two different strata of growth, but both purely and originally European and Grecian. The influence of the Orient was late and slight. The two early migrations may be called Danaan and Achæan; but the chief fact remains that they were both of indigenous cultural development, not imported or exotic.

What is more, the later, historic Greeks directly inherited this culture, as is proved by the identity or close similiarity of architecture, ornament, pottery, arms, and religious and political institutions. This also is asserted by Homer and all early Greek tradition.

The linear and hieroglyphic writing, scantily represented in the Mycenean horizon, may point to Asiatic fonts; rather Anatolian (Hittite) than Phœnician; but the evidence is too slight to speak finally on this question.

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NOTES ON INORGANIC CHEMISTRY.

A PAPER was recently read before the Royal Society, by Dr. W. A. Tilden, on the gases enclosed in crystalline rocks and minerals. From the time of Brewster, observers have found in many crystallized minerals, notably in quartz, cavities containing gas, and often drops of liquid. Water, carbon dioxid, hydrocarbons and nitrogen and, more recently, hydrogen and carbon monoxid have been found. A large number of crystalline rocks—granite, gneiss, basalt, etc.—have been examined by Dr. Tilden, and the yield of gas varied from 0.65 volumes, in a recent (1760) lava from Vesuvius, to 17.8 volumes, in a gneiss containing corundum from Serringapatam. The gas is apparently contained in cavities which are visible in thin microscopic sections, but that these cavities are extremely minute is shown by the fact that there is practically no diminution of yield when the rock has been reduced to a coarse powder before heating. The largest portion of the gas is carbon dioxid and hydrogen, with nitrogen, methane, and carbon monoxid, each to the extent of a few per cent. In no case was any evidence of helium found. The presence of hydrogen and carbon monoxid is accounted for by the formation of the rock in an atmosphere rich in steam and carbon dioxid, which was or had been in contact with an easily oxidizable substance; this might be metallic iron, which has been found in basalts and other rocks. The presence of marsh gas in the rocks tends to support the view that in the interior of the earth's crust there are large masses, not only of metal, but compounds of metals, such as iron and manganese, with carbon. This view, first put forth by Mendeleef, which would account for the great deposits of natural gas, petroleum and other natural hydrocarbons, appears to be steadily gaining ground, and has received further support by the work of Moissan and others on the metallic carbids.

MAURICE DE THIERRY communicates to the *Comptes Rendus* determinations of atmospheric ozone on Mount Blanc, begun in 1894. At Chamounix the amount of ozone was 3.5 mg. per 1,000 cubic meters of air; on the Grand Mulets (elevation 3,020 meters), 9.4 mg., or nearly four times as much as at Paris. The conclusion is drawn that the amount of ozone increases with the elevation, a confirmation of earlier results. Hail, falling at an elevation of 4,200 meters, when placed on a sheet of iodo-starch ozonoscopic paper gave immediately circular violet spots of larger diameter than the hailstones and paler in the center, but it was not determined whether these spots were due to an atmosphere of ozone surrounding the stone, or to hydrogen dioxid from the melting hail. Neighboring snows, however, have never shown a reaction for hydrogen dioxid.

The Journal of the College of Science, Imperial University, Japan, quoted in the *Chemical News* for April 9th, gives the full description of the atomic weight determination of tellurium by Masumi Chikashige, already noticed in Science. Previous determinations have been made from tellurium associated with heavy metals, and the figure found, 127.6, is higher than that of iodin, below which it should be, according to the periodic law. It has been thought that some impurity of higher atomic weight might account for the anomaly. Chikashige worked with a tellurium of a wholly different (Japanese) origin, occurring associated with sulfur and selenium. He also reaches the same result, 127.6. It may, however, be noted that if the supposed contamination in the American and European tellurium be due to a higher element of the sulfur group, it would not be unnatural to suppose the same element present in the Japanese mineral, which contains 99.75 per cent. sulfur, 0.06 per cent. selenium, and 0.17 per cent. tellurium.

J. L. H.

ASTROPHYSICAL NOTES.

In *Circular No. 12* of the Harvard College Observatory, dated November 2, 1896, Professor Pickering published the discovery on the Draper Memorial photographs of a remarkable stellar spectrum, that of Zeta *Puppis* (Mag., 2.5; R. A., 8^h 0.1^m; Dec., $-39°$ 43′).

In addition to dark hydrogen lines and *K*, there were two broad bright lines at λ 4633 and 4688, and a peculiar series of dark lines whose wave-lengths were rhythmically related. These were λ 4544, 4201, 4027, 3925, 3859, 3816 and 3783. It was at first thought that they represented some new element not yet found on the earth or in the stars. *Circular No. 16*, of date January 12, 1897, announced, however, the important discovery that these lines are very probably due to hydrogen, being produced under conditions of luminosity not hitherto known. Professor Pickering finds that by writing Balmer's formula, connecting the wave-lengths of the hydrogen lines, in the form

$$\lambda = 3646.1 \frac{n^2}{n^2 - 16}$$

the ordinary lines will be given when for n the even integers 6, 8, 10, etc., are substituted, and the new lines when the odd integers from 9 to 21 are successively assigned to n. It appears that the lines for n = 7 (λ 5412), 9 (λ 4544), 11 (λ 4201) and 13 (λ 4027) have been hitherto recorded in certain spectra of type IIb. Professor Pickering has since reported that three other southern stars are somewhat similar to Zeta *Puppis* in having part of the lines of the new series.

Meanwhile Professor H. Kayser, of Bonn —whose work in conjunction with Professor Runge on the harmonic relations of spectral lines is so favorably known—also investigated the origin of the new lines, and publishes his conclusions in two articles in the *Astrophysical Journal* for February and April. Hydrogen had been the only element having harmonically related lines which had possessed only a single series of such lines. Now Kayser and Runge have found that two of the series of lines for an element end at nearly the same place. Hence on examining the frequencies of the new lines, Kayser concluded that they have this characteristic and represent a new hydrogen series, a conclusion confirmed in his second article written after seeing *Circular No. 16*. Thus the spectral relations of hydrogen lines become normal.

It is a matter of much interest to know if the lines of the new series can be produced in laboratory experiments. If so, important information as to stellar temperatures and pressures is likely to be o btained