pockets, so made as to take advantage of all the material used, but not evenly arranged side by side. Each pocket had been completed by itself and without reference to those about it. They were designed for the young ants, but in this case were empty. I am persuaded that this comb, if I may so call it, is made of the partially masticated cuttings bound together with web-like filaments. Washing a little of it in alcohol and placing it under the glass, I distinctly saw white web completely covering some of the particles.—*American Entomologist.*

New Phototype Process.

At the last meeting in Paris of the Society for the Encouragement of National Industry, a communication was received of a process discovered by M. Lenoir, for producing engraved plates from negatives photographed from nature.

The inventor illustrated his process before the council, preparing plates serving to show different styles of engraving, which were distributed among the audience.

M. Lenoir himself describes his process as follows:

"Until now, in order to obtain these negatives, a print was made in fatty inks by Poitevin's system. An impression was taken upon a sheet of transfer paper, which was placed upon a metal plate; after submitting it to the action of acid, it was inked several times under water. All this was difficult as well as uncertain. I have sought a means of operating directly upon the plate, without inking, and in this manner I set to work:

"I lightly coat a metal plate with albumen mixed with bichromate and carmine; this last is used not only as a dye, but it assists in the lifting of the film, on account of its solubility in ammonia. Gamboge and various resins answer the same purpose almost as well.

"The use of carmine is in the stripping off of the mass, because, the exposure taking place upon the upper surface, the carmine draws the albumen with it, more or less, according to exposure.

"When the film is stripped off, an image remains formed of albumen, in itself unable to resist the action of acids. It must, therefore, be rendered insoluble. There are two ways by which this may be effected; one is to cause the albumen to absorb a solution of gum lac, dissolved in hot water with borax; the other, and that which I prefer, is to plunge the plate, once stripped, in a solution of bichromate of potash, then drying at the heat of about 120°. The albumen has by this means acquired the required resistance to the action of acids. The plate has now to be engraved to give it a grain according to the amount of ink it should take up. Upon the unabsorbent and stripped plate a film is spread, consisting of a solution of bitumen of Judea and turpentine mixed with carbonate of lime. When plunged in acid, carbonic acid is liberated; it forms tiny canals through which the acid attacks the metal more or less quickly, by reason of the thickness of the albumen.

"But if strong acid be employed, the minute canals would be soon destroyed; I therefore use acid liquid composed of water acidulated with nitric and oxalic acids and alum. An oxalate of the metal is then formed on the sides of the canals, and causes them to adhere to the plate. The texture of the etching is more or less fine according to the length of time the albumen is allowed to absorb the acid. Minute hillocks remain in form of microscopical obelisks.

"In this state the plate is finished; it requires only to be dried, and is ready to be printed from immediately. No preliminary preparation is necessary, as the whole operation may be conducted in three hours."

A Railway in the Rocky Mountains.

A correspondent of the Denver *Times*, describing the extension of the Denver and Rio Grande Railway from Conejos westward toward the San Juan country, gives these picturesque bits. He says:

For miles the railway curved among the hills, keeping sight of the plains and catching frequent glimpses of the village. Its innumerable windings along the brows of the hills seemed, in mere wantonness, as loth to abandon so beautiful a region. Almost imperceptibly the foothills changed into mountains and the valleys deepened into cañons, and winding around the point of one of the mountains it found itself overlooking the picturesque valley or cañon of Los Pinos creek. Eastward was the rounded summit of the great mountain of San Antonio; over the nearest height could be seen the top of Sierra Blanca, canopied with perpetual clouds; in front were castellated crags, art-like monuments, and stupendous precipices. Having allured the railway into their awful fastnesses, the mountains seemed determined to baffle its further progress. But it was a strong hearted railway, and, although a little giddy 1,000 feet above the stream, it cuts its way through the crags and among the monuments and bears onward for miles up the valley. A projecting point, too high for a cut and too abrupt for a curve, was overcome by a tunnel. The track layers are now busy at work laying down the steel rail at a point a few miles beyond this tunnel. The grade is nearly completed for many miles further. From the present end of the track for the next four or five miles along the grade, the scenery is unsurpassed by any railroad scenery in North America. Engineers who have traversed every mile of mountain railroad in the Union, assert that it is the finest they have seen. Perched on the dizzy mountain side, at an altitude of 9,5.0 feet above the sea—greater than that of Veta pass—1,000 feet above the valley, with battlemented crags rising 500 or 600 feet above, the beholder is enraptured with the view. At one point the cañon narrows into an awful gorge, apparently but a few yards wide and nearly 1,000 feet in depth, between almost perpendicular walls of granite. Here a high point of granite has to be tunneled, and in this tunnel the rock men are at work drilling and blasting to complete the passage, which is now open to pedestrians. The frequent explosions of the blasts echo and re-echo among the mountains until they die away in the distance. Looking down the valley from the tunnel, the scene is one never to be forgotten. The lofty precipices, the distant heights, the fantastic monuments, the contrast of the rugged crags and the graceful curves of the silvery stream beneath them, the dark green pines interspersed with poplar groves, bright yellow in their autumn foliage, that crown the neighboring summits—height, depth, distance, and color—combine to constitute a landscape that is destined to be painted by thousands of artists, reproduced again and again by photographers, and to adorn the walls of innumerable parlors and galleries of art. Beyond the tunnel for a mile or more the scene is even more picturesque, though of less extent. The traveler looks down into the gorge and sees the stream plunging in a succession of snow-white cascades through narrow cuts between the perpendicular rocks.

Correspondence.

The Expansion of Steam.

To the Editor of the Scientific American:

In the SCIENTIFIC AMERICAN for November 20, 1880, there appears an article referring to my paper in the June number of the *Journal of the Franklin Institute*, in which Prof. R. H. Thurston quotes from a letter from an unnamed correspondent, who asks, "What *is* really the proper point of cut-off in steam engines to give maximum economy in dollars and cents?"

Prof. Thurston himself says, "No *theoretical* determination of the proper point of cut-off has ever been made that is of any service to the engineer."

After first giving the rule for the point of cut-off as $E = \frac{1}{2}\sqrt{P}$, Prof. Thurston quickly invalidates his rule by saying, "Sometimes an engine is found to give maximum economy when expanding fifty per cent more; that is, $E = \frac{3}{4}\sqrt{P}$."

Am I not right in saying that Prof. Thurston is trying to give a definite answer to an indefinite question, and doing some pretty wild guessing in the effort?

"Economy in dollars and cents" covers both economy in the cost of *making* and *running* the engine and *economy of steam*. The article in the *Journal of the Franklin Institute* referred only to *economy of steam.*

It is, I think, acknowledged by all that steam should be used dry or superheated; if steam is not given to the engine in such form proper means should be adopted to make it so. Any attempt to deal with or answer questions referring to ill-devised or imperfect apparatus can only result in failure. It is possible to obtain either dry or superheated steam, and I think I was fully justified in so assuming.

The remaining assumption made was that the curve of expansion of steam is *approximately an equilateral hyperbola*. It was not pretended that it was accurately such a curve.

The precedents both among writers on and practitioners of steam engineering warranting such assumption are too numerous to mention.

The work done by the steam can be divided into two parts: first, that necessary to keep the engine running; and, second, the useful work delivered outside of the engine. These two quantities may bear any ratio to each other, and do vary greatly, "even in two engines built from the same drawings and made from the same patterns."

The user of the steam engine naturally regards the useful work only, but *economy of steam*, considered in itself, does not require a consideration of these two forms of work apart from each other.

If, now, my assumptions that steam can be delivered in a dry or superheated form, and that in being expanded its curve of pressure is *approximately* (that is, with sufficient exactitude for practical purposes) an equilateral hyperbola, then is my result and rule—*that the most economical point of cut off for a steam engine is that fraction of the stroke determined by dividing the absolute back pressure by the absolute initial pressure*—an unavoidable deduction, and it only remains for the engine builders and experimenters to realize the conditions placed as nearly as possible in order to obtain the greatest possible *economy of steam.* I *do not* say in the cost of building the engine or of keeping it in repair.

I *do not* say that the greatest useful work can be obtained from the engine, but that the total work done by the steam in driving the engine and doing work outside of the engine, will be done with close approximation to the greatest possible economy of steam.

Are the assumptions which I have made so impossible of realization that my "theoretical determination of the proper point of cut off" will never be "of any service to the engineer"?

It was not many years ago that a distinguished engineer announced that no engine would cut-off economically earlier than one-half the stroke.

Our small high-speeded engines have since demonstrated his error, and also shown that the ratio of the power required to drive the engine to the useful work can be greatly reduced.

While no one is more willing than myself to acknowledge the fact that many results of theoretical investigation cannot at once be realized, I still believe that much room for improvement in the construction of the steam engine remains, and that the road which we must follow will be marked out by theory.

I would ask those who have read my article in the June number, to do me the favor to also read a paper entitled "The Limitations of the Steam Engine," in the August number of the *Journal of the Franklin Institute*, in which will be found a continuation of the discussion.

Regretting that so famous a theorist on the steam engine should have entirely rejected all theory, and requesting as a special favor that you will permit me to be heard in defense of my theories, I am, very respectfully,

WM. D. MARKS, Ph.B., C.E.

Whitney Prof. Dyn. Eng., University of Pennsylvania.

Grape Vine Oil.

To the Editor of the Scientific American:

In the SCIENTIFIC AMERICAN of October 16 I find an article on "A New Oil from Grape Vines," in which it is said that M. Laliman, a French savant, has discovered that there can be distilled from American vines an oil having the property of remaining fluid at 8° Fah., while other oils congeal at or above 27½°. The oil is recommended for use in watches, etc.

M. Laliman's alleged discovery has been known for more than a century. As early as 1770 oil was made from grape seeds in Italy and France. In 1800 there was a factory at Olby which had existed from time immemorial. Other factories existed in Bergamo, Italy, in 1770; in Rome and in the vicinity of Ancona before 1782; Naples, 1818; Germany, before 1787.

In the south of France, where the grape-oil industry is carried on, from ten to fifteen per cent of oil is obtained, the oil being better and sweeter than nut oil, and remaining fluid at a lower temperature. It is used in lamps, and gives a bright light, without odor or smoke.

In extracting the oil from the grape kernels, the refuse left after distilling brandy or making verdigris is dried and ground fine in an ordinary mill, the yield of oil being in direct proportion to the fineness of the grinding.

Some manufacturers first press without heat, obtaining about 5 per cent of oil; afterwards the stuff is heated and pressed with a yield of 10 or 15 per cent more oil. The oil is of a light yellow color, and in course of time obtains a density of 0·9202 at 59° Fah., and solidifies at about 3° Fah. M. Laliman errs in recommending this oil for watches, for although it does not congeal so soon as other oils it becomes viscid and rancid when exposed to air. Grape oil saponifies readily, but the soap lacks hardness and density.

Black grapes contain much more oil than white grapes. The kernels of grapes from vines in full vigor yield more oil than those from very young or very old vines. In France the vines of Roussillon, Aude, and Herault give the most oil. In general black grapes produce from 15 to 18 per cent of oil; white grapes, 10 to 14 per cent. It is probable that American vines, especially those of California, yield more oil than French vines. In the south of France 25 pounds of kernels are allowed for 25 gallons of wine. It is easy to estimate the quantity of oil that is annually lost in grape producing countries.

TH. FLEURY,
Directeur de l'Huilerie de Bacalan.

Bordeaux, France, Oct. 22, 1880.

Present Population of the Earth.

Volume VI. of Behm and Wagner's *Bevölkerung der Erde*, just issued, gives a mass of well-digested information on the area and population of the countries of the world. The areas of Europe, Africa, America, Australia, Polynesia, and the Polar regions have been carefully recomputed, and as the results differ in many instances from statements usually found in our handbooks, we give an abstract of these new figures:

	Area in sta. sq. m.	Inhabitants.
Europe (exclusive of Iceland and Novaya Zemyla)	3,749,263	315.929,000
Asia	17,209,806	834 707,000
Africa	11,548.355	205,679,000
America	14,822,471	95,495.500
Australia and Polynesia	3.457,126	4,031,000
Polar regions	1,745,373	82,000
Total	52,532,394	1,455,923,500

If these figures are correct, the ocean covers 144,364,860 square miles, or 73·31 per cent of the earth's surface. The most populous towns in the world are London (3,630,000), Paris (1,988,806), New York (with suburbs, 1,890,000), Canton (1,500,000), Berlin (1,062,008), Vienna (1,020,770).

THE letters patent for the improved nursing bottle illustrated in a recent issue of this paper describes two forms for the body of the bottle, one having an inwardly projecting ridge forming depressions on either side of the bottle, the other with an outwardly projecting ridge forming a central channel for containing the last of the milk, and for receiving the end of the movable tube. In practice the inventor prefers the latter form. The body of the bottle is made in two sections held together when in use by a hard rubber ring. All of the parts, including the nipple, are made with special reference to convenience in use and facility in cleaning. The address of Mr. E. A. Barton, the inventor, is 348 Notre Dame street, Montreal, Canada.

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Disinfection of the Waste Waters of Manufactories.

While the purpose of the usual methods of disinfection is to prevent as much as possible all causes of putrefaction, Dr. Alex. Müller, of Berlin, has received a patent for a method of disinfecting waste waters which is based upon quite a different idea, namely, to cultivate those lower organisms which modern science considers to be causes of fermentation, putrefactive decomposition, etc., and to use them for the precipitation or mineralization of waters by decomposing their organic compounds.

To this end a temperature favorable for the development of such organisms is produced and maintained for a day or two in the waste waters, which are previously freed from substances obnoxious to fungi by means of sedimentation or filtration.

In sugar manufactories the necessary warmth is obtained by means of the condensation waters, in other factories by means of steam or superfluous heat, or if necessary even by heat produced specially for this purpose. Care has to be taken that the heat does not exceed 104° Fah., and a cooling below 73° Fah. may be avoided by covering and surrounding the reservoirs with substances which are bad conductors of heat. All substances that may be obnoxious to the life of the fungi, namely, antiseptic substances, such as tar oil, sulphurous acid, salts of copper, iron, and other heavy metals, must be kept away. Strong acids, as muriatic, sulphuric, or other mineral acids, must be neutralized by means of lime or soda; an excess of caustic alkalies has to be prevented.

A special plauting of organisms of fermentation will be necessary only in rare cases. Mostly the numerous germs contained in the atmosphere are sufficient. Otherwise yeast, manured earth, or other germ-containing materials, may be employed. Of organic substances, salts of ammoniac, lime, and phosphorus may be used. Generally the nitrogen of the organic substances in the refuse waters should be reduced to about one per cent.

Such of the fermentation-organisms which during the defecation process have not been sunk into the ground, may be removed by filtration or oxidized by nitrification.

The mechanical and architectural arrangements for this method are very simple. They consist of 3 or 4 basins, each having a depth of at least 3½ to 4 feet, for the digestion and defecation of the waste water. They must be able to hold at least the quantity of sewer water produced during one day, and must be furnished with inlet and outlet pipes, through which the liquids continually stream in and out.

The basins are constructed by excavating the ground, and are covered with a swimming layer of porous substances (straw, chaff, foam, etc.) in order to prevent the refrigeration or evaporation of the liquids. Obnoxious gases of putrefaction and other disagreeable vapors are made harmless by conducting them into a system of drainage tubes, so placed in the ground that they are kept dry, or at least never filled up with water.

The basins are connected with filtration reservoirs (filled with coal, coke dust, sand, or other similar substances), which may be erected at any distance from the factories, and, being able to hold at least fifty times the quantity of the daily waste water, are furnished with drains, which are open on both sides.

The basin or filtration slime produced by this method of disinfection is a valuable manure for agriculture and horticulture, and the drainage water is as clear as the drinking water of most cities and may be used without danger.

Dr. Müller's method is especially well adapted for the disinfection of the very disagreeable waste water of beet-sugar manufactories, and may be also advantageously used in breweries, dyeing establishments, tanneries, etc.

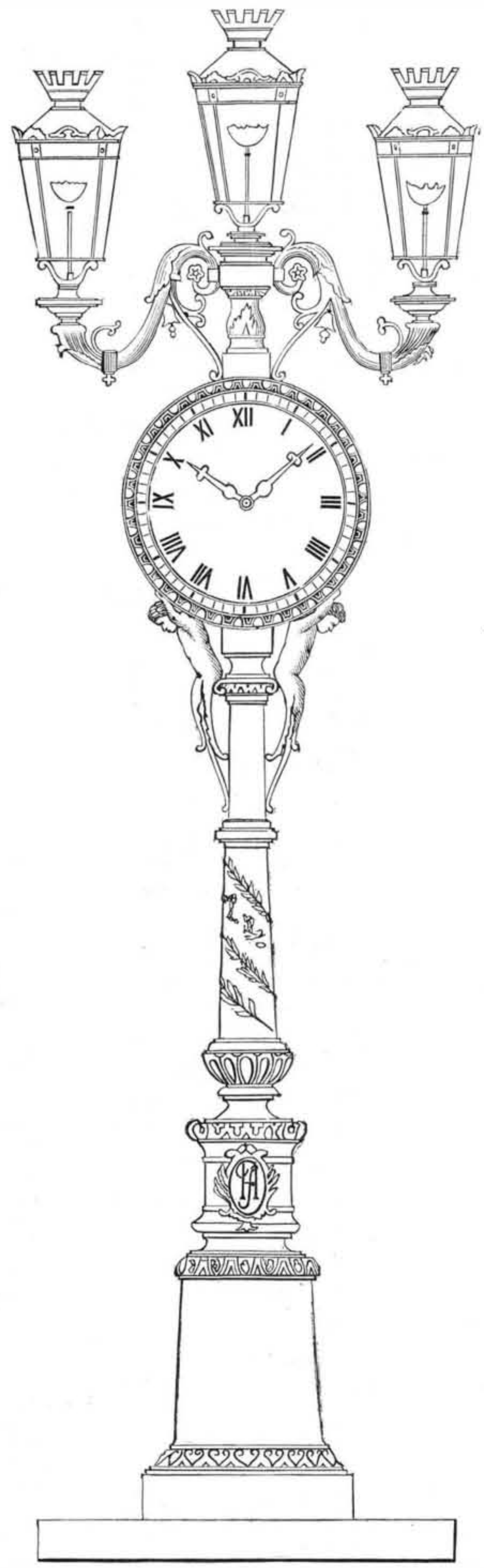
Diamond Mines of India.

A member of the Indian Geological Survey, Mr. V. Ball, says in a recent paper that there are in India three extensive tracts, widely separated from one another, in which the diamond has been found The most southern of these has long borne a familiar name, which is, however, to a certain extent, a misnomer. There are no diamond mines in Golconda. This name, originally applied to a capital town, now represented by a deserted fort in the neighborhood of Hyderabad, seems to have been used for a whole kingdom; but the town itself was many miles distant from the nearest of the diamond mines, and it was only the mart where the precious stones were bought and sold. The second great tract occupies an immense area between the Mahanunda and the Godavery river; and the third great tract is situated in Bundelcund, near the capital of which, Punnah, some of the principal mines are to be found.

The work of the Geological Survey has demonstrated that the diamonds occur in the Vindhyan rocks of Northern India. In the upper division of this formation there is a group of clay slate (Rewah), and in the lower a group of sandstone (Semri), in both of which diamond-bearing beds are met with. It is still very doubtful; however, if a diamond has yet been found in India in its original matrix. Mr. Ball gives an account of the chief mines, describing in detail, from personal observation, that of Sambalpur, which has now for some time ceased to be productive. The Punnah mines are still productive, yielding a mean annual produce of between $200,000 and $300,000 a year. Europeans have attempted diamond mining in each of these three tracts, but in no instance have their operations been attended with success, and yet there does not appear to be the least ground for supposing that there has been any real exhaustion of the localities where mining is possible.

CHANDELIER CLOCK.

An elegant chandelier clock, in which neither the clock nor the lights predominate to such an extent as to impair the effect of one another, has been in demand for public places; but most of the designs presented were encumbered with defects that rendered them unfit for their purpose. The chandelier represented in the annexed cut is of a very elegant design, and yet is not too elaborate. It may be provided



CHANDELIER CLOCK.

with three lights in one row or with five, of which four rest on arms or brackets surrounding the center light, which rests on the top of the standard. The chandelier is designed to be 17½ feet in height, and to have a dial 3 feet in diameter. The design represented in our engraving is to us ornamental, but a manufacturer would likely change the style and adopt one more or less elaborate to suit the demand. We would suggest to Mr. J. W. Fiske, the extensive manufacturer of ornamental iron work in this city, a trial of the combined clock frame, with gas lights on the same post. They would be especially ornamental and useful in public squares and in front of public buildings.

Electrical Phenomena in Tropical Countries.

In a note addressed to the French Academy (*Comptes Rendus*, p. 446), M. L. Amat calls attention to the fact that the electrical phenomena produced by the friction of the hairy coat of animals acquire a remarkable intensity in tropical countries, especially to the north of the Sahara, toward the 35th degree of latitude. At an altitude of 2,500 to 3,600 feet he found that by passing a comb through the hair of the head or beard, sparks might be produced two or three inches in length. The phenomenon occurred at its best at from 7 to 9 o'clock in the evening, when the weather was warm and dry. In horses the effects are still more marked, and the hairs of their tail stand out from each other so as to form a sort of fan. If the hairs be touched a crackling of the sparks is heard, and at night these are distinctly visible. Sparks are also easily produced by the use of the brush or currycomb. According to M. Amat, the electricity developed in the tail of the horse is positive, as he learned by experiment. Naturally, during rainy or moist weather, the electrical tension is considerably lessened, and it is likewise less sensible in the stable than in the open air. In man the accumulation of the electric fluid is not so great as in the horse, doubtless because he is not so well insulated from the earth as the latter, the horny hoofs of which furnish insulating supports.

Professor Max Muller on Progress.

At the recent opening of the Mason Science College, at Birmingham, Professor Max Muller made the following remarks:

"The spirit in which this college has been founded strikes me as a truly liberal spirit—a spirit of faith in the future, a spirit of confidence in youth. Much as I admire the enlightened generosity of the venerable founder of this college, nothing I admire more than one clause in the statutes, which states that, with the exception of a few fundamental provisions, the trustees not only may, but must from time to time, so change the rules of this institution as to keep it always in harmony with the requirements of the age. You know how other colleges and universities have suffered, have been hampered in their career of usefulness, by the wills of pious and faithful founders and benefactors. Now here, in the founder of this college, we have a truly faithful founder—a man who has proved his faith in the future and his confidence in youth—who is convinced that in the long run the path followed by mankind will be the right path; nay, that those who come after us will be, as they ought to be, wiser and better than ourselves. We who are growing older ourselves know how difficult it sometimes is for an old man to have faith in youth and confidence in the future. Yet that firm faith in youth, that unshaken confidence in the future, seems to me to form the only safe foundation of all science, and on them, as on a corner-stone, every college of science ought to be founded. The professors of a college of science should not be conservative only, satisfied to hand down the stock of knowledge, as they received it, as it were, laid up in a napkin. Professors must try to add something, however little it may be, to the talent they have received; they must not be afraid of what is new, but face every new theory boldly, trying to discover what is good and true in it, and what is not. I know this is sometimes difficult. Young men with their new theories are sometimes very aggravating. But let us be honest. We ourselves have been young and aggravating too, and yet on the whole we seem to have worked in the right direction. Let us hope, therefore, that the professors of this college will always be animated by the spirit of its founder, that they will never lose their faith in progress, never bow before the idol of finality. Let them always keep in the statutes of their own mind that one saving clause in the statutes of this college—to keep pace with the progress of the world. By that clause, by that profession of faith in the future, Sir Josiah Mason has done honor to himself and honor to posterity. Let him rest assured that such faith is never belied, and that rising and coming generations, while applauding his munificence, will honor and cherish his memory for nothing so much as for that one clause, in which he seems to say, like a wise father, 'Children, I trust you.'"

To Get a Large Yield of Rich Milk.

The *Farm*, published in England, confirms our own experience in feeding milch cows with bran. If a large yield of rich milk is desired, says the writer, give your cows, every day, water slightly salted, in which bran has been stirred at the rate of one quart to two gallons of water. You will find, if you have not tried this daily practice, that your cows will give 25 per cent more milk immediately under the effects of it, and will become so accustomed to the diet as to refuse to drink clear water, unless very thirsty.

Prof. J. W. Sanborn, superintendent of the college farm, Hanover, N. H., reports experiments in feeding cows, giving full details of weights of each kind of feed, of milk and butter yield, and the weights of the animals at the beginning and end of each period. In summing up he says: "Meal will make more milk than bran, I no longer hesitate to say. The change in the butter product is remarkable; in changing from meal to bran there was a loss of 17·7 per cent in the butter-producing capacity of milk; in changing from bran to meal there was a gain in the butter-producing capacity of milk of 21·8 per cent." "The results in weighing the cows form an exception to previous experiments, bran and middlings keeping weight better than meal in this experiment. Is it a chance result, asks the professor, or is it due to well defined causes? I will not discuss it, he answers, but observe that it was not at the season of the year when a cow needs a carbonaceous food to maintain animal heat; also the grass of our pasture was browned, and in different condition from June grass or properly cut hay."

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