - 6 inch zone weathered from  $\frac{1}{8}$  -  $\frac{1}{4}$  of an inch deep below three of the four third floor window sills. These sills project from the wall two inches and do not have a groove on their under edge. The rest of the second and third floor wall and window casings are in good condition.

Location 15.

30% of the blocks in the two lower courses have weathered to an average depth of  $\frac{1}{4}$  of an inch. That the decay has been due in a large measure to

the presence of silty patches and all filled worm tubes in front of which the firm, frequently coarse-banded sandstone has spalled away. is strikingly shown in two of the large blocks here. There are hyphes set close to this wall, but as to their effect on the weathering of the wall I cannot pass judgment.

The remainder of the basement wall is in good condition. Before leaving the basement course it is well to note that this weathering in the lower courses is not confined to the outer wall, but is also seen in recesses in which the windows are placed.

The lower belt course has a few shallow pits that have weathered out not over  $1/8$  of an inch and the upper course shows similar but slightly deeper pits over 50% of its length, and weathered bands two inches wide and averaging  $7/8$  of an inch deep are seen in one-third <sup>of</sup> the length. Both these courses are much discolored by a green black fungus seen, especially under the windows.

The first floor wall is in fair condition. There is some black discoloration from the balcony above, and a little weathering in the upper end in the lower regular courses.

10 - 15% of the lower course is affected  $1/8$  -  $1/4$  of an inch in depth. The weathering is in the form of small spillings which rarely reach  $1/4$  of an inch in depth. The water which has caused the decay seems to have worked laterally from the window sills along the groove between the first and second courses and then out and down over the face of the first course stone.

The three belt courses which lie just below the balcony are all pretty thoroughly discolored a greenish black. The lower of these is pitted over 40% of its length to an average depth of  $1/8$  of an inch. A much smaller percentage, not over 10%, shows spalling  $1/4$  -  $3/8$  of an inch deep. This decay is caused from water from above, but silty patches control the position of weathering rather than joints in the projecting belt course just above.

Both the outer and under sides of the projecting courses are pitted to a depth of  $1/8$  -  $1/4$  of an inch deep where weak silty areas have weathered out, but very little spalling is to be seen. Where spalling has occurred, it has been on the underside immediately surrounding the mortar joints.

In the upper belt course staller pitting, rarely deeper than  $1/8$  of an inch is seen, and one block (about 10 % of the length) is badly spalled due to the presence of silt to depths of  $1/2$  to 1 inch.

The columns at the ends of this location are in very good condition, and so are the narrow bands of wall outside of them.

#### Location 17.

About 30% of the stone in the lower four courses of this location have weathered from  $1/8$  to 1 inch deep. The decay is most marked behind the bushes which are set close to the wall and which must contribute some water and lots of rubbing to hasten the decay of the wall. Here, too, the weathering is seen on the sides of the window recesses as well as on outer walls. This is the most severe weathering observed in this building. The ground below the wall is in several instances covered with scales that have spalled off, and the window sills are similarly covered. In one place, for example, the pile of material that has come from a two square foot area would form a three-inch cube.

The very lowest course is not very seriously affected, which would indicate that the bushes, in some manner, rather than capillary water, have caused the decay.

The weathering has been so deep here that it is possible to tell that the beds are laid vertically, but so they are believed to be laid elsewhere. As usual silty patches, laminations, and silt filled worm tubes are a most important factor contributing to the decay of the stone.

With the exception of small areas just under the projecting lowest belt course where decay to an average depth of  $5/8$  of an inch is seen, the remainder of the basement courses are in fair condition.

The lowest belt course shows shallow (never over  $1/8$  of an inch) pitting, and one block shows spalling  $3/8$  of an inch deep in its lower half. The pitting in the upper of the two belt courses is more deep after reaching  $1/4$  of an inch, and in 35% of its length silty bands have weathered out  $1/4 - 3/8$  of an inch. These bands are 2 - 4 inches wide and are an aggregate of pits.

The first floor wall is in good shape, though the window sills and the first courses near the down spout have been slightly ( $1/8$  of an inch deep) affected.

The lower of the six belt courses shows shallow pitting and a slight amount of spalling over 30% of its length. This weathering is chiefly confined to the upper one-half of the course.

Spalling on the under side of the projecting belt course just above, due to the lack of a groove, is seen along 25% of the length to a depth of  $1/8$  to  $1/4$  of an inch. The outer face of this course shows a little shallow pitting and near its top a slight greenish discoloration. The remaining belt courses are in good condition.

The under sides of the projecting oop stones over the second floor windows are but very slightly attacked. However, beneath the sills of all the third floor windows there are zones from four to ten inches wide where weathering averaging  $1/4$  (?) of an inch deep has taken place.

The lower regular courses of the second floor wall show a weathered area of five to six square feet near the angle of the wall close to the down spout.

Except for the weathered areas already mentioned, this wall is in very good condition.

Location 18.

The two courses just above the ground are 80% weathered to depths ranging from  $1/8$  -  $3/8$  of an inch, due mainly to capillary water and silty patches in the stone. The sides of the window recesses are all weathered below ground level to an average depth of  $1/2$  an inch.

The two lower belt courses are, in spite of a little shallow pitting, in very good condition except for one badly spelled block at the south end of the lower course.

In the first floor wall the lowest course which includes the window sills has been weathered  $1/4$  of an inch deep over 50% of its length. The decay is due to silty patches, and usually only the lower half of each block is affected.

80% of the upper half of the first belt course has been weathered to an average depth of  $3/8$  of an inch through spelling in front of silty patches and water running back from and coming through the bedding joint of the projecting layer just above. On the eastern one-third of this location, this decay extends all the way across the belt course and has attacked the upper course of stone in the first floor wall from  $1/8$  -  $1/4$  of an inch.

The underside of the projecting belt course above the belt course just mentioned, has decayed and spelled off  $1/8$  -  $1/4$  of an inch in 30% of its length, and the outer side of the same course, though discolored and slightly pitted, is essentially unweathered.

The belt course just below the base of the columns shows a pitted band three to four inches wide and  $1/2$  -  $5/8$  of an inch deep over 25% of its length. This band is in the lower half of the course and is due to water working up from the shelf just below. The four columns are in good condition, although the southernmost one is slightly pitted and shows an irregular area of white efflorescence in its upper third.

The wall just south has five or six blocks which show by their lighter color

that the outer case hardened shell has been broken through. The depth penetrated by decay is as yet only  $1/8$  + of an inch.

The under sides of the projecting cap stones of the second floor windows are somewhat discolored and especially below the mortar joints are spalled off to depths of  $1/8$  -  $3/8$  of an inch. Areas under the third floor sills are but very slightly affected, but the under sides of the cap stones (within the recesses) have spalled slightly ( $1/8$  to  $1/4$  (?) of an inch).

The remainder of the wall is in good condition.

#### Location 18 A

40% of the basement courses, that is, just below the lower two belt courses, has weathered and spalled off to an average depth of  $3/8$  of an inch due, it seems, to capillary water. The two belt courses just above are in fair condition. The lower one is slightly pitted and the upper of the two has a pitted band three inches wide and averaging  $1/4$  of an inch deep over 40% of its length. First floor courses are in good condition.

In the six belt courses above # 4 and 5 (counting from the base) are in good shape. # 1 is weathered  $1/8$  -  $1/4$  of an inch in its upper part over 60% of its length. The worst damage is just below joints in the projecting belt course above. In the projecting second belt course, the outside is considerably pitted to very shallow depths and the underside is decayed  $1/4$  of an inch along 80% of its length. This weathering is most conspicuous around the mortar joints.

In the third belt course about 10% of the stone is spalled off an eighth of an inch, and half the length of the upper half of belt #5 is pitted  $1/8$  -  $1/4$  of an inch from water working back from the projecting shelf just above.

The remainder of the wall, save for two light colored slightly weathered blocks, is in very good shape.

Location 19.

Basement courses are exposed only on the west half of this location where 70% of the stone is affected to a depth of  $1/4 - 1/2$  an inch. The decay is most noticeable in the upper part of the upper course just below the first belt course which is set out about two inches. This would indicate that water from above did more weathering than capillary water drawn up from the ground. The other place where decay is common is in the lower parts of the recessed basement window frames.

The largest weathered areas in this location are two bands from one to three feet wide in the corner on either side of the down spout. These bands extend from the base to the top of the wall and the average depth penetrated is estimated at  $1/4$  of an inch.

In the three lowest belt courses weathering out of small silty pits is common, but this reached serious proportions only in the upper thicker one of the three. Here coalescing pits form bands two to four inches wide and one-fourth of an inch deep; such bands are found along 60% of this course.

The lowest regular course in the first floor wall, including the window sills, is similarly affected over a like percentage of its length. The remainder of the first floor wall is in fair to good condition except in the upper course. Here a zone two to eight inches wide just below, and slightly set in from the first belt course, has decayed from  $1/8 - 1/4$  of an inch over 60% of the length.

Weathering, aside from slight pitting and one small area of spalling, is not appreciable in the lower fourth and the sixth belt courses between the first and second floors. This is excepting the corner area near the down spout.

The fifth belt course shows weathering by spalling and pitting to depths of  $1/8 - 3/8$  of an inch in its upper one-third along 70% of its length.



projecting belt course just above.

noted. This weathering is confined to areas adjacent to mortar joints in the  
inch deep and in a zone three to five inches wide over 36% of the length is  
slightly more in some instances. At the top of belt #5, decay  $1/8$  to  $1/4$  of an  
the balcony) just above. 30% of #5 has spalled to a depth of  $1/8$  of an inch or  
length due to water working back in from the projecting ledge (and in part from  
both pitting and spalling to a depth of  $1/8$  -  $3/8$  of an inch over 50% of its  
of the six belt courses, #2, 4, and 6 are only slightly pitted; #1 shows  
of an inch, and only rarely does it reach  $1/4$  of an inch.

floor balcony. In these areas the depth affected is not often greater than  $1/8$   
half the upper course blocks and in the three courses below the front second  
angle of the wall. In one-third of the smooth cut stones around the windows, in  
In the first floor wall weathering is observed in the window sills, in the  
splash water may have done a good deal of the damage.

is more marked in shelter portions of the stone and the arrangement suggests that  
inches wide and  $1/8$  -  $1/4$  an inch deep over 46% of the length. This weathering  
three, more serious pitting and also some spalling have affected bands 2 - 3  
Lower two belt courses are but slightly pitted, but in upper one of the

#### Location 19 A.

The rest of the second and third floor walls is in good condition.  
of  $1/8$  -  $3/8$  of an inch is seen.  
two to six inches wide below them, where weathering and  
All the projecting ungrooved third floor window sills have weathered some  
does not exceed  $1/4$  of an inch.  
original outer surface is entirely removed by spalling. The depth penetrated  
the smooth cut cap stones just below them where in 70% of these blocks the  
somewhat decayed on their under sides; the most serious decay is found in  
While the projecting cap stones over the second floor windows are

Areas around the second and third floor windows are similar to those described under location 18, and except for such areas, and seven or eight slightly decayed scattered blocks, the second and third floor walls are in good condition.

Location 19 B.

Lower three belt courses are essentially unweathered except for a slight amount of pitting. This is most noticeable in the upper course where in a few blocks it reaches a depth of  $\frac{5}{8}$  of an inch. In the first floor wall decay is noticed in the angle of the wall over the top along 50% of the length of the upper course (this is worst around the arch under the second floor balcony near the front of the building; here three and sometimes four of the upper courses are affected) and in a few of the smooth out blocks of the window casings. In the belt courses just above, courses 2, 3, 4, and 6 are unweathered except for a few shallow pits. 60% of #1 shows pitting and spalling to a depth of  $\frac{1}{8}$  -  $\frac{1}{4}$  of an inch, and in #6 the upper one-third of the course has spalled to a depth ranging from  $\frac{1}{8}$  -  $\frac{3}{8}$  of an inch along 50% of its length. In both these cases the decay has been due to lack of protection on the under side of projecting belt courses.

The condition of the areas around the windows is similar but less advanced than that described under location 18. The remainder of the second and third floor walls is in good condition.

Location 20.

Weathering in this location is confined to the outer first floor wall, for the second and third floor walls and the first floor wall under the balcony are protected by the balcony.

Decay on the outer first floor wall is seen in pitting in the lower courses probably due to splash water, and in the upper three regular courses where water from the balcony above has weathered 50% of the stone in these courses

from  $1/8$  -  $3/8$  inches deep.

The lowest belt course just above has been pitted to depths of  $1/8$  -  $1/4$  of an inch over 88% of its length and has spalled from  $1/4$  to  $1/2$  an inch over an additional 15%.

The next two belt courses are pitted from  $1/8$  -  $1/4$  of an inch deep. This pitting is especially noticeable on both the outer and under sides of the projecting belt course where 50% of the length is affected.

#### Mechanical Engineering Building.

The Mechanical Engineering Building was completed in 1932. The materials used in its construction were Madison sandstone, Bedford oolitic limestone, and terra cotta.

The Madison sandstone is used as a facing stone in the walls. The stone has not been cut or smoothed beyond chiseling into roughly square or oblong blocks, most of which are slightly concave outward. Although the stone is too massive in most cases to tell accurately, it seems that some effort was made to place the blocks with their bedding planes in horizontal position. Oblong blocks in the wall range in size from 8 x 14 inches down, but only in very rare instances is the long dimension placed in a vertical position.

Smooth cut Madison with a small ribbing is used around the frames of the round topped windows and in the central portion of the third floor wall on the north side of the building.

The Bedford limestone is used in a foot thick belt course entirely surrounding the building. At the front (north side) this belt course is  $3\frac{1}{2}$  feet above the ground, but on other parts of the building its distance above the ground varies on account of the different level of grading.

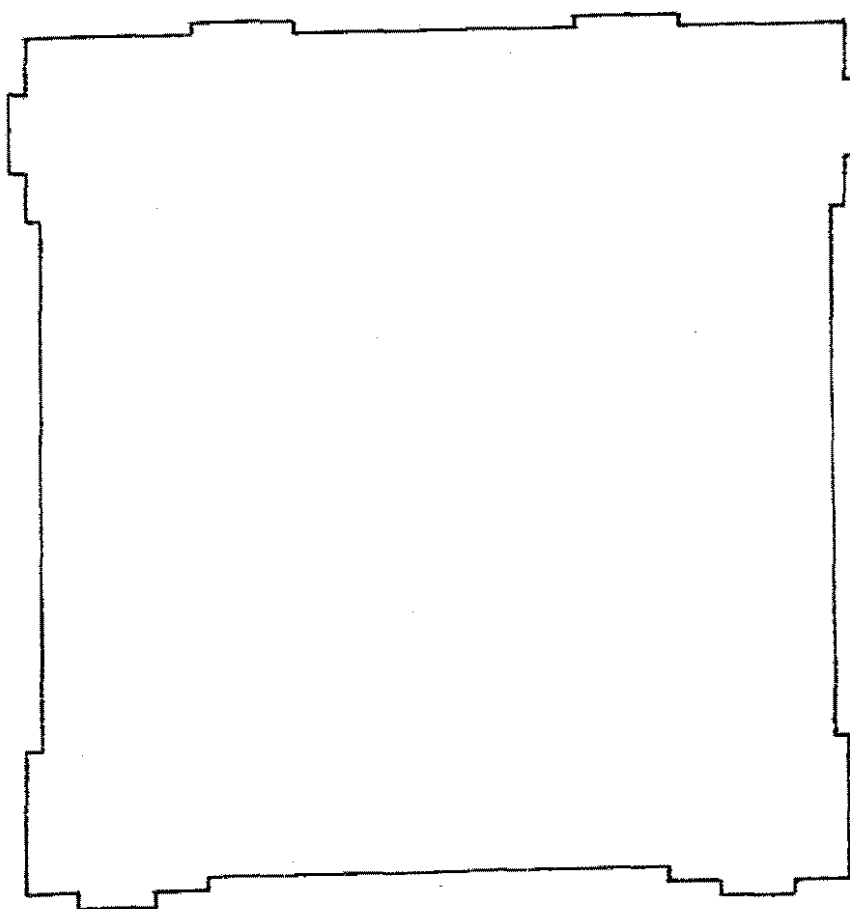
One objection to this limestone is the fact that many of the blocks are cross bedded and this gives a streaky appearance to many of the blocks.

On the central portion of the front of the building, this same limestone is used in the foundation up to the belt course.

Terra cotta is used extensively in this building. The first and second floor walls of the front central portion are of this material, as are many window frames.

Three belt courses of terra cotta surround the building. The first of these is between the second and third floors. It is a combination of three courses and its upper margin projects some eight inches beyond the wall. Its underside is not grooved, and there is evidence that water has worked down the under face here.

Mechanical Engineering Building.



*90 x 90 Paces*

There is a group of four belt courses at the top of the third floor window, the upper one of which projects out at least 18 inches from the wall. Here there is very adequate protection from water running back on to the wall in the form of a heading (x)



The topmost belt course is a six inch layer which caps and sets flush with the wall.

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At present this building is unweathered and except for certain discolorations is in excellent condition. For this reason the usual procedure of dividing the building into areas will be dispensed with and a few suggestions will be made especially in regard to the discoloration and also where future weathering is to be expected.

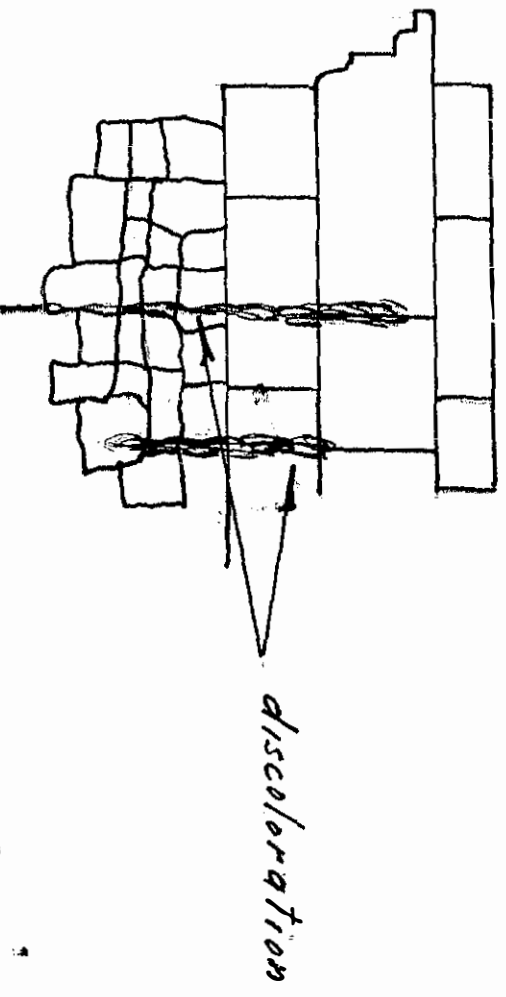
1. Certain areas show that the lowest course of Madison rests on a concrete foundation. However in 90% of the wall, soil has been graded above this contact and capillary water is free to attack the stone. As yet the sandstone has not been affected, but in numerous instances the mortar between the stones has drawn away slightly from the stones and as time goes on, it is inevitable that mortar and stone will decay. Also at the present time the lower 18 inches of the stone is discolored by soil from splash water, showing that this will also contribute to the decay of the stone.

2. Discoloration is pretty generally confined to two bands on the east side of the building. These are below the lower belt course of limestone and

below the belt course at the base of the third floor windows. Below the limestone belt course there are not only streaks of gray black discoloration two to four feet long and four to eight inches wide, but also blotchy discolored areas between the streaks. These streaks are just below mortar joints in the belt course. To me their origin seems to be this. Coal soot and other similar material tends to lodge on the outwardly convex surface and horizontal shelves below the windows, both of which are a part of the limestone belt course.

Since the mortar joints are slightly below the general surface of the belt layer, when rain strikes the building, water carrying the soot and other discoloring matter tends to run down those joints and onto the wall below. In this manner I think the discoloration is to be accounted for.

In the belt course below the third floor windows, the same thing takes place because the underside of the projecting course is not properly grooved. Here the joints are staggered (see sketch) and it is clearly seen that the joints of the projecting course are the offenders.



Just why this discoloration is so much more marked on the East side is a puzzle. It may perhaps be related to the greater exposure to smoke from the university heating plant.

On this side there is also a little white efflorescence seen in the

limestone belt courses and in the sandstone below.

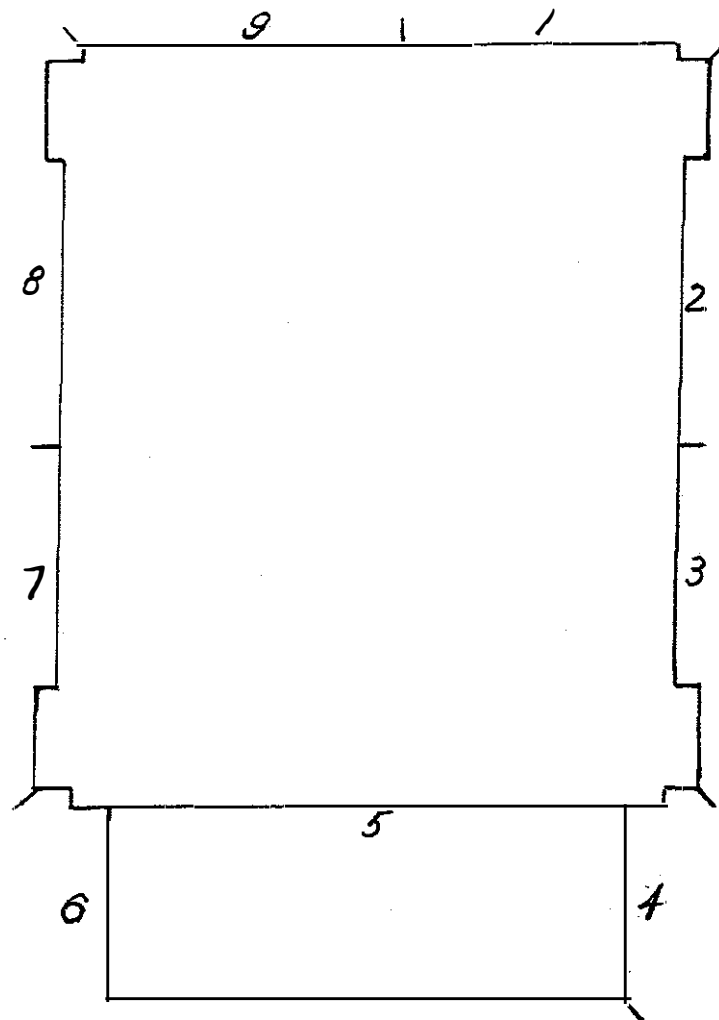
3. Some of the terra cotta blocks show fine cracks on their outer surfaces. It is not possible to tell whether these cracks just affect the outer glaze or if they go deeper. In any event these cracked blocks should be inspected from time to time so that if such cracks are detrimental to the terra cotta, they can be rejected in future buildings.

4. A good point is that the windows have either a terra cotta cap or no cap at all, in which case a steel plate is used; and the undersides of all terra cotta sills are well grooved. No Madison is used for window sills.

5. South side. Slight discoloration in the same two zones as mentioned for the east side, though much less extensive here.

The west side is very similar, but the discoloration is so light that it is hardly noticeable.

University Field House.



65 x 100 Paces



The field house was completed in 1930. Madison sandstone was used for facing the structure and terra cotta was used for two wide belt courses just above grade level. For door frames, window sills and other belt courses.

The window frames are laid up with green colored brick.

Cracks, discoloration, and efflorescence are the chief faults to be found in this building, for as yet the stone is unweathered.

#### Location 1.

At the base here as elsewhere in this building there are two wide belt courses of terra cotta. These are effective in keeping capillary water out of the wall and are pleasing in appearance. The use of similar belt courses at grade level is to be recommended.

The next belt course is eight feet above the ground; it projects from the wall and is not grooved on its under side. The sills of the panels in which



the windows are set, as well as the window sills themselves, are of terra cotta. They project slightly from the wall but are grooved below, as is the wide belt course at the top of the window panels. The top of the wall is capped with four courses of terra cotta, the

bottom one of which projects two inches beyond the wall below it. From the ground this does not appear to have a groove on its underside.

The Madison below the eight foot high belt course shows grayish black discoloration of varying shades in one-third of the area. While a part of these discolored areas are below mortar joints in the belt course and seem due to water-borne soot, etc., others are scattered at random through the wall and their discoloration seems due to their further projection from the wall where they may intercept soot and silt-laden water dripping from the belt course.

Just below this belt course in several instances the mortar has pulled

away from the stone, leaving a minute crack which will let water in and which may in time raise havoc with both stone and mortar. The projecting terra cotta door frame is protected on top by a copper sheet. This sheet contributes discoloring matter to the stone above, for a distance of one foot, and the sandstone at the sides of the door frames where water from this copper sheet drips off is also discolored. This staining will grow much worse in the future. There are four of these low doors on each side. All of these show the same features and will not be described in detail again.

A slight discoloration is also seen just below the large ornamental lamps.

Thirty feet west of the center door in this location, a crack in the wall extends from the window sill down to the base. This crack cuts right through the stone and terra cotta. It should be patched.

There is slight discoloration below the sills of the small windows 12 feet above ground level and also below the large window sills. In these large windows the discoloration is more noticeable. It seems to be due to not having set the sill out far enough, for in spite of the groove on the under side, water dripping off this sill strikes the more projecting stones in the wall and stains them.

The remainder of the wall in this location is in excellent condition until the upper part of the wall is reached. Here just below the lowest belt of terra cotta in the capping belt courses, there is a zone from one to six feet wide and averaging three feet in width, which shows abundant white efflorescence and some brown discoloration. This efflorescence looks like lime that has worked out from the interior of the stone. The dirty brown discoloration seems to be an accompanying thing and is either a late or an early phase of the efflorescence. This efflorescence is most abundant near the lower ends of the gable. It seems quite probable that water working through the wall from the roof on the other side may have caused this efflorescence. Apparently the white material has come from within

by an outward elimination of moisture so the above explanation would seem to fit the facts better than relating the efflorescence to water entering the stone from the terra cotta belt course above it.

#### Location 2.

Discoloration in the sandstone below the eight foot belt course is seen mainly in blocks that project far enough out to intercept drip water coming off the lower edge of the belt course.

Some streaks of discoloration are also seen below mortar joints in the belt course, indicating that the downward flow of water is concentrated at some of these joints.

Areas above and beside the door frames are stained as mentioned in

#### Location 1.

Above the eight foot belt course slight discoloration is starting to appear below the lamps and under the small window sills. These small windows are set into the walls and their sills are set flush with the wall so that the soot and dirt lodging on the sills is rubbed out onto the wall just below.

The grooves on the large window sills are very effective and the stone in the wall below these sills is entirely fresh and undiscolored.

The remainder of the wall is fresh, unweathered, and undiscolored. It is in excellent condition except for two long cracks. In the third window from the south end, a well defined but not a very wide crack extends from the top of the window to the top of the wall. Near the center of the fourth window from the south end, a similar crack extends from the top to the base of the wall.

#### Location 3.

The condition of the wall in this location, as regard to discoloration, is very similar to that described in detail under Location 2.

Cracks above the second and fourth windows from the north end extend

from the tops of the windows to the top of the wall. A similar narrow crack runs from the base of the fifth window to the ground.

#### Location 4.

In this location the main building is in excellent condition above the eight foot belt course. However, below this belt course there is considerable discoloration. Here the discoloration seems to have come from the interior of the stone rather than from the projecting belt course above. The discoloration is not very dark or displeasing. The reason for its appearance can not be definitely stated.

On the grandstand wall discoloration is seen below the ventilator which has copper vanes, below the flush-set window sills, and below the terra cotta course which caps the wall. Joints in this cap layer break the flow of water and direct it vertically downward where it stains the wall. The under side of this capping course is grooved on its under side, but it does not project far enough beyond the wall to be effective. Projecting stones in the wall are the most seriously stained.

There are three well defined discolored streaks here which range from four to eight feet long and are about one foot wide. The remainder of the wall is in good condition.

#### Location 5.

Aside from a little discoloration on some of the more projecting stones below the window sills, the main wall of the building is in excellent condition until the upper four to six feet are reached. In this zone, just below the capping courses of terra cotta, there is abundant dirty brown discoloration and a little efflorescence. Here it can be seen that the lowest capping course is grooved on its under side, but the terra cotta is not set out from the wall far enough but that water flowing over the terra cotta can easily enter the stone below it. Streaks are most abundant below joints in the terra cotta

where small offsets break the lateral flow of water and direct it vertically downward, but discoloration all along attests to the ineffectiveness of the grooves here.

There is decidedly less of the white efflorescence here as compared with Location 1. This is probably due to the greater amount of evaporation on the south side which would tend to bring the carbonate to the surface.

The walls at the ends of the Grandstand show gray to black discolored streaks under 40 % of the joints in the terra cotta coping course. The darker streaks point plainly to slight offsets at the joints of this coping course, for when a block is set any farther than the one above, the flow of water is at once directed down onto the sandstone below.

#### Location 5.

The wall of the main building is in fresh and excellent condition above the eight foot belt course; below this course there is some gray discoloration from water dripping on the more projecting stones. About 1/3 of the area is so affected.

In the Grandstand wall discoloration of a greenish black color and also small spots of white efflorescence are seen below the copper veneer of the ventilation intake. Five or six discolored bands are seen below joints in the terra cotta course which caps this wall; also below the window sills there are slightly discolored areas.

#### Location 7.

In this location the sandstone below the eight foot belt course is discolored gray to black in at least 80% of the area and there is also some white efflorescence in this zone.

The discoloration is due to dirty water dripping off the belt course and striking the projecting stones and also flowing back under the belt course and discoloring the stone set more flush with the wall. This shows very

plainly that this belt course should have been grooved, and should have been set out farther from the wall below it.

The efflorescence is white and is most frequently seen where dark discoloration is heaviest, thus emphasizing the discolored areas. This efflorescence coats both stone and mortar. I am unable to tell for sure from which it comes, but I think it is from the stone.

There is greenish black discoloration above and beside the door frames, as mentioned in location 1.

Aside from the slight discolorations below the large lamps, the remainder of the wall is unstained and unweathered. The second and fourth windows from the north end have narrow cracks from their tops to the top of the wall, and above the sixth window there is a wide crack to the top of the wall which ought to be patched.

#### Location 8.

Gray to black discoloration affects 50% of the sandstone below the eight foot belt course here. While more projecting stones are usually most affected, in this location more than in any previous one, there has been a back flow of dirty water on the underside of the belt course which has led to discolored zones immediately below this belt course. Areas showing white efflorescence are more numerous and more widely scattered here than in location 7. This efflorescence seems to come from the stone rather than the mortar, and, since it is confined to the zone below the eight foot belt course, it must be due to water moving over and out from the stone below this belt course. About 15% of the stone shows these scattered, slightly white areas.

Areas above and beside door frames show greenish black discoloring similar to that described in location 1.

The second window from the south end has a big crack 1/2 an inch wide running from its top to the top of the wall. This should be patched at once.

Except for these cracks the wall above the eight foot (high) belt course is undisturbed and in excellent shape.

Staining and efflorescence similar to that described for location 8 is to be seen here, but to a slightly less extent. There is a little discoloration below the large lamps. Except for this, there is no fault to be found with the wall above the eight foot belt course, aside from a narrow diagonal crack below the second window from the east and the badly discolored and efflorescent zone at the top of the wall. This is entirely similar to that on the other half of the south end, described under location 1.

Discoloration and efflorescence in this building are confined to two areas: (1) below the belt course eight feet above the ground and (2) in a 5-6 foot zone at the top of the sandstone wall on the north and south ends. The upper zone is somewhat hard to explain. It may be due to water working through the wall from the roof or it may be caused by water getting at the wall because the terra cotta courses above are not set out sufficiently from the sandstone. The discoloration and efflorescence below the eight foot belt course is more easily explained. It is due to a lack of grouting and to the inadequate setting out of this course from the sandstone below it.



Root and dirt collected on this belt course and there are

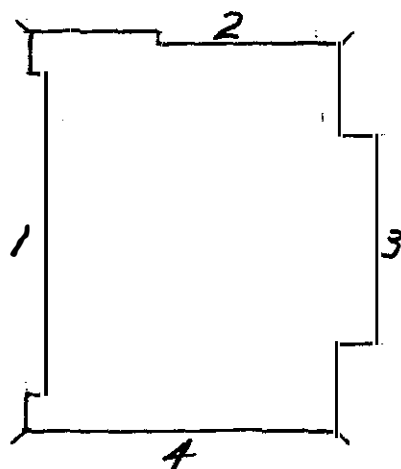
washed down to stain the wall, and this same water promotes efflorescence.

Another fault to be found is that of the copper sheets over the door frames. These contribute a green-black stain to the sandstone above and beside the doors.

The stone of the walls is of chiseled-squared, roughly cubical blocks. These have taken on a hard outer shell and are not weathered.

There are several large cracks above and below the windows. These are probably due to unequal settling of the foundation. A few of these are quite wide and should be filled with mortar.

#### The Refectory.



*35x40 Paces*



## The Refectory.

### Location 1.

The sandstone rests on a concrete foundation from 8 - 18 inches off the ground so capillary water cannot get at the sandstone. Two feet above the foundation is an eight-inch bush-hammered belt course set flush with the wall below and above which the wall is set in six inches. The first floor window sills carry grooves on their under sides, and the bush-hammered belt course below the second floor windows is also grooved.

The entire wall of this location is in excellent condition. There is no discoloration nor any appreciable weathering. The wide cornice and the grooves below the sills and belt courses have protected the stone very well.

A number of the stones have been placed with their beds in vertical position, and a few blocks show a blue-green color on their bedding planes which adds to the attractiveness of the wall. So far these vertically placed blocks are standing up just as well as the others.

### Location 2.

Here also the sandstone rests on a concrete foundation, and capillary water is excluded. There is no belt course near the ground. Instead, about five feet from the ground, the wall is set in six inches, leaving a small shelf. The stone below this shelf is all discolored to black or gray in a belt six inches to a foot wide. This is due to soot and dirt-laden water, running over the edge of the shelf.

The bush-hammered stone belt course on the west half of the building and the corresponding cement block course which caps the wall in the east half are both grooved on their under side.

The stone in the wall is all in excellent condition, although some of the mortar between the stones has the appearance of having been patched.

### Location 3.

All projecting belt courses and sills are protected by a groove on their

under sides.

All the stone here is in excellent condition. There is a little discoloration below the sills of the first floor windows, but the outer surface of the blocks is still firm. There is also a little discoloring on the outer faces of the projecting smooth-cut stone of the ornamental gable.

#### Location 4.

While there is a concrete foundation under the whole sandstone wall in this location, on the east twenty feet the soil has been graded up above the contact, and capillary water will be able to enter the stone. As yet there has been no decay from this. The entire wall is in excellent condition.

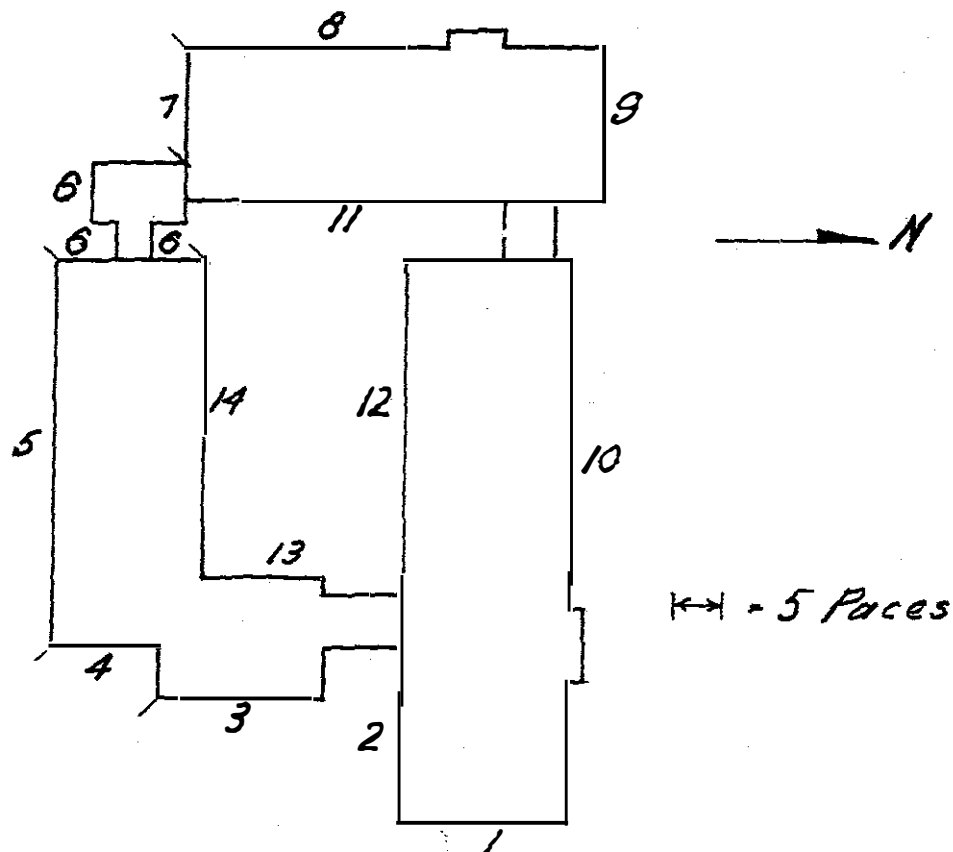
#### Summary.

The refectory is faced with Madison sandstone in irregularly shaped, rather rough-surfaced blocks. Many of the blocks are laid in a vertical position. The joints between stones are rather wide, the average being about one inch.

All projecting belt courses and sills are well grooved. A wide cornice protects a part of the building.

Without exception, the stone of this building is in excellent condition.

Tripp Hall.



Tripp Hall. General.

Tripp Hall was completed in 1926. The facing stone is the Madison sandstone. The sandstone blocks are not smoothed and while most of the blocks are roughly square or oblong, a good many stones are of irregular shape and with their bedding vertical are placed in the wall. However, odd shaped stones are much less common in the walls here than in the Refectory walls.

The sandstone in all cases rests on a concrete wall six to twenty-four inches above ground level so that capillary water is kept out of the sandstone.

There is a bush-hammered, eight-inch belt course some four to six feet above ground level. At its base this course is flush with the wall; above it the wall is set in five to eight inches; it has a sloping upper surface. In parts of the building there is another eight-inch bush-hammered belt course below the third floor windows. This belt course projects from the wall one to two inches and is grooved on its under side only where set in panels below it give it a projection of four or five inches.

Except where belt courses form the window sills, brick is used for window sills; and as the bricks are tilted out slightly, the lower edge acts as an effective drip in preventing water from running back into the wall.

The wide courses also are effective in preserving the wall.

#### Location 1.

The outer face of the lower belt course is a little discolored, as are the stones just below it and a narrow band above it, due to soot and other dirt collecting on the shelf and later being carried down by water. This discoloration is most noticeable under the windows, suggesting that the soot may have contributed some of this dark stain.

Three or four blocks just under this belt course show the beginnings of a slight white efflorescence, which seems to come from the stone rather than the mortar.

One block in the belt course is more ality than the others and has weathered by spalling in front of these patches to a depth of  $1/8$  -  $1/4$  of an inch. With these exceptions, the wall here is in excellent condition. However, some of the large irregularly shaped, vertically placed blocks do not appear quite as firm as those laid horizontally. They will no doubt be the first to show weathering, and I feel their use should be avoided.

#### Location 2.

Discoloration of the belt course and the wall just below is confined to the areas under the window sills. In the wall above a small amount of

discoloration is seen in the stones which project far enough from the wall to intercept dirty water dripping off the brick window sills.

From the standpoint of weathering, the wall is in excellent condition.

#### Location 3.

The description given of Location 2 applies here, although areas beneath the second and third floor windows are not stained. Altho' six or eight of the vertically laid blocks are beginning to show a tendency to spall off, as yet little or no spalling has taken place.

#### Location 4.

In this location, the outer side of the lower belt course and a small part of the stones below it are discolored gray to gray-black. This is most noticeable below the windows. Projecting stones below windows are in several cases similarly stained where they intercept dripping water from the sills. The walls here are unweathered and in excellent condition.

The upper belt course all around the building is so well protected from water by the wide cornice that a groove on its under side is really unnecessary.

#### Location 5.

Discoloration in this location is located in areas similar to those described under Location 4. Roughly one-fourth of the stones that can be positively said to be in a vertical position are starting to show a tendency to decay, and in a few of them spalling and in others grain by grain disintegration has gone on to a very slight extent.

The western down spout here is broken near the ground, and below this break there is an area of three square feet which shows marked discoloration and efflorescences. With the minor exceptions noted, the wall is in excellent condition.

#### Location 6.

There is a minor amount of staining below the few windows in this wall.

and one very silty vertically placed stone is conspicuous because it has spalled off to a depth of 1/2 to 3/4 of an inch. Otherwise the wall here and in the Gate House is in excellent shape.

#### Location 7.

Weathering here is seen only in the thin spalling of a couple of vertically laid blocks. Discoloration is seen on the outer faces of both the upper and lower belt courses just below the windows. While this discoloration is rather light, there is a dark black streak below the junction of the Gate House roof and the wall.

#### Location 8.

There is nothing new to be recorded here. There is some slight discoloration in areas similar to those previously discussed. Also there are numerous rather large stones of irregular shape laid vertically in the wall. As yet these have not been seriously attacked, but there is every reason to believe that as time goes on, these will decay more rapidly than those horizontally laid, which will lead to a serious disfiguring of the walls.

#### Locations 9 and 10.

The generalizations listed under Location 8, and the more detailed descriptions of the location and causes of discoloration previously given, apply so closely in these two locations that a separate description is deemed unnecessary.

#### Location 11.

Discoloration in this location is confined to the outer face of the lower belt course below the windows and to the areas below three or four scattered windows whose sills have not been projected far enough from the wall to avoid stain from water dripping from their under sides.

Several of the vertically placed blocks in the wall are beginning to show an inherent tendency to spall off, but as yet there has been little or

no spalling. The outer edge of the stone balcony is noticeably discolored, and a slight pitting and spalling is taking place. The depth affected is not greater than  $1/8$  of an inch.

Aside from these minor exceptions, this wall is in excellent condition.

#### Location 12.

Excepting the usual discoloration of the lower belt course, the placing of stones in the wall in vertical position where they will, in the future, weather more rapidly than the correctly placed stones, and the balcony, which is weathered in a manner similar to the one in location 11, no fault can be found with the condition of the wall here.

#### Location 13.

There is nothing noteworthy or new to be mentioned about the condition of the wall in this location. It is entirely similar to the other locations previously described.

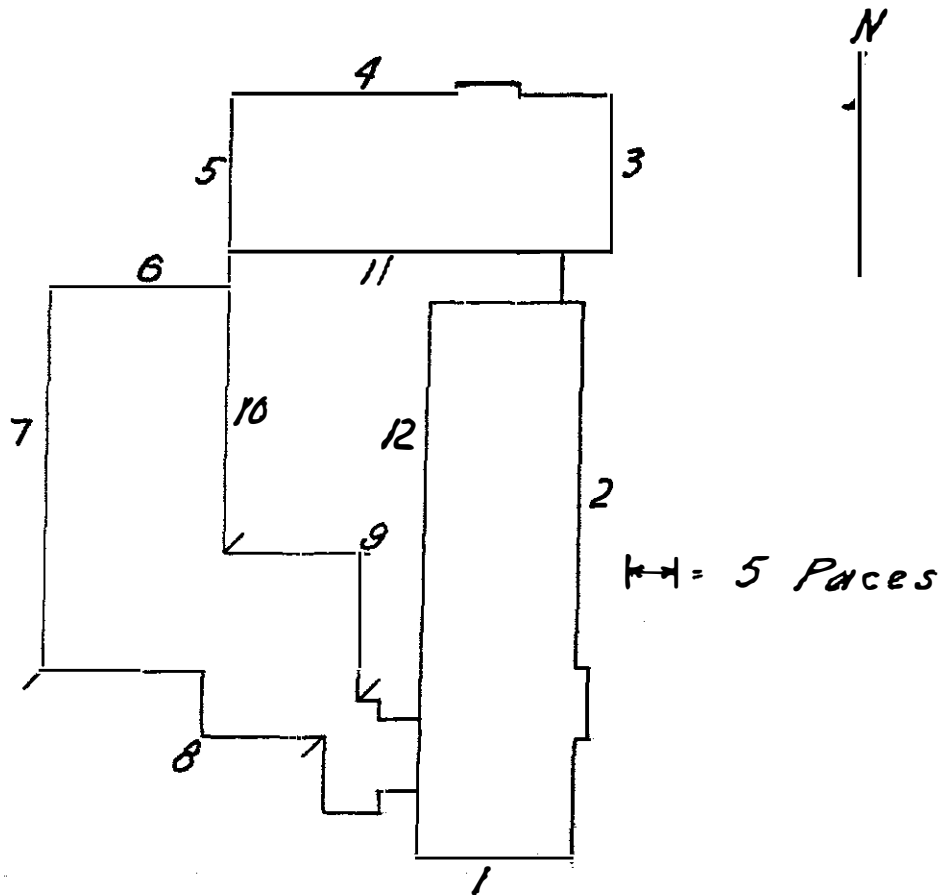
#### Location 14.

The most serious discoloration here is seen near the top of the wall around the down spout. Some defect or clogging of the box at the top of this spout has resulted in a flow of water on the wall behind; this has stained a streak five feet long and one foot wide. Small areas of white efflorescence are noted just below this black stained area. They are no doubt due to the same cause.

There is a slight discoloration and pitting up to  $1/8$  of an inch deep on the outer side of the floor of the balcony. This pitting is most noticeable below a horizontal mortar joint. The use of a waterproof covering in all the joints of the balcony would have arrested, at least, if not prevented this pitting.

In other respects this wall is similar to the one across the court, described under location 12.

Adams Hall.



Adams Hall.

Adams Hall, completed in 1926, is built on the same plan as Tripp Hall. The general discussion given under Tripp Hall applies to Adams Hall and will not be repeated.

Location 1.

The upper and outer faces of the lower belt course are discolored gray to black. This is especially noticeable under the windows and is due to dirt and soot from the shelf at the top of this belt course being washed down onto the stone below.

The vertically placed stones in this wall may easily be picked out by their lighter color. This appears to be due to their not having taken on the



firm, case-hardened shell the other stone has. While there has been a very minor amount of thin spalling in these stones, the state of slow, grain by grain disintegration seems to account for most of this lighter color. As yet the decay is very superficial and the wall is in excellent condition.

#### Location 2.

There is the usual discoloration of the lower belt course here. This is the more severe under the windows and in a few places it has affected the stone below this belt course. Beneath some of the windows where stones project far enough to intercept dirty water dripping off the sills, these projecting stones are somewhat discolored.

From the standpoint of weathering, the stone in the wall is in excellent condition; at the present time no evidence of decay is to be seen. However, it is expected that as time goes on, the blocks placed with their bedding planes vertical will yield more rapidly; and if the building were to be built again, this practice should not be allowed.

#### Location 3.

Similar in every way to the conditions described under Location 2.

#### Location 4.

The discoloration here is similar in location, causes, and amount to that described in Location 2. The stone is in a similar condition, also, but serious fault can be found with the mortar in the joints of several rather large areas, ranging in size from five to twenty or more square feet. Apparently the mortar was allowed to freeze before it set, for in many places one sees the small needle-like impressions of ice crystals. This freezing, or also the poor quality of the mortar originally, has rendered the mortar soft, and in many cases it has weathered out 1/2 an inch or more. In many places the mortar is so soft that it can easily be picked or rubbed away with the fingers.

All the joints below the belt course and many places in the wall above

have been patched with a smooth waterproof (?) mortar. This has been very necessary, and though rather unsightly, because the new mortar does not match the color of the old, has been very effective.

Further patching is needed now in many places, and before long the entire wall as far up as I could examine it from the ground, and probably much higher, will require patching throughout. As high up as it could be examined and over the whole length of the wall, the mortar is in poor to no better than fair condition.

#### Location 5.

The same fault is to be found with the mortar in this location. Impressions of ice crystals are frequently seen, and much of the mortar is weak and very soft.

Considerable patching has already been necessary, and at present some more repairing could be done. It seems best, to me at least, to wait for a time and let the joints get deeper, lest the thin sheets of new mortar spall off from in front of this old rotten stuff, as it has done here in some cases.

Considerable patching has already been done, about 12 - 15% of the joints having required repair. This has been somewhat localized above and below the windows, but pretty generally spread over the wall.

The stone itself, aside from slight discoloration in the usual places, is unweathered and firm.

#### Location 6.

The lower belt course is some seven feet above the ground here. The mortar between the stones below it is not standing up well. Part of this has been patched, and more patching will be needed in a few years. Above the belt course it has apparently been necessary to patch all the joints; at least from the ground it appears that they have all been so treated.

The use of such low grade mortar or the allowing of the mortar to freeze is deplorable. The rotten, soft material pulls away from the stones and spalls

out, to leave deep, wide cracks that require expensive and careful patching. No patching is needed above the belt course here, but below it patching will be required within a year. The stone itself is in very fine condition, though there is a little staining below the windows and on the lower belt course.

#### Location 7.

The joints between blocks here have, since the original construction of the building, been effectively patched, so that at present there are no bad open joints, as are seen in location 4. A complete patching job such as is seen here is to be recommended for location 4.

Discoloration is seen on the lower belt course and on the stones below where the belt course is beneath windows. At other places discoloration is very light. Projecting stones below brick window sills are similarly stained. In the rock of the wall, there is no discoloration or efflorescence. All of it is, so far, in excellent shape.

#### Location 8.

From the freshness of the mortar and the numerous trowel marks which are clearly seen here, but are not observed in the older mortar, it appears that the entire wall in this location has been patched. Be that as it may, the joints between stones are all in good condition, and the patches are holding well.

Discoloration, and the freshness and unweathered nature of the stones are similar to that described under location 7.

#### Location 9.

It is not possible to tell for certain how much patching has been done in this location. All the joints below the belt course are retouched, and I think it likely that all the joints have been treated likewise. Anyway both stones and mortar joints are in very good condition. There is the usual discoloration below the windows on the lower belt course.

Location 10.

As one compares this wall with the one in the adjacent location 11, where there are but a few and conspicuous patches, it becomes clear that all of the wall in this location (10) has had its joints retouched. The patching is holding very well, and the stone of the wall is in excellent condition, though slightly discolored in the usual places.

The balcony here is slightly discolored, and pitting is just beginning to show up. Several joints in the floor slab need to be touched up. This should be done at once, lest the water following these cracks cause serious spalling.

Location 11.

In this location the more seriously weathered mortar joints have been patched, but only a small part of the area has been so treated. In nearly all of the joints which can be closely observed, the mortar has fallen away to depths of  $1/4$  to  $1/2$  an inch. This has taken place both by disintegration and by the spalling of thin sheets. At present there are no joints in dire need of attention, but as all the mortar is soft and crumbly, at least on the outside, the retouching of the entire wall is recommended. This patching will all have to be done sooner or later, and it is not well to leave the sandstone exposed so that water can get behind the outer face of the stone, as it can at present.

So far the stone of the wall is unweathered and in excellent condition, aside from minor discoloration. The balcony shows pitting and slight spalling to a depth of  $1/8$  of an inch on its outer side. Also the center joint in the floor slab is badly in need of retouching.

Location 12.

Sufficient retouching has been done in the joints in this location that the wall is in fair to good condition on that score. However, additional work of that kind, especially on the north end, will be needed within two years. The stone itself is in fresh unweathered condition, aside from the usual

staining.

In the northernmost of the two balconies, pitting and spalling from 1/8 to 1/4 of an inch deep is seen in the more ality portions of the blocks. Both the outer and a small part of the under side are so weathered. The other balcony is only slightly discolored.

Additional Note on Location 1, 2, and 3.

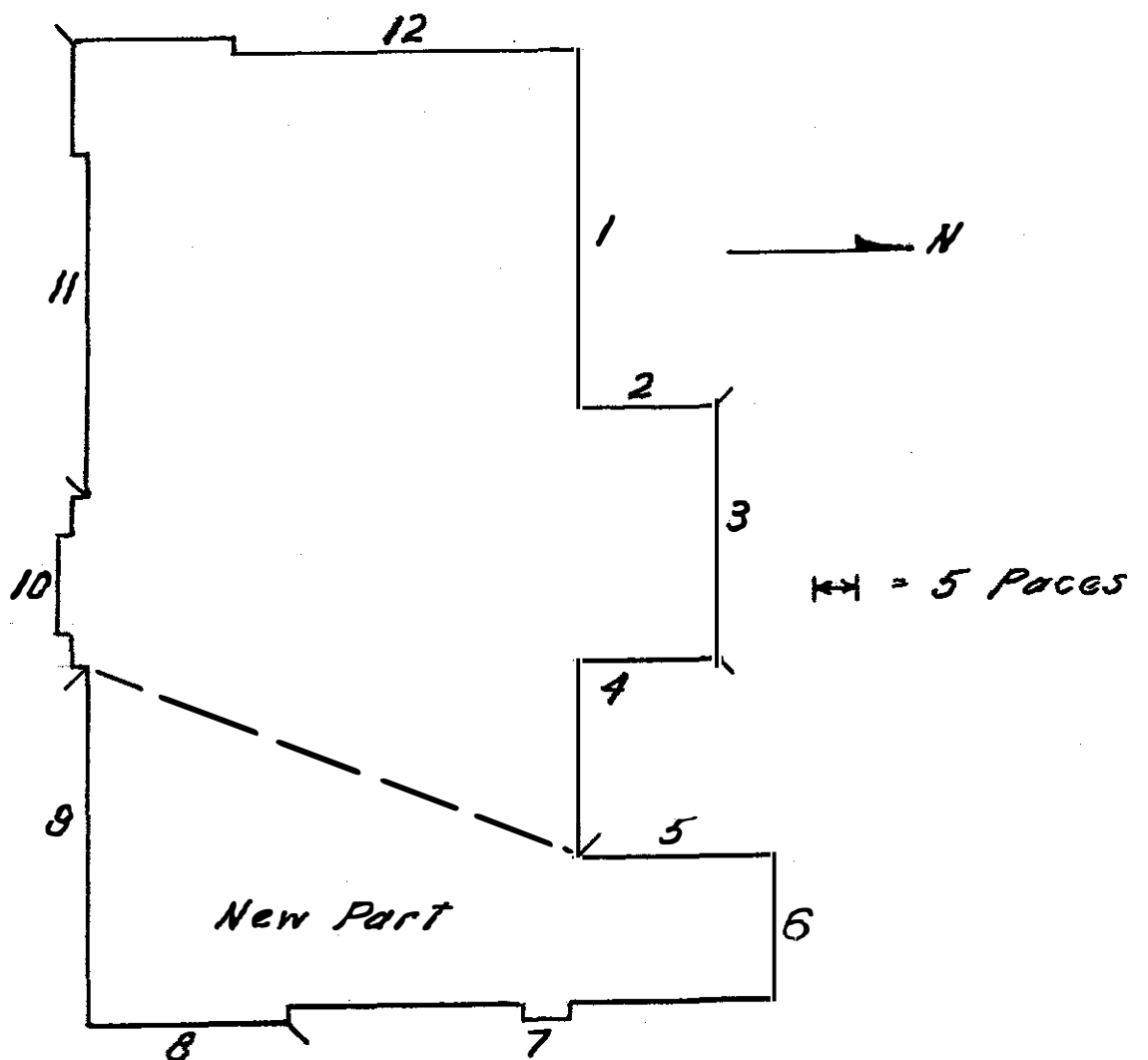
The mortar in the joints in these locations is not holding up the way it should. However, the bad spots have been effectively patched, so that at the present time there are no openings in need of immediate repair, such as are found in Location 4. Spots in need of repair will be found from time to time in these locations, especially in #3, and a careful year by year inspection should be maintained.

Very great care should be exercised to prevent in any new buildings the wholesale disintegration of mortar, such as has occurred in this building!

Tripp Ball.

My attention was not directed to the question of the weathering of the mortar until I saw the very serious decay described under Location 4 (Adams Hall). A brief review of Tripp Hall showed similar, though less deep, weathering. Spots that have been deeply effloresced have been patched, and at present further work of retouching does not seem essential.

Chemistry Building.



Chemistry Building.

Location 1.

The wall here is considerably newer than in Location 2. Sand-lime brick has been used from the ground up. The brick is standing up very well so far.

Location 2.

There are two projecting belt courses of limestone in the wall: one four, and another six feet above the ground. Only the upper one has a groove on its under side. The Bedford limestone is used for the window sills. The rest of the wall is sand-lime brick.

Weathering of the brick is most pronounced in the three lower courses, where <sup>top</sup> of the bricks are decayed to depths of  $1/4 - 3/4$  of an inch. The bricks rest on a concrete foundation, but this foundation sets up only two or three inches above ground level: so splash and capillary water have been effective in weathering the brick. The remainder of the brick below the first belt course is discolored from the splashing of muddy water from below and the running back of sooty water on the under side of the belt course. Nearly all of the brick below the first belt course have lost their original smooth outer glass and have begun a slow grain by grain disintegration.

The brick between the first and second belt courses are in fair to good condition, showing the effectiveness of the groove on the under side of the second belt course.

The brick of the first floor wall is in fair condition. On the north wall the brick has retained its glass and is standing up very well, but on the west wall there are areas where disintegration has begun. Over one-third of the wall is affected.

The brick belt course and the areas under the window sills of the second floor are equipped with a projecting strip of tin to keep water from the walls just below them. In the case of the projecting brick belt courses, this has

been only partially successful, for the outer and under sides of this course are discolored, and weathering (especially on the under side) is seen up to  $1/4$  of an inch deep.

Between 85 and 90% of the bricks in the second and third floor walls show evidence of grain by grain disintegration. This is rarely deeper than  $1/16$  of an inch, but now that the outer shell has gone, this will go on more rapidly in the future.

The sand-lime brick shows rather low tensional strength, and there are numerous cracks, especially over the windows. However, in all but the easternmost first floor window on the north wall, these cracks have been patched.

#### Location 3.

Below the lower belt course there is not much decay, except on the eastern twenty feet of the wall, where the soil is in direct contact with the sand-lime brick. Here the spalling of thin sheets has taken place to depths of  $1/4$  -  $1/2$  an inch, due to the alternate freezing and thawing of capillary water.

The brick above in the first floor wall is in fair to good condition, except an area below a pipe, where water has run down the wall and has caused spalling  $1/16$  -  $1/8$  of an inch deep over an area of fifteen square feet.

In spite of the tin flange above the projecting brick belt course between the first and second floors, the outer side of this belt course is discolored and on the under side 80% of the brick shows weathering at least  $1/8$  of an inch, and in a few cases  $1/4$  of an inch deep. This weathering has been caused by water working down from the shelf above. It has proceeded both by spalling and slow disintegration.

Just above this, one sees weathered areas at the ends of the second floor window sills, where water has run laterally until the end of the sill is reached



and then has gotten into the brick work. At the end of each sill there is an area of about one square foot where the end of the brick has fallen away, following the loss of its setting material, to depths of  $1/8$  to rarely  $1/4$  of an inch.

The brick of the second and third floor walls is in fair to good condition. Top of the brick has lost its original firm, glazed surface and is disintegrating slowly. However, except for two small areas in the central columns where the bricks have weathered to a depth of  $1/4$  of an inch, none of the brick is affected more than  $1/8$  of an inch.

Nothing can be done about this disintegration while as yet it is not serious, it will in time weaken the wall.

Clearly in this climate sand-lime brick should not be used in exterior walls.

#### Location 4.

In this location the lowest belt course is from level with to one foot above the level of the ground, and 90% of the brick below this belt course is weathered  $1/4$  -  $1/2$  an inch. On the ground below is a small pile of sand all along, which has come from the decay of the brick in the wall. The decay has been caused by the freezing and thawing of capillary water.

The limestone belt course shows a slight amount of decay in the more cross-bedded blocks. This is in the form of pitting and seems due to the weathering of all surrounding shell fragments. The depth affected is not over  $1/16$  of an inch, but the decayed portions are much lighter in color, so the result is unsightly.

A row in the brick four to twelve inches wide just above this belt course shows decay  $1/4$  to 1 inch deep over 60% of the length. Spalling is the form of weathering most commonly seen.

The brick of the first floor wall is in fair condition. While the

surface appears quite firm and unaffected by weathering in many places, a hole 1/8 of an inch deep can be dug in the brick with the finger nail.

For the remainder of the wall, the description of Location 3 fits very well. It should be added that below the tin cornices which cap the wall, there are several areas of grey to black discoloration.

#### Location 5.

The wall here is a part of the latest addition to the Chemistry Building, and there is no weathering to be seen. The brick is cream colored and well glazed; it will stand up almost indefinitely. Bedford oolitic limestone is used in belt courses and under the window sills.

Discoloration is the only fault to be noted here. The most serious discoloration is seen just below where fire-escape braces enter the wall. Below these braces, dark rusty brown streaks one to four feet long and six to eighteen inches wide stain both brick and limestone.

All three of the limestone belt courses between the first and second floors show considerable light to dark grey discoloration. This is due to the movement of dirt and soot-laden water. It is most noticeable below the windows. There is less noticeable discoloration below the windows on the belt courses between the third and fourth floors.

Any of the mortar joints in the belt courses will require repointing with mortar within a year or two.

#### Location 6.

From the standpoint of weathering, this wall is in splendid condition. There is a slight amount of discoloration on the limestone sills and belt courses. The worst offenders are the belt courses between the first and second floor, the middle one of which projects some eight inches from the wall. In spite of its sloping upper surface, soot and dirt lodge on this shelf and are carried down by water to stain the stone below.

This discoloration is not particularly unsightly. It can be avoided,

I believe, only by eliminating such projecting belt courses.

Location 7.

No defects other than discoloration are seen in this wall.

The upper of the three belt courses between the first and second floors is slightly stained below the windows. This course projects no more than an inch beyond the wall, yet such a narrow shelf catches enough dirt to stain the stone below it.

The middle and most set out of the belt courses is somewhat stained on its outer side, and even in spite of the groove on its under side, water has run back and down, to lightly streak the course below.

The belt courses which form the fourth floor window sills show a little light gray discoloration under the windows.

Location 8.

Similar to Location 7 in all respects except for the large 18 - 24 inch projecting ornamental belt course below the fourth floor windows.

Staining and efflorescence are seen on the outer-facing, under-hanging portion of this course. The most serious staining and efflorescence are around the now rather open joints between blocks, but there is also efflorescence where water has run back under the outer edge or lip of this projecting shelf.

Location 9.

Aside from the fact that the efflorescence and staining in the belt course below the fourth floor windows is less marked in this location than in Location 8, the two areas are so similar as to make a separate description unnecessary.

Location 10.

All the wall in this location is faced with the Bedford poliotholimestone. The limestone used seems to be of a rather poor grade, for weathering is rather conspicuous in several places. In most instances the decay appears to be due to the weathering out of silt or mud-surrounded shell fragments. This is especially

uneighty in blocks which show cross bedded structure.

The limestone is in direct contact with the ground at the base of the wall, and the three lower courses show shallow pitting in 50% of their surface area.

Continuing upward, one sees pitting, bleaching, and efflorescence in the scroll-work of the door frame and in the two windows on either side of the door. The under sides of the projecting ledges above these same frames show weathering in the form of pits and small spalled areas. The depth affected ranges from  $1/8$  -  $1/4$  of an inch and is clearly due to water from the balcony, working down under these projecting ledges.

None of the stone in the second and third floors presents a smooth fresh face; all of it seems very slightly pitted and small white blotches of efflorescence spot the wall. This efflorescence comes from the stone rather than the mortar. The columns were cut from cross bedded stone which has been weathered unevenly, so that streaks of lighter and darker stone mark the appearance of the columns.

In the projecting belt course at the base of the fourth floor, staining and efflorescence, more particularly the former, are seen in abundance. These features are most severe but are by no means confined to the joints between blocks, the majority of which are wide open and much in need of retouching. Fully 30% of the under side of this belt course has decayed to a depth of  $1/8$  -  $3/8$  of an inch by spalling, and there is also some pitting. The groove at the outer edge of this under side is not effective, because the mortar joints are open, and the deepest decay is adjacent to these open joints.

#### Location II.

Here the foundation courses up to the first belt course are of the Bedford limestone, and weathering is conspicuous. The areas most severely affected are those behind the bushes.

Weathering takes place by spalling in both very small thin sheets and in larger sheets up to  $1/4$  of an inch in thickness. The spalling seems to be due to silt surrounded shell fragments which weather out rather easily. 30% of the stone below the first belt course is thus affected to depths ranging from  $1/8$  to  $1/2$  an inch. The texture and appearance of unweathered portions of weathered blocks are very similar to that of completely unweathered blocks. There are numerous places around the joints where the mortar has weathered out and the stone is badly decayed. Whether the loss of the mortar caused the decay or resulted from it, cannot be stated. In any case there are numerous joints here which should be patched. It appears certain that the bushes have aided in the decay of the stone. There is often a little efflorescence below the weathered areas.

The belt courses between the first and second floor are somewhat discolored, but while darker than in the newer parts of the same building, the discoloration is a blended gray. Streaks are not present, and the whole appearance is not displeasing. The same statement applies to the projecting belt below the fourth floor windows. Here, however, there are dark stains adjacent to the mortar joints.

Weathering on the under side of this course is not prominent as it is in Location 10.

#### Location 12.

Here again the courses below the first belt course are of limestone, and though the lowest course rests on a concrete foundation, along 50% of the wall, soil is graded above this contact and capillary water can enter the limestone courses. This has had little effect in weathering the stone.

In the second and also in some places in the third course above the ground the stone is weathered in a manner similar to that described under Location 11 over 65% of its length.

The first belt course is discolored a dark gray to black, and the few streaked cross-bedded blocks show up prominently. The belt courses that cap this wall show rather even, blotted discoloration. There are also two small areas of efflorescence in the wide belt course just at the top of the wall.

#### Chadbourne Hall.

Chadbourne Hall, built in 1871, is faced with Madison sandstone. The stone is bush-hammered, with a smoother chiseled border  $\frac{3}{4}$  to  $1\frac{1}{2}$  inches wide on each block. The stone is laid up in regular courses twelve inches wide, but each course contains smaller square and oblong blocks. It is not possible to accurately tell the position of the bedding in the blocks of the wall. It seems quite obvious, however, that the larger stones are laid with their bedding in a vertical position.

There is only one belt course of stone in the entire wall. It is just a little above the ground and is of Madison sandstone.

Window sills and cap stones are set out from the wall about  $1\frac{1}{2}$  inches. The under sides of the sills have had a crude, shallow, rather ineffective groove cut in them with a chisel.

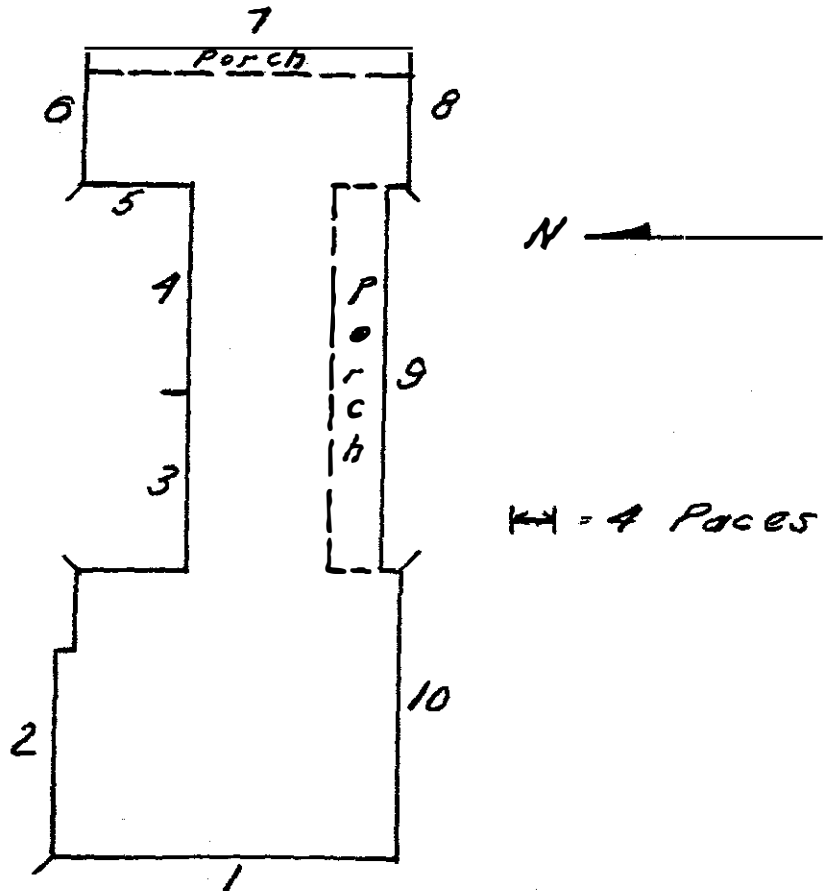
#### Location 1.

In general the stone of this wall is in excellent condition. The exceptions to this sweeping statement are listed below.

1. The capstones over the windows do not have a groove on their under side, and as a result water from the eaves <sup>works</sup> back on the under side and has caused spalling from  $\frac{1}{8}$ , rarely  $\frac{1}{4}$  of an inch on practically every window in the wall, except those with wooden frames on the fourth floor.

2. A good example of what happens to this sandstone when water has frequent access to its surface, is seen in the corner where the bakery well joins the dormitory wall. A defective drain pipe allows water to get at the stone, and there is a 12 inch wide band below this pipe to the ground, where

Chadbourne Hall.



weathering  $\frac{1}{4}$  -  $\frac{3}{4}$  of an inch has taken place. The weathering of silt-filled worm tubes and spalling in front of silty blotches is clearly illustrated here.

3. There are small discolored streaks below where fire-escape braces enter the wall and also at the ends of several of the window sills. Four or five blocks show a minor amount of white efflorescence.

4. The smooth cut blocks around half of the windows show  $\frac{1}{8}$  of an inch of spalling on their sides that are normal to the face of the wall. This is seen only in the upper parts of the window frames and is due to the same cause as mentioned under #1.

### Location 2.

The base of the fourteen inch belt course is level with the cement drive. Pitting and minor spalling have affected 60% of this belt course to depths of  $1/8$  and very rarely  $5/8$  of an inch.

The eastern one-third of the wall to a width of two feet above this belt course has spalled off from  $1/4$  - 1 inch deep. Both vertically and horizontally laid stones are affected. Splash water working on blocks with abundant silt patches and laminations has been responsible for this serious decay.

Many of the blocks at the west corner in this location show by their lighter color where thin spalling and grain by grain disintegration have taken place. The depth affected seldom exceeds  $1/8$  of an inch.

A more or less weathered area one foot wide on either side of the down spout is seen here. This is essentially a grain by grain disintegration as water has leached the cementing material of the sandstone. The depth of decay does not exceed  $1/8$  of an inch.

The window frames in this location are of wood. Except for the areas mentioned above, the wall here is in very good condition.

### Location 3.

In this location the thick belt course is from one to two feet off the ground. The stone below it, especially on the west wall where concrete doesn't protect it from capillary water from the soil, is all weathered. The depth of decay ranges from  $1/4$  to 2 inches. The average is close to  $3/4$  of an inch. The stones most deeply weathered contain very abundant soft, silt-filled worm tubes.

In the belt course itself, pitting  $1/8$  -  $1/2$  an inch is universal, except in the east wall where there is little decay in this belt course.

In fully 75% of the twenty-inch zone below the first floor window sills and above the belt course, spalling to an average depth of  $1/4$  of an inch is



seam. This has been due to water working back under the sills and also probably due to capillary water working up from the shelf at the top of the belt course.

In spite of the crude grooves on the under sides of window sills, areas two to eight inches wide, where weathering has penetrated up to  $\frac{3}{8}$  of an inch, are found under 40% of the windows.

Scattered blocks which constitute 10% of the wall show disintegration and spalling to depths of  $\frac{1}{8}$  -  $\frac{1}{4}$  of an inch. With exceptions noted above and discoloration below the fire-escapes, the wall is in fair condition.

#### Location 4.

There are three eight-inch courses below the belt course here, and 80% of the stone in these three courses is decayed to depths ranging from  $\frac{1}{8}$  to 1 inch. This appears to be principally due to the lack of a grooving on the under side of the belt course, for the upper course is, in general, more deeply affected than are the lower courses. These foundation stones are not bush-hammered, and it appears to me that this, as well as their position in the wall, is responsible for their deep decay.

There is a slight depth of pitting all along the belt course, but spalling is seen in less than 15% of the length. The depth to which this spalling has gone on ranges from  $\frac{1}{4}$  to rarely  $\frac{3}{4}$  of an inch.

Practically all of the cap stones over the windows show spalling  $\frac{1}{8}$  -  $\frac{1}{4}$  of an inch deep. Reasons for this are discussed under Location 1.

Under 50% of the window sills there are zones two to eight inches wide where decay averaging  $\frac{1}{4}$  of an inch deep has gone on, in spite of the grooves below the sills.

Scattered blocks, most numerous around the down spout, but in other parts of the wall as well, and making up about 5% of the wall, show weathering  $\frac{1}{8}$  -  $\frac{1}{4}$  of an inch deep.

The remainder of the wall is in good condition.

Location 5.

Compared with the two previous locations, the foundation stones and the belt course here are in very good condition. There is considerable pitting, but serious spalling  $1/4$  to  $1/2$  an inch is seen in less than 10% of the blocks. This lower part of the wall was once painted with white paint. This may have helped to protect the wall, but now much of the paint has weathered away, and a bad spicately appearance is produced.

The wall above fits the description given under Location 4, with this addition: Numerous mortar joints near the down spout are open and should be patched.

Location 6.

The foundation courses in this location are in fair condition (similar to Location 5) except for the western five feet of the wall, where serious decay has taken place. The poor quality of the stone, (frequent salt patches) the vertical pitting of the blocks, and the abundant capillary water from the soil have all combined to weather the wall to a depth ranging from  $1/4$  to  $1\frac{1}{2}$  inches, and averaging almost an inch, over an area of twenty square feet.

Blocks weathered to depths of  $1/8$  -  $1/4$  of an inch and in many cases with the mortar between the joints gone, are seen on both the east and west corners of this location. It is not very clear what has caused this decay. It is probably related to the down spouts just around the corners.

All but the first floor window frames are made of wood. The only decay below the eills is seen under two of these first floor windows.

Excepting the areas mentioned above, the wall of this location is in good condition.

Location 7.

The porch in this location has protected the first floor wall. At present it is in excellent condition, except for a narrow band of spalling at the north

and, caused by a defective down spout.

The wall above the porch is in fair to good condition. There is very little weathering of the stones, but discoloration from the metal saps over the dormer windows has stained the wall somewhat.

#### Location 8.

In the foundation courses between the ground and the first belt course, 65% of the stone has spalled off in front of silty patches. The depth affected ranges from  $1/4$  to 1 inch.

The belt course is in good condition. Scattered blocks in the wall above show weathering up to  $1/4$  of an inch deep. These weathered blocks comprise 10 - 15% of the wall. Their decay is not related to places where water has run over the face, and must be attributed to their original poor quality, probably a high silt content.

Extending to a depth of  $1/4$  of an inch is seen on the outer and under sides of the projecting sump stone over the middle window on the third floor. Discoloration is seen below the ends of this sump stone, as well as below the metal saps over the wooden windows.

Much of the wood work on this east wall is about ready to fall down, but on the whole the stone is in fair to good condition.

#### Location 9.

The stone of the first and second floor wall is protected from the weather by the porches. As far as can be seen from the ground, these two floors and even the more exposed third floor wall are all in good to excellent condition. Several of the joints near the down spout at the east end of this location need patching with mortar.

#### Location 10.

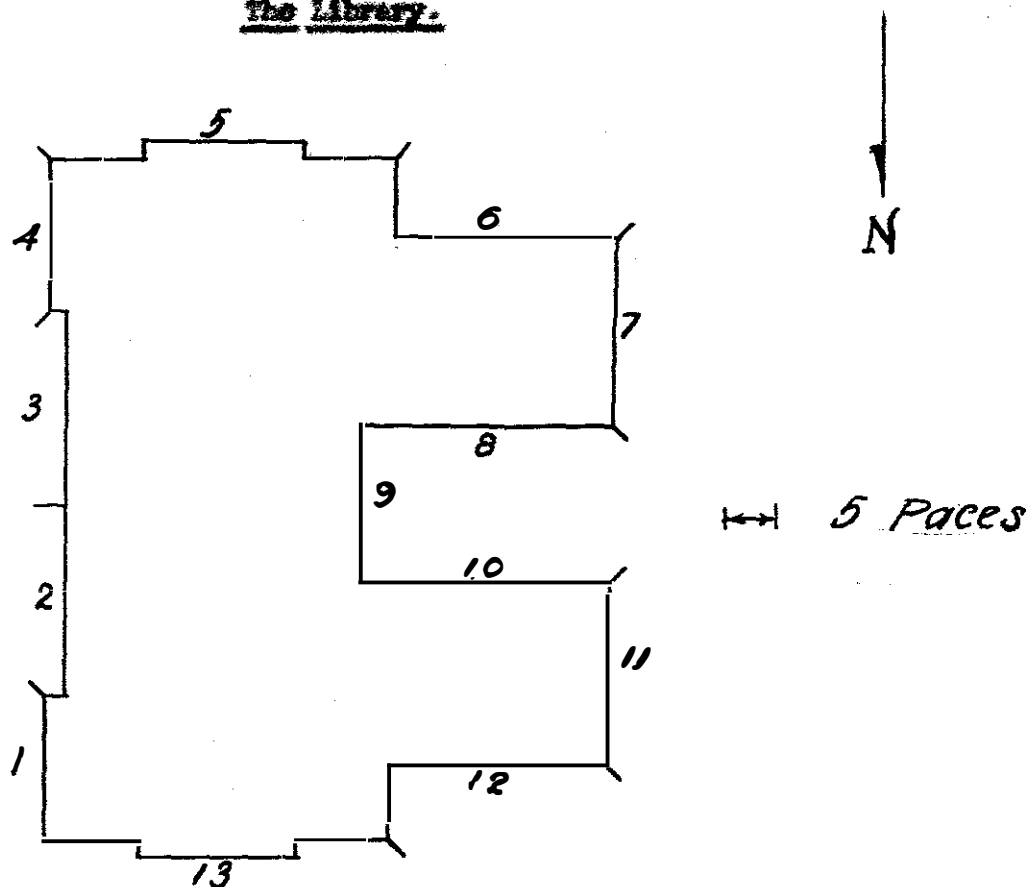
In the foundation courses, 60 % of the stone shows spalling to an average depth of  $1/4$  of an inch. In a few more silty blocks, the depth penetrated

reaches  $3/4$  of an inch. This decay has been due both to capillary water from below and surface water running back under the belt course and attacking the stone below it.

25% of the length of the belt course shows weathering in the form of the spalling of thin sheets in front of silty patches and silt-filled worm tubes. The average depth of this decay is about  $1/4$  of an inch, but on the lower edge of the course, it extends inward  $3/4$  of an inch in places.

An irregularly weathered zone 2--4 feet wide extends intermittently from the top to the base of the wall at the east end of this location. The depth of the decay usually ranges between  $1/8$  and  $1/4$  of an inch, but in a few blocks it reaches  $3/4$  of an inch. Much of the mortar is gone from the joints of the fourth floor in this weathered band. The decay is related to the down spout just around the corner.

The Library.



The Library.

Location 1.

All belt courses and other projecting stones such as window sills and window capping stones are well grooved on their under sides, so that water does not run back into the wall along their under sides.

In this location the soil is in contact with the lowest course of limestone, but capillary water does not appear to affect this stone to any appreciable extent.

The most serious decay in this location is seen in the three lower courses. Included with the decay are dark gray discolored areas and also patches of white efflorescence. The weathering is not deep; in most cases it is not over  $1/8$  of an inch that is affected, though in a few cases it reaches  $1/4$  of an inch. The decay takes the form of the spalling of small silt surrounded shell fragments. It is very prominent and unsightly where the depth penetrated is greater than  $1/8$  of an inch, because such areas show up white against the gray of the wall.

The weathering is not entirely due to silt. Some of it appears to be more of a chemical process. First little spots appear, which are spongy and soft. These gradually increase in size and number till they are quite prominent. Having brushed away their soft dust-like outer coating, one sees the firm, fresh limestone behind. This, I think, is a chemical process, a mushrooming out of tiny spots in response to some chemical agent in the water or the air that touches the stone.

It is not clear just why this weathering is confined to the lower portion of the wall. One would think it due to capillary water, but the second and third courses are more seriously affected than the first course above the ground is.

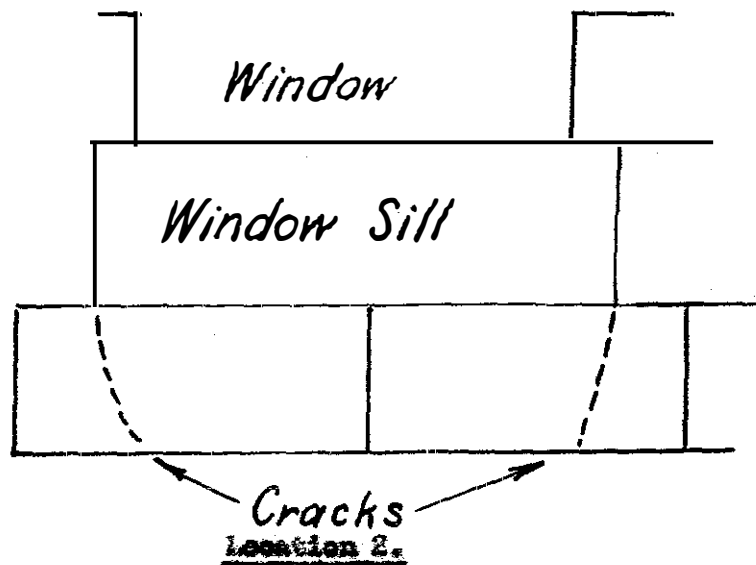
Between 15 and 20% of the stone in the second and third belt courses

has been affected to a depth of  $\frac{1}{8}$  of an inch.

Above this point weathering is common, but inconspicuous. All the stone used in this building, except the fancy cut stone, is grooved on its outer face, the grooves  $\frac{1}{8}$  of an inch wide, a similar distance apart, and  $\frac{1}{16}$  of an inch deep. In many places on the wall, the ridge between the grooves has weathered away. While slightly disfiguring, this does not appear to be serious, at least as yet, for the stone still presents a firm, evenly colored face.

There is a belt course above the third floor windows, which projects about two and one-half feet from the wall. On its outer and under sides there is considerable streaking and discoloration adjacent to the joints. This very likely would have been avoided by using water proof mortar.

A serious mistake was made in the placing of the stones below the first floor windows. Cracks cutting across the limestone blocks are seen below practically every window, thus:--



30 - 35% of the stone of the second and third courses is weathered in a manner similar to that described in Location 1, to a maximum depth of  $\frac{1}{8}$  of an inch. However, more serious decay up to  $\frac{5}{8}$  of an inch deep is seen in these courses of the north column of the doorway. Splash water has apparently

caused this decay.

A small amount of white efflorescence is seen accompanying this weathering. The efflorescence is from the stone itself rather than from the mortar.

Aside from the weathering of the ridges between the small grooves, there is no weathering to be seen below the balcony which is described below.

The stone of the columns and the wall behind them on the large balcony are in very good condition. There is rather abundant white efflorescence at the base of the inner columns. This is obviously due to water working up into the stone from the floor of the balcony. The efflorescence is in the form of a band four to six inches wide and usually about eight inches below the base of the columns.

The square foundation blocks of the round columns at the front of the balcony show light area where decay has gone on to a depth of  $1/16$  to  $1/8$  of an inch.

On the under side of the balcony over the main entrance, a little of the intricately cut ornamental stone is decayed to depths up to  $1/4$  of an inch.

In the three-foot projecting belt course near the top of the wall, discoloration is very noticeable on the upper part of the outward face. This is due to dirty water working downward and backward. A second groove should have been put in here.



*Groove needed  
X marks discoloration*

Location 3.

All but the area below the balcony has been described in the previous

discussion under Location 2.

Aside from the usual slow decay of the small ridges which is seen widely distributed here, there is very little weathering. Only one block shows weathering similar to that described from the second and third courses of Locations 1 and 2.

Six or eight small milky white patches of efflorescence are seen in the lower three courses.

#### Location 4.

There is no serious weathering in this location, although the beading (small groovings) is wearing away over almost the entire surface.

Stone below the upper projecting belt course and also the projecting belt course between the first and second floors is beginning to weather very slightly, indicating that in future buildings such belt courses should be laid with water proof mortar. Discoloration is noted on the outer sides of the projecting second floor window sapping stones and the outer side of the projecting upper belt course. In the latter case it is concentrated in the vicinity of the joints.

#### Location 5.

In this location 30% of the second course (counting from the ground) and 20% of the third course have a pitted appearance, due to the spalling of very small silt surrounded shell fragments and flakes of the limestone. The depth affected is seldom an eighth of an inch deep and only very rarely greater than this figure. Conspicuous white blotches due to weathering are very rare, and efflorescence is absent from the entire wall, except for an area of about one square foot in the second floor wall just above and to the left of the entrance.

The condition of the stone in the pillars and around the balcony is similar to that in the large eastward facing balcony, described under



**Location 2.**

For the remainder of the wall, the description under Location 4 fits so very closely that a separate description is unnecessary.

**Location 6.**

There is no serious or conspicuous weathering of the wall in this location, but several small ( $1/2$  -  $1\ 1/2$  inch) spots in the first floor wall have been retouched with mortar. These seem to be where large shells have weathered out.

The heading is somewhat weathered throughout the entire wall. This is most noticeable on the large square blocks which form the bases of the columns. Two to three-inch horizontal bands of milky white efflorescence are also noted here.

Discoloration on the outer side of the upper projecting belt course is most marked, but not entirely confined to the areas adjacent to joints. The worst offenders in this respect are the two joints near the east corner of the wall. Here not only staining, but also considerable efflorescence and perhaps decay are seen. This is due to the concentration of water at the corner.

**Location 7.**

Aside from the usual slight weathering of the heading all over the wall, and the discoloration of the upper projecting belt course around the joints of the stone, there is little comment required here. The wide belt course at the base of the columns is slightly discolored, seemingly due to the former presence of vines; and in the two small areas here, white efflorescence is noted.

**Location 8.**

The condition of the stone here is adequately covered by the description under Location 6. Here again there is heavier discoloration and efflorescence in the eastern corner of the wall just below the wide, top projecting belt

course.

The efflorescence in the large square blocks at the base of the column is much less marked here, but the unevenness of the color of the stone indicates some movement of capillary water. This unevenness of color is noted at the bases of all such columns, throughout the building.

#### Location 9.

The most conspicuous fault with the wall in this location is the very marked discoloration on the outer side of the top projecting belt course. It seems likely that on the upper side of this wide shelf there is a metal drain trough. Stain from the metal and from leaves which might lodge in such a trough contribute to the discoloration of the stone below. There is a large area of marked efflorescence in the wide smooth belt course two and one half to three feet below this projecting shelf.

With these two exceptions, where staining and discoloration are worse than anywhere else in the building, and aside from the usual weathering of the heading, the wall is in excellent condition.

#### Location 10.

The heading of the stone here has been attacked slightly, but aside from that, the usual staining, and spalling estimated at  $1/8$  of an inch deep over 15% of the under side of the upper projecting belt course, the wall here is in good condition.

Varying shades of color in the second and third courses suggest the movement of capillary water in these stones, but as yet it has had no marked effects.

#### Location 11.

In general, the wall in this location is the freshest and most unweathered appearing of any of the locations so far examined in this building.

The first floor wall is rather heavily covered with vines. These vines have very, very little effect on the stone.

Behind the vines one sees two rather large areas that are much lighter in color than the rest of the stone. This does not seem to be efflorescence. I am not able to account for it.

The beading has been lightly attacked over all the wall, and as has been previously noted in other locations, there is marked staining and a lesser amount of efflorescence on the outer and under sides of the cornice or top projecting belt course.

#### Location 12.

The most apparent defect in the stone of the wall here is seen in several blocks of the two central columns. These blocks have prominent, irregularly curving white markings. Just what they are, it is difficult to say, from the ground. They may be congregations of fossils. In any case, the stone is of inferior quality, and the use of such blocks should be avoided in the future.

In the four westernmost columns, there are numerous small round patches of mortar. These are probably places where fossils larger in size than the majority of fossils in this stone have weathered out.

The beading is being slowly attacked, but the projecting belt course is unusually free from staining, and there is no efflorescence to be noted.

#### Location 13.

The second and third courses above the ground in this location have the moist appearance so common in the same courses on the east and south sides of the building. Accompanying this darker, moist zone, weathering ranging from  $1/8$  to rarely  $3/8$  of an inch is seen in  $10\%$  of the length.

The wall above is in good condition, although the beading is almost universally attacked.

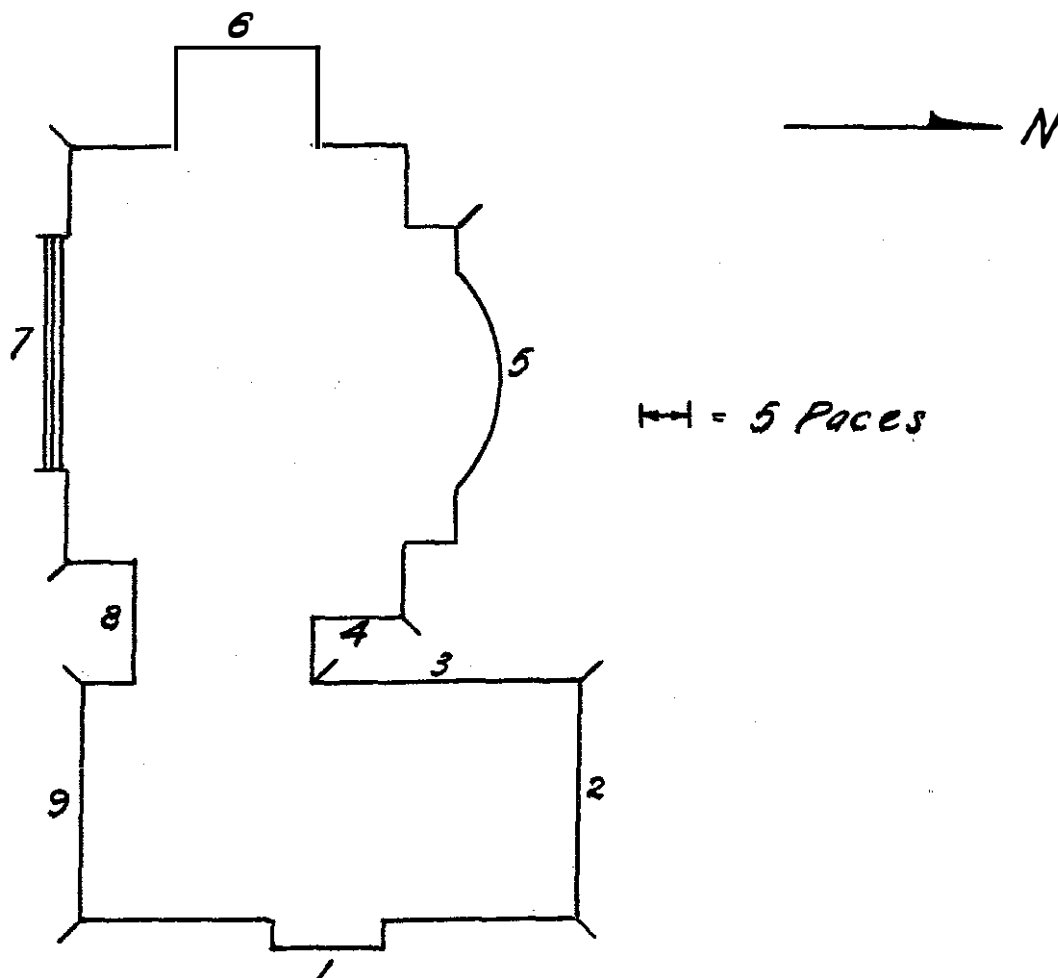
On the outer and under sides of the projecting cornice, discoloration is especially noticeable around the joints.

Memorial Union.

The Memorial Union building was completed in 1887. The stone used for facing consists of Bedford celitic limestones, Madison sandstone, and terra cotta. Lower Magnesian dolomite from Minnesota is used in the front steps.

As yet there has been almost no weathering of the stone, except in the smooth cut Madison blocks and in the dolomite blocks of the entrance steps. Aside from this, all there is to be mentioned is the discoloration and efflorescence; so the descriptions are rather brief.

Memorial Union.



#### Location 1.

The Bedford limestone of the first floor wall is in very fine condition. The upper courses are slightly streaked with discoloration below the belt course at the top of the limestone. This is due to the sloping shelf formed by the setting in of the wall above the limestone, so that dirty water collects and stains the limestone.

The wall of the second and third floors is made up of two kinds of Madison sandstone. Around the windows there are panels of sandstone, on the surface of which parallel grooves are tooled. Between these panels are areas where smooth cut Madison is <sup>used. This is</sup> not standing up nearly as well as is the grooved Madison. It shows an unevenness of texture, is quite often cracked on its outer surface, and has required patching in several instances. Small holes where silt has weathered out are also frequently seen. It is clear that the tool-roughened Madison stands up better than this smooth cut stone.

There is no groove beneath the narrow, slightly projecting belt course at the base of the fourth floor windows, and the smooth cut Madison below it is streaked with discoloring stain. This is especially noticeable below the windows.

sandstone,

The fourth floor wall is all of Madison, the majority of which bears parallel groovings and is in excellent condition.

The ornamental belt courses of Bedford limestone just below the terra cotta cornice show extensive white efflorescence. The two smooth-cut belt courses just below are likewise, but less extensively affected.

There is some dark staining on the outer side of the terra cotta courses which forms the top of the cornice.

#### Location 2.

This location is very similar to that described under Location 1. The only difference is that the efflorescence in the ornately-cut limestone belt course immediately below the terra cotta cornice affects only 25% of the

length. In Location 1, 80% of the same course showed such efflorescence.

#### Location 3.

The description of Location 2 fits so well here that a separate description is not required. However, in the southern one-third of the wall, the Bedford limestone is used throughout. Except for one small area of efflorescence near the top of the wall, and the staining below the belt course just beneath the second floor windows, the stone is in excellent condition.

#### Location 4.

The first floor wall of Bedford limestone in the south wall of this location is abundantly but not darkly stained by water coming from the outer shelf of the balcony. Above this balcony, the story and a half high wall consists of: (1) The uneven-textured, smooth-out Madison that has already been criticized; and (2) the grooved Madison sandstone. Both are in good condition now, and the grooved stone shows every indication of staying that way the longest.

The eastward facing wall in this location is in excellent condition, except for a slight amount of discoloration near the top of the first floor wall, and a limited amount of efflorescence just under the cornice. Here again, as in all the locations in this building, too frequent use has been made of the smooth-out, uneven or spotty Madison sandstone.

#### Location 5.

The courses of Bedford limestone are in their usual excellent condition. There is some staining in the upper part of the first floor wall. This is most marked below the stone railing of the balcony. It is especially noticeable in the belt course just below the railing, where the varying porosity of cross-bedded layers has rendered them more or less susceptible to staining, and a streaked appearance results.

The second and third floor walls are in first class condition, though

the circular portion of the ornately cut belt course just below the cornice shows efflorescence in 20% of its length.

In the highest part of the wall, mixed blocks of Madison sandstone and Bedford limestone have been used. Efflorescence is conspicuous in a large number of the Bedford blocks, but it is not seen in the sandstone.

#### Location 6.

There is nothing new that is worthy of note in this location.

Staining is seen at the top of the limestone of the first floor wall. This discoloration is most marked in the small west wing which contains the writing room. On the north and south sides of this wing, this is obviously due to water running down from the balconies. The streaking on the west wall is not as easily explained.

The higher parts of the wall are similar to corresponding areas already described. In the limestone belt course just beneath the terra cotta cornice, efflorescence is seen in 30% of the length of this course.

#### Location 7.

The terra cotta cornice in this location shows marked discoloration along its outer side over a-third of its length. Efflorescence in the limestone belt course just below extends <sup>over</sup> 40% of the course's length.

The remainder of the wall is of smooth-cut and grooved Madison. The latter is in the better condition of the two.

#### Location 8.

The stone in this location is in every way similar to that described under Location 4. A separate description is unnecessary.

#### Location 9.

Along 50% of the limestone course just beneath the cornice, efflorescence is very marked. At one point about ten feet from the west end of the location, this efflorescence extends down three or four feet onto the Madison sandstone.

There is staining of the first floor Bedford wall just below the belt course at its top. The remainder of the wall is of the two types of Madison sandstone previously described.