BACILLI IN BUTTER.

THE fact that milk affords a particularly suitable medium for the growth and multiplication of most micro-organisms, has rightly led to its being regarded as a dangerous vehicle for the propagation of disease. On the Continent the practice of boiling all milk before use, and so destroying any pathogenic microbes which may be present, is almost universal, and recently a number of special pieces of apparatus have been devised for household use, ensuring the efficient so-called "pasteurization" of milk. In England, however, we but rarely boil our milk in spite of outbreaks of diphtheria and typhoid fever having been not infrequently traced to a particular milk supply. In a paper by Cnopf on the bacterial contents of milk it is stated, that on one occasion out of every thirteen samples of milk supplied to Paris one was found to contain tubercle bacilli, whilst it is well known that the germs of typhoid, cholera, diphtheria, anthrax, &c., thrive readily in this medium. But although milk has been made the subject of much careful experimental investigation, comparatively little is known of the microbial condition of butter. Heim has shown that cholera bacilli purposely rubbed into butter could be demonstrated after thirty-two days, whilst typhoid bacilli similarly introduced were found after three weeks, and tubercle bacilli after the lapse of a month, although Gasperini discovered the latter in butter even after 120 days. Quite recently Lafar has published a paper, "Bacteriologische Studien über Butter" in the *Archiv für Hygiene*, in which he has recorded his investigations on the micro-organisms found in Munich butter. These experiments are instructive as exhibiting the fitness of butter to support a large number of bacteria, and thus furnish an interesting supplement to what is already known concerning the longevity of pathogenic microbes in this medium. The samples examined were prepared from fresh cream and were investigated as soon as possible after the butter was made. It was found that the number of microbes differed according as the portion for experiment was taken from the outside or from the interior of the piece of butter. Thus in one instance whilst one gram from the centre of the pat contained 2,465,555, on the outside in the same quantity as many as 47,250,000 micro-organisms were found. Taking the average of a number of examinations, it was estimated that the interior of a lump of butter possessed from 10 to 25 millions of bacteria in a single gram. Lafar is inclined to regard this as an under rather than an over-statement of the number, inasmuch as there are always probably present a certain proportion of microbes which will not develop at the ordinary temperature, or on the gelatine-peptone medium usually employed. He graphically puts it that, in some cases it is conceivable that the number of organisms swallowed with a moderately-sized slice of bread and butter may exceed that of the whole population of Europe! Lafar found that butter kept in a refrigerator, with a temperature of between 0° to $+1^{\circ}$ C. at first (after five days) showed a marked reduction in the number of bacteria, but that no further diminution took place, although the sample was kept for a month at this temperature. Samples kept at from 12° to 15° C. exhibited a marked increase in the number of micro-organisms, a rise from 6 to 35 millions being observed in the course of nine days, whilst when placed in the incubator (35° C.) after four days the bacteria had fallen from 25 to 10 millions, and after thirty-four days only 5 per cent. of the original number present were discoverable. Experiments were also made to ascertain what was the bacterial effect of adding salt to butter kept in a refrigerator. It was found that although the numbers were thereby considerably reduced, that yet, even when as much as 10 per cent. of salt was added, the complete destruction of the bacteria was not accomplished. On examining, however, gelatine-plates prepared from these samples, it was ascertained that the organisms present consisted almost entirely of a pure cultivation of one particular microbe, which was apparently entirely unaffected by the addition of salt, and had grown and multiplied to the exclusion of nearly all the other bacteria originally present. When samples similarly salted were placed in the incubator (35° C.) the result was rather different, for whilst there was more apparent connection between the proportion of salt added and the diminution in the number of bacteria, more varieties of micro-organisms were found on the gelatine-plates. But in this case, also, the germicidal effect produced was not proportional to the increase in the amount of salt. Samples of artificial butter were also examined, and were invariably found to be much poorer in bacteria than ordi-

nary butter. Thus, whilst the smallest number found in one gram was 747,059, in real butter considerably over two million microbes was the minimum. Two varieties of bacilli have been isolated and described, which were found very constantly present in butter throughout these investigations. They are beautifully illustrated and shown in coloured plates as individual organisms and colonies at the end of the paper. Lafar purposes continuing his investigations, and it is to be hoped that the examination of butter for pathogenic micro-organisms, about which so little is known, will form an important feature in any further researches he may undertake.

GRACE C. FRANKLAND.

THE OCCURRENCE OF NATIVE ZIRCONIA (BADDELEYITE).

THE discovery of native zirconia was first made public in my letter to NATURE (vol. xlv. p. 620) in October last; at the same time I gave characters sufficient for the recognition of the new mineral, and suggested the name *Baddeleyite*, in honour of Mr. Joseph Baddeley who had brought the specimen with other dense minerals from Rakwana in Ceylon. As there was only a single fragment of what at first sight seemed a hopelessly imperfect crystal, the determination of all the important characters without appreciable injury of the specimen was a task of an attractive kind: the technical details of the investigation (including quantitative chemical analyses) and the line of argument by which definite results were evolved from the observations, were communicated to the Mineralogical Society at the meeting held on October 25 (NATURE, vol. xlvii. p. 70), and crystals of hydrous zirconium oxychloride prepared by identical methods from Baddeleyite and artificial zirconia, respectively, were exhibited for comparison. Having regard to the unexpected result of the chemical examination and the difference of the characters of Baddeleyite from those of artificially prepared crystals of zirconia, every care had been taken to get results as accurate as the material itself would admit of.

Of course it was hoped that the occurrence of native zirconia, once established, would soon be noticed elsewhere; and in fact, I hear this morning (January 3) from Dr. Hussak of the Geological Survey of Brazil, that flawless crystals of zirconia are actually met with in the south of São Paulo as an accessory constituent of an augitic rock described under the name of Jacupirangite by my friend Mr. O. A. Derby.

The Brazilian mineral had three or four years ago been regarded by Dr. Hussak (who had then only a small amount of material for examination) as probably orthite (silicate of cerium, iron, &c.), a mineral with which it agrees in its more obvious external characters, and it was mentioned later under that name in Mr. Derby's description of the Jacupirangite; but more recently Dr. Hussak, on isolating a score of flawless crystals from the decomposed rock, recognized the distinctness of the mineral from orthite, determined the geometrical and physical characters of the crystals, and decided from a chemical examination that the material was a tantalum-niobate of probably some member of the yttrium-cerium group: these results were published in the *Neues Jahrbuch für Mineralogie*, 1892, Band II. p. 142, immediately after my announcement of the occurrence of native zirconia in Ceylon had been sent for publication, but they had been forwarded from Brazil as early as the month of June. Dr. Hussak now informs me that the Brazilian mineral, which had been sent to Sweden for a complete quantitative examination, has been determined by Prof. Blomstrand to be almost pure zirconia.

As regards crystalline form, the parametral elements obtained by myself for Baddeleyite, and announced at the meeting of October 25, agree in a very satisfactory way with those determined by Dr. Hussak for the Brazilian mineral, while as regards optical characters, the two descriptions are practically identical. The only important deviation of external character is in the specific gravity; that of Baddeleyite is 6.025, that of selected crystals of the Brazilian mineral is 5.006.

Now it seems almost impossible that the specific gravity of crystals of a simple oxide presenting otherwise identical characters can vary to this extent, and the explanation of all the difficulty will probably be found to be that Dr. Hussak's specimens really belong to two distinct minerals; that while the crystalline form and optical characters were determined from the one (zirconia), the specific gravity and the chemical composition

were originally determined from the other (yttrium tantalate). In fact, it was stated in my former communication that the Baddeleyite of Ceylon is itself associated with such a chemical compound; and I may add that this associated mineral was there designated without the mention of a species-name because it had been found to have a specific gravity (4.9) far below the inferior limit (5.5) hitherto observed in the case of undoubted Ytrotantalite: it was intended to determine later whether or not the lowness of the specific gravity was accompanied by a difference in the proportion of the chemical constituents; further, the similarity of aspect of the zirconia and yttrium tantalate of Ceylon is such that a confusion of the two would be easy. In this way the discrepancy of the chemical results and the complete accuracy of the observations of Dr. Hussak, whose reputation stands so high in the annals of mineralogical science, would be found consistent with each other.

There remains the inconvenience that two names have been suggested for the same mineral; but according to the rules of nomenclature formulated by Dana (rule 13*a*) the name of *Baddeleyite* has the prior claim. I may add that the name *Brasilite* was in use eight years ago, commercially at least, for the specification of an oil-bearing rock found in the neighbourhood of Bahia.

L. FLETCHER.

GAS POWER FOR ELECTRIC LIGHTING.

AT the ordinary meeting of the Institution of Civil Engineers on Tuesday, January 10, an interesting paper on "Gas-Power for Electric Lighting" was read by Mr. J. Emerson Dowson. The author stated that in Great Britain alone gas-engines had been sold for electric lighting, exceeding in the aggregate 7000 horse-power, and that in Germany engines were used for about 1100 arc- and 90,000 glow-lamps. It was, however, only within the last few years that gas-engines of large size had been before the world in a practical form. The varying load-factor in central stations was a serious trouble, and the author hoped to show that much of the present loss, due to fuel, water, and wages, would be avoided if gas-power were used instead of steam-power.

Special reference was made to the central-station at Dessau, belonging to the German Continental Gas Company. That station was opened in 1886 with two 60 horse-power, one 30 horse-power, and one 8 horse-power (effective) engines, worked with town-gas, and all the dynamos were driven by belting and counter-shafts. In 1891 considerable alterations were made. One 60 horse-power engine, with its belting and counter-shaft, was retained, and one of 120 horse-power introduced, coupled direct to its dynamo. The speed of the engine and coupled dynamo was 145 revolutions per minute, and the consumption of town-gas was equal to 39 cubic feet per kilowatt. Formerly, without accumulators, it was thought necessary to adjust the size of the engines to the supply, so that they should always be worked to their full extent. It had, however, been found that a limited supply could more advantageously be furnished entirely from accumulators. In spite of the loss of about 21 per cent. in the accumulators, large engines worked more profitably in parallel than smaller ones supplying direct without accumulators. Since February, 1889, the Municipality of Schwabing, a suburb of Munich, had used an Otto engine worked with Dowson gas for 10 arc- and 300 glow-lamps. The load was variable, but with an average output of 22.5 kilowatts per hour the fuel-consumption was 3.3 lbs. per kilowatt. The town of Morecambe was lighted by nine arc-lamps and glow-lamps, equal to 1600 of eight candle-power each, the dynamos being driven by Stockport gas-engines worked with Dowson gas. With an output of only 1155 kilowatts per week the consumption of fuel was 2.58 lbs., and the cost of the gas, including wages and fuel, was $\frac{3}{4}$ d. per kilowatt delivered. At the château of Mr. Say, at Longpont, in the South of France, there were 650 glow-lamps and one arc-lamp, supplied by a dynamo driven by a Crossley engine worked with Dowson gas. The consumption of fuel was 1.2 lb. per indicated horse-power, and 2.7 lbs. per kilowatt per hour.

It was believed that the late Sir William Siemens first drew attention to the fact, that when illuminating-gas was burnt in a gas-engine to drive a dynamo, much more light was produced electrically than could be produced by burning the same quantity of gas in burners in the usual way. Latterly the consumption of gas per horse power in gas-engines had been reduced, and the

ratio was at the present time about 20 to 1 in favour of converting the gas into an arc-light, by means of a gas-engine. The author had collected data from various sources, as to the consumption of ordinary town-gas by engines supplying electric light with and without accumulators. The average of all the returns, with engines under varying loads and without accumulators, was about 47 cubic feet per kilowatt-hour; when accumulators were used, the consumption of gas was less, because the engines then worked under a full load. With 47 cubic feet per kilowatt, and 55 watts per 16 candle-power, one light of that power required only 2.6 cubic feet per hour; whereas a standard Argand burner required 5 cubic feet per hour. In this comparison, it was assumed that the glow-lamps and gas-burners were in good order, but under ordinary working conditions they did not maintain so high a duty.

The question of load-factor was a serious one with any type of engine, but with gas-engines the loss was much less than with steam-engines. When a gas-engine was stopped, its consumption of fuel stopped also, and there was no furnace to maintain, nor was there any water to boil at starting. At the same time, it was desirable that the gas-engine should be worked as much as possible under a full load, and in this respect the experience at Dessau was generally confirmed. A central-station was worked under trying conditions, and in the London district there was only a full output of current during from three to five hours in every twenty-four; moreover, about 60 per cent. of the total output was required during that short period. In practice, this meant that in a station where the current was supplied without accumulators, the engines were run at a reduced speed during a portion of the time, and at other times some of them were stopped altogether; but all had to be ready to work in the evening, and occasionally in the day-time, when there was fog. Generally, it might be assumed that the average consumption was more than 6 pounds per kilowatt where accumulators were used, and about 9 to 12 pounds where they were not used. In any case, with the best possible arrangement of steam-power, there must be a large amount of fuel consumed which did no useful work; for, even if some of the fires were drawn, they had to be re-lighted, and the large quantity of water which had cooled during the time of standing must be re-heated.

The author believed that the solution of the difficulty was to be found in the use of gas-plant instead of steam-plant. With a large gas-engine, one brake horse-power per hour could be obtained with a consumption of about 1 lb. of anthracite, or $1\frac{1}{4}$ lb. of coke; whereas the consumption of coal with the steam-engines used for central-stations, must be taken at about 2.5 lbs. per brake horse-power, when working under a full load. A saving of not less than 50 per cent. could therefore be effected in stations where the engines were fully loaded; and where there were great fluctuations in the output, the loss of fuel with boilers not used, or only partly used, could be almost entirely avoided. For a maximum of 400 kilowatts, there would be three gas-generators, each capable of supplying one-third of the maximum required. The production of gas could be raised or lowered in several ways, and the working of each generator could be stopped immediately by shutting off its steam supply. Supposing, therefore, that all three generators were working at their maximum rate, and a gradual reduction was required, this could easily be effected; and when the production of one or two generators could be dispensed with their operation was at once stopped. The third generator could then be kept at work, and its production adjusted to suit the minimum consumption required. A gas-generator had a small grate-area compared with that of a boiler, and much less cooling-surface; it contained no water, and required no chimney-draught. A generator of the size referred to lost only 6 to 8 lbs. per hour whilst standing. If an average of only 40 per cent. of the maximum power were required for twenty-one hours, it was equivalent to letting two of the generators stand for that period; and at 8 lbs. each per hour that meant a total loss of only 3 cwt.; compared with the much greater waste when steam-power was used. As the use of large engines, driven with generator gas, was of recent date, the author proceeded to describe the gas-plant used, and gave the results of engines working regularly with Dowson gas, under the usual conditions obtaining in factories. He also gave the results of brake-tests made with several engines of large size, and reproduced indicator diagrams taken from engines of different makers. Although admirable results had undoubtedly been obtained from engines