

twelve days, the younger the germ the less time should it be exposed to chromic acid. After having been in alcohol a week it is transferred to a sherry wine colored solution of bichromate of potash for a period sufficient to harden it.

With a cataract needle the investigator will then cut a trench around the embryo, cutting through the vitelline membrane, which fixes the embryo to the vitellus, and then lift it away and remove it from the latter, which, brittle and crumbly, cannot be cut. The staining in a solution of carmine, as described for adult brains in this paper, will require from one to four days, according to the size of the embryo. Of each stage three series of sections are necessary, one transverse, one horizontal, and a third, the most important, sagittal, that is parallel to the median plane.

All these minutiae, however wearisome they will prove, are necessary, and he who has thus with his scalpel, reagents and razor, constructed an open volume of natural specimens, will find himself richly rewarded by the richness in detail, the manifold character of the morphologies, and the suggestive character of the relations exposed.

The material for such a study can be obtained in a fresh state from no one locality. The student residing in New York will have to take a vacation trip to the Mississippi; he living in Chicago a corresponding trip to the Atlantic coast.

In the West he will find the great lake catfish, the lake sturgeon, the *Amia calva*, the gar-pike, and the remarkable spatularia, the brains of all of which should be studied. Possibly he may obtain the fresh water lamprey (*Hylomyzon*), but one brain which he should not neglect is that of the blind fish of the Kentucky caves, whose examination is destined to clear up somewhat the true relations of the *lobi inferiores* and the optic lobes. On the Atlantic coast all the bony fish, obtainable in the fresh waters of the West, besides a rich variety of salt water forms, also the lamprey, the shark and ray are obtainable. A trip to the Bermudas or the Florida coast, occupying about two weeks, will increase the student's *repertoire* with a host of tropical and sub-tropical genera.

#### WEIGHT, SPECIFIC GRAVITY, RATES OF ABSORPTION, AND CAPABILITIES OF STANDING HEAT OF VARIOUS BUILDING STONES.

By HIRAM A. CUTTING, PH. D., State Geologist Vermont.

Having during the past year instituted, and carried out, a series of experiments to ascertain, as nearly as possible, the capabilities of the various materials used in the construction of so called fire proof buildings, to stand heat, I submit, in tabulated form, the result of such experiments, hoping they may be of use to the architects, quarrymen and Insurance companies of our country, and also of some interest to those interested in science.

In connection with the capabilities of the various building stones to stand fire and water, I have taken their specific gravity, and weight per cubic foot, so that the identity of the various stones could at any time be com-

pared, and if in the working of a quarry there was a change in gravity, or weight, that it could be easily detected, and thus all who choose could know whether the tests given would apply or not.

I have procured sample specimens of the most important building stones in the United States, and Canada, and, after dressing them into as regular form as possible, three by four inches, and two inches in thickness, I have taken their ratio of absorption, which ratio I have expressed in units of weight, according to the amount of water taken up. If 450 units of stone absorbed one unit of water, I have expressed it thus:  $1 + 450$ , meaning that the stone weighed 450 units when immersed, and 451 when taken from the water.

To accelerate the process of absorption I have placed the specimens in water under the exhausted receiver of an air pump. I find that in this way as much water is absorbed in a few minutes as in days of soaking. When specimens were removed from the water, I have, before weighing, dried their outsides with blotting paper. In relation to the specific gravity, I have not followed "Gilmore's" rule in full. He weighed the specimens in air, immersed them in water, and allowed them to remain until bubbling had ceased and then weighed them in water, after which he took them from the water, dried them outside with bibulous paper, and weighed them again in air. From this last weight he subtracted the weight in water, dividing the dry weight by the difference.

This gave a specific gravity subject to two sources of error. I have followed the more frequent custom of weighing the dry stone, using pieces of two or three pounds in weight, and then immersing them in water. After the usual saturation I have taken their weight in water, subtracting it from the dry weight in air, and then dividing the dry weight by the difference. This gives the specific gravity of the rock itself, as usually found, which is what we desire, and I believe as it would generally be in buildings constructed of the given material. The specimens were previously dried by long exposure to a temperature not exceeding 200° Fah. To verify this I have taken specimens from the quarries direct, and after weighing, have brushed them over with paraffine dissolved in naphtha, weighing them again so as to ascertain the exact amount of paraffine, which made no visible change in the stone, other than to keep out water. I have then weighed in the usual way, and thus obtained the exact specific gravity of the stone as in the quarry, and I find my method used, as stated, to give the best results, and so have adopted it.

After this I have placed them in a charcoal furnace, the heat of which was shown by a standard pyrometer. In many instances I have placed them side by side with dry specimens, but have been unable to note any marked difference in the action of heat, beyond this, that the dry specimens became sooner heated. I have, however, no doubt that the capacity of a stone to absorb water is against its durability, even in warm climates, and vastly more so in the changeable and wintry climate of New England. It is here often frozen before any considerable part of the moisture from Autumn rains can be evaporated.

When the specimens were heated to 600° Fah., I have immersed them in water, also immersing others, or the same, if uninjured, at 800° and 900°, that is if they are not spoiled at less temperatures. I find that all of these samples of building stones have stood heat without damage up to 500°. At 600° a few are injured; but the injury in many cases commences at or near that point. When cooled without immersion they appear to the eye

to be injured less, but are ready to crumble, and I think they are many times nearly as much impaired, and always somewhat injured, when water produces any injury.

I would remark that my experiments with granites show that there is quite a range in their capabilities of standing heat, a range in fact much greater than I anticipated. With the sandstones the difference is also marked, as is their power of absorption. When exposed to the heat wet, they show a marked difference in the time required to heat them, the saturated ones seeming to resist the heat for a time; but when equally hot they crumble the same as those not previously saturated. Their relative worth can be seen by the table. The conglomerates

stand heat badly; while the limestones and marble stand best of all (up to the point where they, by continued heat, are changed to quick lime) except soapstone, and a species of artificial stone made under the McMurtire & Chamberlain patent. The indications are, from this and other samples of artificial stone, that it may be possible to make an artificial stone cheaper and better for fire proof buildings than our native quarries furnish; and we hope this possibility may receive attention. But common's are useless, as the facts set forth in the tables speak for themselves.

I give you results in tabulated form below.

## GRANITES.

No.	KIND.	LOCALITY.	Specific Gravity.	Weight of One Cubic Foot.	Ratio of Absorption.	First Appearance of Injury.		Crumbles or Cracks Slightly.	Cracks Badly or Becomes Friable.	Injured so as to be Worthless for a Building.		Melted or Ruined.
						Deg. Fah.	Deg. Fah.			Deg. Fah.	Deg. Fah.	
1	Light colored.....	Hallowell, Me.....	2.638	164.8	1 + 7.0	800	900	950	1000	1000	1100	
2	".....	Fox Island, Me.....	2.642	165.1	1 + 6.80	700	800	850	900	1000	1000	
3	Denning's Quarry.....	Mt. Desert, Me.....	2.631	164.1	1 + 7.16	800	850	950	1000	1000	1100	
4	Light colored.....	Rockford, Me.....	2.600	162.5	1 + 4.82	600	800	850	900	950	1000	
5	Red.....	Red Beach, Calais, Me.....	2.616	164.7	1 + 5.90	800	850	900	950	1000	1000	
6	Light colored.....	Oak Hill, Me.....	2.620	157.8	1 + 3.10	800	850	900	950	1000	1000	
7	Red.....	Stark, N. H.....	2.611	164.1	1 + 5.14	600	700	800	850	900	950	
8	Colored medium.....	Concord, N. H.....	2.616	164.7	1 + 7.78	800	900	950	1000	1000	1200	
9	Sanborn's Quarry.....	Plymouth, N. H.....	2.640	165.5	1 + 6.85	800	900	950	1000	1000	1200	
10	Carter's Quarry.....	Rye, N. H.....	2.647	165.4	1 + 7.00	800	900	950	1000	1000	1200	
11	".....	Woodbury, Vt.....	2.634	165.8	1 + 7.84	800	900	950	1000	1000	1200	
12	Wetmore & Morse's Quarry.....	Barre, Vt.....	2.651	165.6	1 + 7.00	800	900	950	1000	1000	1200	
13	Syenite.....	Quincy, Mass.....	2.610	166.2	1 + 6.50	750	800	850	900	950	1000	
14	Gray.....	Croton, Conn.....	2.800	175.0	1 + 8.18	700	750	800	850	900	950	
15	Common.....	Woodstock, Md.....	2.648	165.3	1 + 3.94	700	750	800	850	900	950	
16	".....	Port Deposit, Md.....	2.700	168.7	1 + 8.10	800	900	950	1000	1000	1100	
17	Scranton County Quarry.....	Richmond, Va.....	2.727	170.3	1 + 3.98	750	800	850	900	950	1000	
18	Old Dominion Quarry.....	".....	2.674	167.7	1 + 4.02	750	800	850	900	950	1000	
19	Light colored.....	St. Cloud, Minn.....	2.600	168.2	1 + 2.50	700	700	800	850	900	950	
20	".....	Stanstead, P. Q.....	2.833	177.0	1 + 4.20	800	900	950	1000	1000	1200	
21	Coarse.....	North Halifax, N. S.....	2.648	168.6	1 + 5.84	700	800	850	900	950	1000	
22	".....	Guananogue, P. O., Can.....	2.657	167.9	1 + 7.16	800	850	900	950	1000	1000	

## SANDSTONE.

1	Freestone.....	Portland, Conn.....	2.380	148.7	1 + 27	850	900	950	1000	1100	
2	".....	North of England.....	2.165	135.5	1 + 27	850	900	950	1000	1000	
3	Seneca Stone.....	Montgomery Co., Md.....	2.500	150.2	1 + 20	850	900	950	1000	950	
4	Sandstone.....	Salem, Md.....	2.452	153.2	1 + 24	850	900	950	1000	1100	
5	".....	Seneca, Md.....	2.410	150.6	1 + 40	900	1000	1100	1200	1200	
6	Montrose Stone.....	Ulster Co., N. Y.....	2.601	166.1	1 + 314	900	1000	1100	1200	1200	
7	Freestone.....	Belleville, N. J.....	2.350	146.8	1 + 27	900	950	1000	1100	1100	
8	".....	Nova Scotia.....	2.424	151.5	1 + 240	900	950	1000	1100	1100	
9	S. Carboniferous.....	Br. Phillippe, N. S.....	2.351	147.0	1 + 10	900	950	950	1000	1000	
10	Freestone.....	Dorchester, N. B.....	2.391	147.7	1 + 20	800	850	900	950	1000	1000
11	Cincinnati Stone.....	Cincinnati, O.....	2.188	139.1	1 + 23	900	950	1000	1100	1100	
12	Potsdam Sandstone.....	McBride's Corners, O.....	2.133	145.8	1 + 25	800	850	900	950	1000	1000
13	Berlin Stone.....	Cleveland, O.....	2.210	138.1	1 + 22	850	900	950	1000	1100	1100
14	Potsdam.....	McBride's Corners, O.....	2.100	156.2	1 + 22	850	900	950	1000	1000	1000
15	Euclid Stone.....	Near Cleveland, O.....	2.200	143.1	1 + 35	850	900	950	1000	1000	1000
16	Berea Stone.....	Berea, O.....	2.254	143.8	1 + 20	850	900	950	1000	1000	1000
17	Amherst Stone.....	Amherst, O.....	2.209	137.5	1 + 18	850	900	950	1000	1000	1000
18	Brown Stone.....	Humbletown, Penn.....	2.346	146.0	1 + 28	850	900	950	1000	1000	1000
19	Potsdam Sandstone.....	Beaumont, P. Q.....	2.512	157.0	1 + 33	850	900	950	1000	1000	1000
20	Sandstone.....	Murray Bay, P. Q.....	2.577	161.0	1 + 35	900	950	1000	1100	1100	1100
21	".....	Cheat River, W. Va.....	2.632	164.5	1 + 80	800	850	900	950	1000	1000
22	Freestone.....	Aquia Creek, Va.....	2.181	136.4	1 + 19	900	950	1000	1100	1100	1200
23	Brown Stone.....	Manassas, Va.....	2.348	146.7	1 + 17	850	900	950	1000	1100	1200

## LIMESTONE.

1	Limestone.....	Baltimore, Md.....	2.917	181.8	1 + 315	950	1000	1100	1200	1200	
2	".....	Bedford, Ind.....	2.475	154.8	1 + 285	850	900	950	1000	1000	
3	Cincinnati Limestone.....	Hamilton County, O.....	2.524	157.7	1 + 25	850	900	950	1000	1000	
4	Potts Blue.....	Springfield, Penn.....	2.656	166.6	1 + 280	850	900	950	1000	1000	
5	Dolomite Limestone.....	Owen Sound, P. O.....	2.571	160.6	1 + 430	850	900	950	1000	1000	
6	Trenton Limestone.....	Montreal, P. Q.....	2.705	169.1	1 + 316	900	950	1000	1100	1200	
7	Limestone.....	Ile La Motte, Vt.....	2.616	165.5	1 + 320	950	1000	1100	1200	1200	

## CONGLOMERATES.

1	Conglomerate.....	Roxbury, Mass.....	2.708	169.2	1 + 49	700	800	900	1000	1000	
2	Potomac Stone.....	Point of Rocks, Md.....	2.724	170.2	1 + 60	600	700	800	900	900	
3	Conglomerate.....	Cape a la Aisle, P. Q.....	2.645	165.3	1 + 80	600	700	800	900	900	

## MARBLES.

No.	KIND.	LOCALITY.	Specific Gravity.	Weight of One Cubic Foot.	Ratio of Absorption.	First Appearance of Injury.	Crumbles or Cracks Slightly.	Cracks Badly or Becomes Friable.	Injured so as to be Worthless for a Building.	Melted or Ruined.
						Deg. Fah.	Deg. Fah.	Deg. Fah.	Deg. Fah.	Deg. Fah.
1	Tuckahoe.....	Westchester Co., N. Y....	2.704	194.6	1+293	9.0	10.0	1.00	1.00	12.0
2	Ashley Falls.....	Ashley Falls, N. Y....	2.742	171.1	1+28.0	60.5	100.0	110.0	1.00	12.0
3	Snow Flake.....	Westchester Co., N. Y....	2.848	173.0	1+350	95.0	95.0	10.0	12.0	1200
4	Tennessee.....	Dougherty's Q'y, E. Tenn	2.711	169.4	1+320	95.0	95.0	10.0	12.0	12.0
5	Duke Marble.....	Near Harper's Ferry, Va.	2.812	175.7	1+340	10.0	10.0	11.0	12.0	12.0
6	Black Marble.....	Isle La Motte, Vt.....	2.682	176.6	1+320	10.0	10.0	11.0	12.0	1200
7	Sutherland Falls.....	Rutland, Vt.....	2.666	166.6	1+342	100.0	10.0	11.0	12.0	1200

## SLATES.

1	Sabin's Quarry.....	Montpelier, Vt.....	2.869	179.3	1+110	800	850	9.0	10.0	1200
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## SOAPSTONES.

1	Soapstone.....	Weatherfield, Vt.....	2.604	166.7	1+3.8	1200	----	----	----	----
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## ARTIFICIAL STONE.

1	Artificial Stone.....	McMurtre & Chamberlain's patent.....	2.235	159.7	1+280	750	800	1100	1200	----
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## MINERAL WAX, A RESUME.

By M. BENJAMIN, PH. D.

**Geographical Distribution.** Mineral wax or ozocerite (from *ozeo*, to smell, and *ceres*, wax) is found in a sandstone in Moldavia, in the vicinity of coal and rock salt. It also occurs in large quantities at Borislav, near Drohobycz, and at Dzwiniacz, near Stainstawow in Galicia, a province of Austria. The mines are situated at the northern foot of the Carpathian Mountains. It has also been found at several other places in the same province. Small quantities have been discovered in England, at Binney Quarry, Linlithgowshire; at the Urpeth Colliery, Newcastle-on-Tyne, and in Wales. In this country it has been found in Texas, in Utah and in California, about fifty miles north-east of Los Angeles, among the Sierra Madre Mountains. In Utah the mineral occurs in shale beds, out of which the ozocerite appears as exudations. These shale beds are quite extensive—some forty to sixty miles long by twenty wide, and from seventy to forty feet in thickness. It is thought that by digging and boring the supply of the wax may be increased.

**Geologically** it is presumed that these beds were formed in a tertiary lake or peat bog. Prof. J. S. Newberry suspects that it will be found to be an evolved product, the distillation of beds of cretaceous lignite and the residue of a petroleum unusually rich in paraffine. The foreign deposits are considered to be about of the same age.

**Mode of Occurrence.** It is generally found (referring to Galicia) in thin layers and small pieces which must be separated from the matrix in which they are found. The smallest pieces are only obtained by a process of washing. It is sometimes found in lumps or layers from one to three feet in thickness, a lump sometimes weighing several hundred weight.

**Physical Properties.** It is like a resinous wax in consistency and translucency, sometimes with a foliated structure. Its color is brown or brownish yellow by transmitted light and leek green by reflected light. The poorer qualities, which are colored black and are either too soft from abundance of petroleum or too hard (asphalt like in character), are mainly used for the pro-

duction of paraffin. It possesses a pleasantly aromatic odor. The American variety is described as black in the mass, sections of which are translucent.

**Its Chemical Nature.** The specific gravity of ozocerite is 0.94 to 0.97. According to Dana it ranges from 0.85 to 0.90.

Its melting point is variously given as follows:

The Moldavian, 54	Malaguti.
Urpeth mineral, 60	Johnson.
Galician, 60	Hänsel.
Utah, 61.5	Newberry.
Moldavian, 62	Schröter.
From Slank, 62	Glocker.
Galician, 65	Wagner.

The boiling point is likewise differently given by the authorities:

Urpeth mineral, 121	Johnson.
Moldavian, 210	Schröter.
Moldavian, 300	Malaguti.
Utah, between 350° and 380°	Newberry.

Concerning this last determination, Dr. S. B. Newberry says: 1.5 grammes of the substance were treated with about 300 c. c. of cold ether, and allowed to stand for twenty-four hours. The substance was decanted through a filter, evaporated, and the resulting mineral tested to obtain the melting point. This treatment gave me a fraction equal to 25.4 per cent. of the original substance, and having a melting point of 49.° C. The residue was again treated with 200 c. c. of cold ether for about the same time, and gave a further product equal to 9.1 per cent. of the original mass, fusing at 61°. On boiling the undissolved portion in about 500 c. c. of ether the whole mass went into solution, and upon evaporation was found to have a fusing point of 67°. It distills without decomposition, is not altered by strong acids, and very little by hot alcohol. The Moldavian variety dissolves but slightly in ether, whereas that found at Urpeth dissolves in this medium to the amount of four-fifths, and separates on evaporation in brown flocks, which melt at 38.9 to a yellowish brown liquid. The solubility of the variety found in Utah has been sufficiently referred to in the remarks on its fusing point. The composition of ozocerite has been found to be: