ON AMERICAN LITHOGRAPHIC STONES.

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I regret that, in preparing this report, I cannot give an exhaustive reference to existing literature on this subject; what I have been enabled to consult did not give me the desired information, and in order to obtain material for comparison I analyzed some mineral from Germany. This was of undoubtedly good quality. Lithographic limestone is the product of different geological formations. If it is true that any limestone of fine, even grain can be used in the lithographer's art, it is equally true that such material seems to be very difficult to find, although we have immense tracts of calcareous deposits to select from. Of the various samples of limestone which have been tested for lithographing purposes, many show in outward appearance a very close resemblance in grain and structure to varieties known to be good, but prove nevertheless worthless. To ascertain the real cause a physical examination seems insufficient, and on the other hand the chemical examination, so far as has come under my notice, does not show sufficient grounds for the established distinction. I quote here the analytical results given in the "Report of Mineral Resources of the United States, 1893," as follows:

Stone from Missouri.

Silicates	31.2
$CaCO_3$	817.7
$MgCO_3$	151.0
Fe_2O_3	0.1
	10000.

Stone from Bavaria.

Silicates	44.5
$CaCO_3$	814.7
$MgCO_3$	138.3
Fe_2O_3	2.5
	1000.0

Nothing here would indicate any practical difference, and as it is reasonably sure that in physical properties, fineness of grain, etc., these stones resembled each other, a distinction for practical use could not be deduced from these analyses. To obtain, however, material for comparison, I procured German stones of undoubted good qualities as lithographic stone, and selected two, one of dark blue and one of light yellow color, with these results:

Dark blue stone from Solenhofen:

Spec. gravity at 15.5°=2.952.

Insoluble silicate	2.0000
Organic matter	0.7200
$CaCO_3$	90.9341
$MgCO_3$	3.5710
Soluble silica	0.5200
Al_2O_3	0.5840
Fe_2O_3	0.2360
FeO	0.1300
Water	0.4000
	99.951

Light yellow stone from Solenhofen.

Spec. gravity at 15.5°=2.8388.

Insoluble silicate	1.8930
Organic matter	0.1320
Soluble silica	0.0200
$CaCO_3$	89.5390
$MgCO_3$	4.3801
Al_2O_3	0.1010
Fe_2O_3	0.3210
FeO	0.0030
Water	1.379
	97.7681

Light gray stone from Kentucky.

Spec. gravity at 15.5°=2.99331.

Insoluble silicate	11.500
Organic matter	0.400
$CaCO_3$	73.241
$MgCO_3$	12.431
Al_2O_3 Soluble silica Fe_2O_3	1.141
Water	0.935
	99.648

Blue stone from Iowa.

Spec. gravity at 15.5°=2.8173.

Insoluble silicate	6.97500
Organic matter	3.30000
$CaGC_3$	82.20051
Fe_2O_3 Al_2O_3 Soluble silica	1.07631
$MgCO_3$	4.32703
Water	0.24001
	98.11886

Light gray stone from Missouri.

Spec. gravity at 15.5°=2.7558.

Insoluble silicate	4.300
Organic matter	1.830
$CaCO_3$	77.031
$MgCO_3$	14.271
Fe_2O_3 Al_2O_3 SiO_2	2.143
Water	0.341
	99.916

Light blue gray stone from Canada.

Spec. gravity at 15.5°=2.8388

Insoluble silicate	3.71200
Organic matter	0.40910
$CaCO_3$	89.98900
$MgCO_3$	2.78932
Al_2O_3 and SiO_2	0.73101
Fe_2O_3	0.15302
FeO	0.10431
Water	1.25000
	99.13776

Dark blue stone from Canada.

Spec. gravity at 15.5°=2.89104

Insoluble silicate	3.6000
Organic matter	1.2900
$CaCO_3$	88.0341
$MgCO_3$	2.5000
Soluble silica	0.4900
Al_2O_3	0.5770
Fe_2O_3	0.3590
FeO	0.0410
Water	1.3601
	99.2512

I observed that in a number of stones analyzed, in drying at 100°, a certain amount of organic matter volatilizes and escapes with the moisture contained in the stones. In most cases, therefore, the quantity of water will be found too high at the expense of organic matter. The latter contains nitrogen and traces of iodine, and is evidently the remnant of cretaceous fossils, and the silica may also originate from these fossils. It is certain that these organic remains cause the difference in the color, in fact they form the coloring matter of these limestones, and its presence does not seem to interfere, by any means, with the usefulness of the stone in lithographic art. It might be even presumed that the presence of this partially destroyed animal matter may have had some influence on the peculiar precipitation, and, under great pressure, on the fine and even formation of these peculiar strata. The material collected by me and the work done so far does not justify a final conclusion ; but it is probably sufficiently strong to indicate it, and may give an idea for practical tests ; in all other respects, with the exception of some stones containing too much siliceous matter, the composition varies but little, and the differences are not pronounced enough to impair the quality of the stone for lithographic purposes.

Whatever the influence may have been of this organic matter on the precipitation of calcium carbonate—holding this and other inorganic substances in suspension, retarding quick precipitation and thereby assisting in the formation of even grained and dense strata under subsequent pressure, it may be conceded that lithographic stone was formed during or after the destruction of a large and peculiar fauna, like the jurassic and silurian limestone periods ; and if further analytical work should confirm what my present investigation seems to indicate, that this peculiar coloring matter is an essential feature of good lithographic stone, an identification of the proper material in the original deposits would thereby be greatly facilitated.

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