SCARCITY OF LIVING ORGANISMS IN THE AIR AT HIGH ALTITUDES.

IN the Geneva *Archives des sciences* for November, 1884, Mr. Freuderich has an article upon the number of living organisms in the air of the Swiss Alps. He shows that the experiments made by Pasteur in 1860 upon the same subject, and later by Tyndall, are unsatisfactory because of the small amount of air filtered, and because it seems, from the results, that the germs were not destroyed from the *bouillon* which was used in the experiment. Other observers have found astonishing quantities of germs in high altitudes, and in all these cases it seems very probable that the liquid was not thoroughly sterilized.

In Freuderich's experiments, by means of a portable steam-pump, air was pumped at the rate of a hundred and fifty litres an hour through a small glass tube with a capillary end. This tube was stopped with a wad of spun glass to retain any floating particles. Each wad was then placed entire in the *bouillon*. Later he still further modified this method by using the tube through which the air was pumped as a culture-tube.

Mr. Freuderich's most reliable experiments were made in the summers of 1883 and 1884. On the 12th of July, 1883, at the height of 3,200 metres, in 300 litres of air, no life was found. Again, on Aug. 5, at the height of 2,100 metres, he filtered 500 litres of air, and, on the next day, 400 litres on the summit of a neighboring mountain 3,970 metres high. The filterings from these two were sown in a broth of beef, but showed no signs of life. At Schilthorn (2,972 metres), Aug. 25, 1,500 litres of air were filtered and sown, but the fluid did not cease to be limpid.

In presence of the negative results of 1883, he determined not to confine himself in 1884 to the limit of eternal snow, but to choose some places more accessible to the germs of the air. On the Aletsch glacier, July 15 and 17, at a height of 2,900 metres, he pumped 2,000 litres of air through six wads. One of the wads, after a rest of fifteen days, gave birth to an organism of the family Tortulacea, and another contained a micrococcus, which may have been accidentally introduced. The second series was carried on above snow-level in Theodule pass (3,340 metres above sea-level) on the 6th and 7th of September. But in 3,000 litres of air he could find but one bacterium. The extreme poverty of the air at these heights is sufficiently proved by these figures. While these experiments were going on, the days were clear and the wind light, both circumstances favorable to the growth of microbes.

At Niesen (2,366 metres), July 25 and 26, rain and snow fell, and rendered the work very complicated, soaking the wads, and checking the work, so that not more than 600 litres were pumped through eight wads, all of which were sown at Berne, July 27. On July 29 the liquids sown with two of them were infested with a peculiar long bacillus, never met with except in the air of Berne; the next day another was infested with the same species; a fourth gave another bacillus; and Aug. 1 a mould appeared. Finally, about the first of September, a last conserve brought forth a mould after six weeks' incubation. The two others remained sterile; and hence we have a minimum of four microbes from 600 litres. We say minimum, because it is possible that more than one germ may have been caught on those filters which produced germs. In another trial, July 31 and Aug. 1, he filtered 1,725 litres through fifteen wads, in which he found four bacteria. In reducing the results, we find that we have in the air near Niesen between three and four bacteria in a cubic metre.

The richness of the air in this region is easily explained by the locality, the mountain being situated on the border of Lake Thun, and surrounded by a number of towns. Besides this, a small amount of vegetation is found on its summit. It seems that the purity of the air in these high altitudes is due less to the height than to the lack of a productive home for the growth of these organisms. From these experiments it seems perfectly proper to conclude that the mountain air is much purer than that of the lower regions, and even more so than has been supposed. Indeed, it is surpassed in purity only by that over the sea, which Commander Moreau has shown to contain only five or six microbes to ten cubic metres.

RECENT PROGRESS IN ENGINEERING.

SIR FREDERICK BRAMWELL, in his inaugural address as the recently inducted president of the British institution of civil engineers, called attention to the great progress made, during late years, in various departments of engineering. Taking up, first, the materials of construction, he noted the enormous gain in the economy of brick-making by the introduction of brick-making machines and the continuous kiln; the improvement taking place in the making of artificial stones now enabling them to be produced with uniformity of quality, and of such durability as to constitute them successful rivals of natural stones. The use of wood is steadily decreasing, partly in consequence of its scarcity, and of its unfitness for use where longitudinal stresses are to be encountered, and partly through the introduction of the other materials, which are now made at less cost than formerly. Progress is to be expected in the direction of improved processes for the preservation of timber. Asbestos paint, as used on the buildings of the proposed International inventions exhibition, has proved a safeguard in that case against fire.

The modern processes of steel manufacture are furnishing masses of enormous magnitude, and of great uniformity of quality. The processes of Siemens and of Bessemer are now supplying such steels; while the method of Thomas and Gilchrist is permitting the use of ores formerly quite inapplicable to such purposes. The cost of cast-iron is decreasing with the construction of larger furnaces, and the use of more highly heated blast, and with a better understanding of the chemistry of the process of reduction. Copper is finding new and important applications in the new alloys, phosphor-bronze, manganese-bronze, and other compositions.

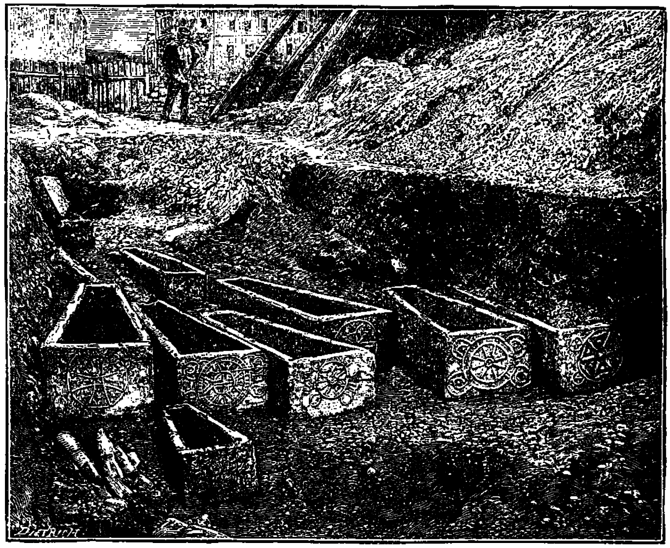
The working of heavy masses is demanding the construction of larger hammers; and it is becoming seen that light steam-hammers are actually injurious to the parts forged by them. Testing-machines are now in daily use, in the hands of the engineer, to determine the exact value of the metals proposed for use in his designs, and to exhibit the strength of completed members.

In bridge-construction, the St. Louis bridge was a novel departure in the use of steel in compression; and the New-York and Brooklyn bridge is an equally successful example of application of wires for suspension over long spans. The new bridge over the Forth exhibits still another modern novelty in its great cantilevers, the only known expedients for successfully spanning seventeen hundred feet with a rigid structure. In railroad and canal construction, the rivalry between the two systems of transportation is best illustrated by the enormous canals, now in progress and proposed, to connect ocean with ocean, and sea with sea, and, as in the case of the Manchester ship-canal, to take ocean-going ships into the interior of the country. This led to the study of harbor-construction, and reference to the methods of making and handling blocks of masonry weighing three hundred and fifty tons each, in the building of their sea-walls. A new and great improvement in the methods of supply of air for respiration, to the workmen sent into the depths during the operations just referred to, is that of absorption of exhaled carbonic acid by a basic salt, and the introduction of oxygen from under compression in small tanks carried by the diver, who is thus enabled to remain under water for considerable periods of time. In tunnelling in red sandstone, a speed of from ten to fourteen yards per day is attained, and of twenty-four yards in chalk. Dynamite and tunnelling machines are making this great progress possible.

Progress in motors has not been rapid during late years. The best of recent double-cylinder non-condensing steam-engines demand but two pounds and seven-tenths of coal per horse-power and per hour; while the condensing-engine has worked down to about a pound and a half. The gas-engine is gradually coming forward as a rival of the steam-engine in small powers; its greater safety, and the reduction of current expenses in various directions, giving it a superiority in some respects. Water-wheels have attained an efficiency of eighty-five per cent; and the turbine, with its high efficiency, offers great advantages in application where the fall is low, or the variation of height of tail-water considerable. In the transmission of power, the introduction of water, steam, and compresed air, sent out from a central station, is a promising direction of progress.

COFFINS OF THE SEVENTH CENTURY.[1]

WHILE digging a trench recently in the rue Salande in Paris, an ancient burial-ground was encountered. The discovery was made among the rubbish and ruined walls of the old Gallo-Roman outskirts at a depth of about one and one-half metres. Nineteen coffins made of plaster, and four or five of stone, were the most interesting things exhumed. The full extent of the burial-ground could not be determined, because it extends beneath some houses. That all the sepultures belonged to Christians is probable from the fact that they invariably pointed toward the east, and by the Christian symbols. The coffins belonged to the seventh, eighth, and ninth centuries. Previous to this period they had been made of stone, but those of the epoch under consideration are mostly of plaster. The coffins all had the shape of an elongated trapezoid, being narrower at the foot, and were found filled with dirt, the covers having given way.



COFFINS OF THE SEVENTH CENTURY.

The plaster sarcophagi are not unique, since fully two thousand have already been reported as found. Figures are usually imprinted upon the exterior of the head and foot, but not more than one or two in a hundred are ornamented on the long side. The cross emblem of Christianity, inscribed in a circle symbolical of eternity, is the predominant form of ornamentation. There are numerous other ornamentations, but it is difficult to classify them, or to understand their signification.

[1] Abridged from *Science et nature.*