A chapter on the history of the germinal layers is promised in volume second. It is pleasant to find from the names of Agassiz, and Brooks, and others, that Embryology is gaining a sure foothold in this country.

The book throughout evinces the greatest ability and care. Clearness and truth will make it attractive to the student, and it may safely be predicted that a fresh impetus in embryological research among young students in this country and abroad will date from this publication. If this prove to be the case, the author may well feel repaid for his labor. H. F. O.

ON ANGULAR APERTURE OF OBJECTIVES FOR MICROSCOPES. By Geo. E. Blackham, M.D., F.R.M.S. New York Industrial Publication Company. New York, 1880.

We are glad to see that the vexed question of the angular aperture of the objectives has at length been treated in an exhaustive manner by Professor Blackham, who, by an untechnical method of treating the subject, has endeavored to interest a wide range of readers. The work has been produced in handsome form, and has eighteen sheets of diagrams. A critical review of this book will appear at a later date.

COAL.

BY P. W. SHEAFER, M. E., POTTSVILLE, PA.

II.

The fearful loss of good material involved in mining and preparing Anthracite, as shown in the accompanying tables, though greatly to be deplored, seems to be almost inevitable. The disposition of the coal in large solid beds, and in highly inclined positions, involves strong supports to keep the superincumbent mass from crushing and closing the avenues to the mines; and these supports must consist of massive pillars of the solid coal itself. Wooden props, however ponderous and strong, can only be used for the minor supports. Some of this pillar coal is ultimately removed, but much of it is inevitably lost, especially in the larger beds which frequently range from 20 to 40 feet in thickness, and are often inclined at an angle of from 40 to 70 degrees.

It is estimated that not more than 66 per cent. of the coal is ever taken out from the mines. That which is brought to the surface is run through a huge structure from 80 to 100 feet high, very appropriately called a "breaker," ingeniously contrived for the destruction of coal. There are over 300 of these immense buildings in the Anthracite region, costing on an average $50,000 each, or an aggregate of $15,000,000. To the top of these the coal is hoisted, and then descends through a succession of rolls and screens, emerging at the bottom, in a series of assorted sizes, from huge blocks of lump coal to unmerchantable dust, which forms a grievously large proportion of the whole. This process involves a loss of good coal, equal to 20 or 25 per cent. of the entire quantity mined. For the coal wasted in mining, say 40 per cent., and in preparing, 25 per cent., no one is paid; it is a total loss to landowner, miner and shipper.

Plans for utilizing the waste coal dirt, or culm of Anthracite collieries, have been frequently suggested, but none have come into general use. The Anthracite Fuel Company, at Port Ewen, on the Hudson, in 1877, used 90 per cent. coal dust and 10 per cent. fuel pitch, and made 300 tons of fuel per day, consuming over 50,000 tons of culm. The Delaware and Hudson Company also use at their mines 60,000 tons per annum. They now ship all their coal down to pea sizes, and consume the culm in generating steam. If all our coal companies would follow this excellent example it would enable them to sell half a million tons more coal, and burn the same amount of refuse, thus earning or saving half a million dollars per annum, to add to their revenues. The Philadelphia and Reading Railroad Company has recently introduced a method of burning coal dust in the furnaces of its engines, and the plan appears to meet with success.

The amount of water which drains into a mine from a mile or more of surface is enormous, for the average amount of rain and snow fall is 58,840 cubic inches per square yard annually, and the mines are liable to absorb not only the rain fall on the surface immediately over them, but all that which by contour of the surface, or by converging strata, tends towards them. On an average possibly five tons of water are hoisted for every ton of coal raised—another loss chargeable to mining.

The preponderance of waste coal seems excessive; but the writer's experience in surveys of certain tracts of land, and in preparing maps which show the area exhausted, compared with the amount marketed from ten or more collieries, in a period of 20 years, proves that the loss is not over-estimated, especially in the Mammoth Bed, whose average thickness is 25 feet. An eight-foot bed of coal yields much better in proportion. When they exceed six or eight feet in thickness, especially if steeply inclined, they are not only expensive to mine, but a large proportion of the coal must be left to support the rocky roof.

The Bituminous coals, particularly those of the United States, are not subject to these serious losses, and are quite cheaply mined and prepared. No breakers are required, as the only division is into coarse and fine coal, which are easily separated by screens; and the fine coal can be readily converted into coke, making a better condensed fuel than the coal in its natural shape. The Bituminous beds are nearly horizontal and rarely more than six feet thick, so that it is not necessary to leave extensive pillars; and as the coal is above water level, or in shallow basins, it is not necessary to put up extensive hoisting and pumping machinery. The simple, natural ventilation of American Bituminous mines also does away with the extensive and costly appliances for this purpose of Anthracite mines, in spite of which so many miners annually fall victims to the noxious gases.

The total amount of coal still to be mined, according to the accompanying tables, is 26,361,076,000 tons. The total waste, as experience has shown, is equal to two-thirds of the coal deposit, and reaches the appalling amount of 17,574,050,666 tons, leaving us only 8,787,075,533 tons to send to market. In all our calculations of Anthracite we have counted the area as if in a level plain, and made no allowance for the undulations which must necessarily increase the amount of coal. But as many of the flexures are abrupt and broken, making much faulty and refuse coal, it will cover any over-estimate of area or thickness we have made in our calculations.

Our tables show that 360,017,817 tons have been sent to market in the 58 years from 1820 to 1878, inclusive. Our consumption now amounts to 20,000,000 tons annually. The increase of production for the past ten years has been 187,112,857 tons. At this rate we shall reach our probable maximum out-put of 50,000,000 tons in year 1900, and will finally exhaust the supply in 186 years.

The present product of the Anthracite coal fields is (1878) as follows:

Southern	50	Collieries	6,282,226 tons.
Middle	161	"	3,237,449 "
Northern	132	"	8,085,587 "
Total	343	"	17,605,262 "

At this rate the eastern end of the northern field is being rapidly exhausted. The middle field, too, which contains the lower productive coals, is likely to cease extensive mining about the year 1900; while the western portion of the northern field, extending from Pittston to the western end, and the southern field from Tamaqua to Tremont, comprising about 100 square miles, which contain more coal beds and deeper basins, must furnish the supply for the coming years.

Partially successful experiments have been made to use petroleum as a substitute for coal to some extent. But is it not already evident, under the reckless prodigality of production, that this occult and mysterious supply of light and heat and color will be exhausted before the Anthracite, and can, at best, only temporarily retard the consumption of the latter?

As already intimated, the question of the exhaustion of our coal supply is scarcely more at the present time than a curious and interesting calculation. It has not yet become so grave and portentous as in Great Britain, where a commission, with the Duke of Argyle, Sir Roderick Murchison and Sir W. G. Armstrong at its head, was recently appointed by Parliament to ascertain the probable duration of the coal supplies of the kingdom. There it is serious indeed; for when Britain's coal fields are exhausted, her inherent vitality is gone, and her world-wide supremacy is on the wane. When her coal mines are abandoned as unproductive, her other industries will shrink to a minimum, and her people become familiar with the sight of idle mills, silent factories and deserted iron works, as cold and spectral as the ruined castles that remain from feudal times.

The modern growth and ultimate decadence of this great empire may be calculated from the statistics of her coal mines. In 1800 her coal product was about 10,000,000 tons; in 1854 it was 64,661,401 tons; and in 1877 it swelled to 136,179,968 tons. This period was a time of continued prosperity, when England ruled the world financially and commercially. In the 23 years from 1854 to 1876, inclusive, she produced the enormous quantity of 2,210,710,091 tons of coal; and, more wonderful still, exported only 222,196,109 tons—say ten per cent—consuming the rest within her own borders.

The average increase of her annual output has been 3½ per cent. Will it so continue? Or has she reached the summit of her industrial greatness and commercial supremacy, and will they now decline, and with it her naval and military power, the subservient agent, and, to a large extent, the creature and result of those great interests?

Our Anthracite product, compared with the coal product of Great Britain, is so small as to really seem insignificant. The English Commission counts as available all coal beds over one foot thick—we count nothing under two and a half feet thick, nor below 4,000 feet in depth—showing a net amount in the explored coal fields of 90,207,285,398 tons; estimated amount in concealed areas, 56,273,000,000 tons; total, 146,480,285,398 tons, distributed as follows:

	Explored.	Unexplored.	Total.
England	45,746,930,555	56,246,000,000	101,992,930,555
Wales	34,461,208,913	....	34,461,208,913
Scotland	9,843,465,930	No estimate.	9,843,465,930
Ireland	155,680,000	27,000,000	182,680,000
Total	90,207,285,398	56,273,000,000	146,480,285,398

The exhaustion of this magnificent mass of coal at this present rate of increase, viz.: three and a half per cent. per annum, is estimated by Professor Jevons as follows:

1876, actual output	133,300,000 tons.
1886, estimated annual output	186,600,000 "
1896, " " "	261,200,000 "
1906, " " "	365,700,000 "
1916, " " "	512,000,000 "
1926, " " "	716,800,000 "
1936, " " "	1,003,500,000 "

Thus in sixty years the output would be nearly eight times the present amount, and about one-fourth of the total amount to be found in Great Britain.

This vast estimate seems too enormous. It does not allow for great loss when cost of labor and much competion will prevent the working of small coal beds under two feet in thickness, or for the cost of mining when from 2000 to 3000 feet deep. Nor is it possible that Great Britain's industries and export trade combined will ever require so great a quantity. Modern discoveries and improvements, in applied science, tend to diminish the consumption. The 8,000,000 tons annually required for gas-works may be materially reduced by the use of the electric light. The domestic consumption, now equal to one-fourth the product, or 33,000,000 tons a year, may increase. But will not the iron manufactures be on the wane, and her coal exports—now ten per cent. of her coal product—fall off as those of other countries increase?

We have about 340 collieries and produce 20,000,000 tons per annum, or about 60,000 tons each. Great Britain has nearly 4000 collieries, and mines 132,000,000 tons, or 33,000 tons per colliery. The greater the yield per colliery the less the expense in mining. If we decrease the number of mines and increase their capacity not only to raise the coal, but to exhaust a constant current of foul air and dangerous gases, clouds of powder smoke and millions of gallons of water, we will reduce the cost of mining. Most of the Anthracite mining in the United States is now done at a less depth than 500 feet vertical; but as the coal nearer the surface becomes exhausted, the mines must go deeper and become more expensive.

What a folly it is to boast of our world's supply of Anthracite, and feverishly endeavor to force it into foreign markets, when we can so readily foresee its end? Would it not be wiser to limit its product, restrict its sale to remunerative prices, and consume it at our own firesides, and in our own manufactures?

The monopoly of the Anthracite coal fields by some seven corporations, which, according to the accompanying tables, now control about two-thirds of the whole, and the best coal area, must prove, under economic management, a profitable investment for their stockholders. Mining, selling and transporting their own coal, as they do, individual enterprise cannot hope to compete with them, and must vanish from the ground, and their only rivalry will be with each other, and with the Bituminous trade. Fortunately for the public, this rivalry will always be keen enough to keep the price of coal at a fair low rate of cost and profit.

The coal resources of Great Britain are all developed now, and in process of depletion; while in this country when our 470 square miles of Anthracite are exhausted, we have more than 400 times that area, or 200,000 square miles of Bituminous, from which to supply ourselves and the rest of mankind with fuel. The coal product of the world is about 300,000,000 tons annually. The North American continent could supply it all for 200 years. With an annual production of 50,000,000 tons, it would require twelve centuries to exhaust the supply. But with a uniform product of 100,000,000 tons per annum, the end of the Bituminous supply would be reached in 800 years. What the annual consumption will be when this continent supports a teeming population of 400,000,000 souls, as will be the case some day, must be left to conjecture. But with half that population, as energetic, restless, and inventive as our people in this stimulating climate have always been, under the hopes of success, such a country as this constantly holds out much to tempt ambition and reward enterprise.

If it be true, as Baron Liebig asserts, that civilization is the economy of power, we have it in our immense areas of Bituminous coal. There is no known agent that can answer as a substitute for the vast power and almost limitless usefulness of coal in its general adaptation to the wants of man; and that nation will maintain the foremost rank in enlightened modern civilization which controls, to the fullest extent, while it lasts, this wonderful combination of light and heat and force. We are wiser than our fathers; and from the modest but sublime altitude to which we are lifted by physicial science, and the far extended range of mental vision which it opens up to us, we can see farther into the plans of Providence than those who went before us, and can conjecture the early, if not the remote, future of the human race in our land and in other lands.

Happy that people whose legislators study the best mode of developing the natural resources of their country, and whose great men become great by improving the condition and promoting the welfare of the human race. The greatest of England's five Georges was not either of those who wore the crown, but plain George Stephenson, of Manchester, who rolled the world farther along the path of progress than all the others; and none of the royal Jameses did half so much for the civilization of his country as James Watt, whose boyish study of the steaming tea-kettle developed the giant power that does the world's work with an energy that is tireless and irresistible.

ETHNOLOGY.*

FRAGMENTARY NOTES ON THE ESKIMO OF CUMBERLAND SOUND.

By Ludwig Kumlien.

II.

They have an interesting custom or superstition, namely, the killing of the *evil spirit* of the deer; some time during the Winter or early in Spring, at any rate before they can go deer-hunting, they congregate together and dispose of this imaginary evil. The chief *ancoot*, *angekok*, or medicine-man, is the main performer. He goes through a number of gyrations and contortions, constantly hallooing and calling, till suddenly the imaginary deer is among them. Now begins a lively time. Every one is screaming, running, jumping, spearing, and stabbing at the imaginary deer, till one would think a whole mad-house was let loose. Often this deer proves very agile, and must be hard to kill, for I have known them to keep this performance up for days; in fact, till they were completely exhausted.

During one of these performances an old man speared the deer, another knocked out an eye, a third stabbed him, and so on till he was dead. Those who are able or fortunate enough to inflict some injury on this bad deer, especially he who inflicts the deathblow, is considered extremely lucky, as he will have no difficulty in procuring as many deer as he wants, for there is no longer an evil spirit to turn his bullets or arrows from their course.

They seldom kill a deer after the regular hunting season is over, till this performance has been gone through with, even though a very good opportunity presents itself.

Salmo salar, and one other species of *Salmo* that I could not procure enough of to identify, are caught to some extent in June and September in some of the larger fjords; they are mostly caught with a spear, but sometimes with a hook. (For description *vide* under hunting-gear, etc.)

When these fish are caught, they are put into a seal-skin bag, and it remains tied up till the whole becomes a mass of putrid and fermenting fish, about as repulsive to taste, sight and smell as can be imagined. *Cottus scorpius*, which contributes so largely towards the Greenlander's larder, is not utilized by the Cumberland Eskimo, except in cases of a scarcity of other food supplies; the fish is abundant in their waters, however, and fully as good eating as they are on the Greenland coast.

Birds and their eggs also contribute towards their sustenance in season; they are extremely fond of eggs, and devour them in astonishing quantities.

The "black skin" of the whale, called by them *muktuk*, is esteemed the greatest delicacy. When they first procure a supply of this food, they almost invariably eat themselves sick, especially the children. We found this black skin not unpleasant tasting when boiled and then pickled in strong vinegar and eaten cold; but the first attempts at masticating it will remind one of chewing India rubber. When eaten to excess, especially when raw, it acts as a powerful laxative. It is generally eaten with about half an inch of blubber adhering.

* Bulletin (15) of the United States National Museum. Contributed to the Natural History of Arctic America, made in connection with the Howgate Polar expedition, 1877-78.