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STABILITY TESTS FOR NITROCELLULOSE AND NITROCELLULOSE POWDERS.*

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THE NEW TEST, 115 DEG. C.

FROM one to four whole pieces of powder are weighed on a watch glass and heated for eight hours in an air bath regulated to 115 deg. C. (+ or - 0.5 deg.); the sample is then taken out, allowed to cool in a desiccator and weighed. This is repeated for six days, at the end of which time the total loss of a powder must not exceed 8 per cent.

A specially-constructed air bath is used for obtaining a uniform temperature. The apparatus, shown in Figs. 5 and 6, consists of a double-walled, sheet copper oven like the water ovens in general use, except that the new oven has the inner bottom slightly V-shaped (Fig. 6, d); this effectively prevents bumping. Between the walls the oven is filled (about two-thirds full) with a mixture of xylol and toluol in such proportion that when the mixture boils, the air in the oven has a temperature of 115 deg. C. A reflux condenser prevents the evaporation of the xylol-toluol.

In developing the new test a great deal of experimental work was necessary (credit is due Capt. Dunn for suggestions and aid in this work). The points to be decided were: 1. Does decomposition increase as the temperature increases? 2. Does a bad powder decompose more rapidly than a good one? 3. Which is the most suitable temperature for the new test?

Decomposition increases with the temperature. Experiments soon showed that a bad powder decomposes much more rapidly than a good one. Decomposition at 100 deg. C. is very slow; at 110 deg. it increases, but requires too much time to show a decided difference between good and bad powders. At 115 deg. decomposition is still further increased, and big differences are shown between good and bad powders in a reasonably short time.

Experiments were made at 120 deg.; at this temperature powders decompose more rapidly than at 115 deg., but the difference between a good and a bad powder is not as great, all powders decomposing more or less rapidly.

Although it is desirable to shorten the time of a test, yet it is undoubtedly of greater value the nearer the temperature approaches that of ordinary conditions of storage and handling.

Experiments were made to shorten the time of the new test by sealing the samples in tin boxes and thus effecting decomposition under pressure and determining the combined effect of heat and pressure.

The weighed samples were sealed up (soldered) in small tin boxes and then exposed to 80 deg. and 100 deg. C., opened at regular intervals and weighed. At 80 deg. decomposition is slow but considerably greater than if heated in the open. At 100 deg. (sealed) decomposition proceeds quite rapidly, being almost as great as at 115 deg. in the open. Further experiments are to be made along this line of testing.

After applying the new test to a large number of powders it was found to give more reliable results than any other test now in use. It has the following advantages:

- (1) The powder is tested in its *natural condition*, the same in which it is stored or used.
- (2) It shows *all* products of decomposition; the older tests show only *acid products*, or only nitrogen as in the Will test.
- (3) It shows the decomposition of *nitro-compounds* other than nitrocellulose which are often present in a powder, and also shows the *effect of this decomposition* on the powder itself.
- (4) It shows the effect on the stability of a powder of added substances (for masking stability); the effect of volatiles; handling and working which may set up local decompositions; traces of nitrating acids; decomposition due to saponification by water, alkalies, carbonates, etc.
- (5) It shows *quantitatively* the progress of *all* decomposition.
- (6) The test itself as well as the apparatus used is simple and not subject to variations like the old tests.

Prof. H. H. Turner, F.R.S., of Oxford, in a communication presented to the British Association dealt with the interesting problem, whether any of the "new" stars had previously been known as faint stars. Our information about the historical examples of new stars was too scanty, he stated. The Nova Persei had, after its discovery, not been traced on Pickering's charts; but longer exposure might have revealed it. The Nova Gemini was discovered this March at Oxford. Exact measurements of the object and other stars in that portion of the sky on plates obtained at the Yerkes Observatory, and by Max Wolf, at Heidelberg, differed slightly, so that he had come to the conclusion that the identity of the new star with a faint old star was doubtful. That morning he had, however, received a letter from Prof. Barnard saying that there was a minute star close to the Nova. Prof. Turner added that it would be necessary in settling such questions to go down to stars of the 15th and 16th magnitudes; it was noteworthy that new stars had almost all been found in or near the Milky Way, presumably at very great distances.

* From Journal of the United States Artillery.

DAIRYING AT HOME AND ABROAD.*

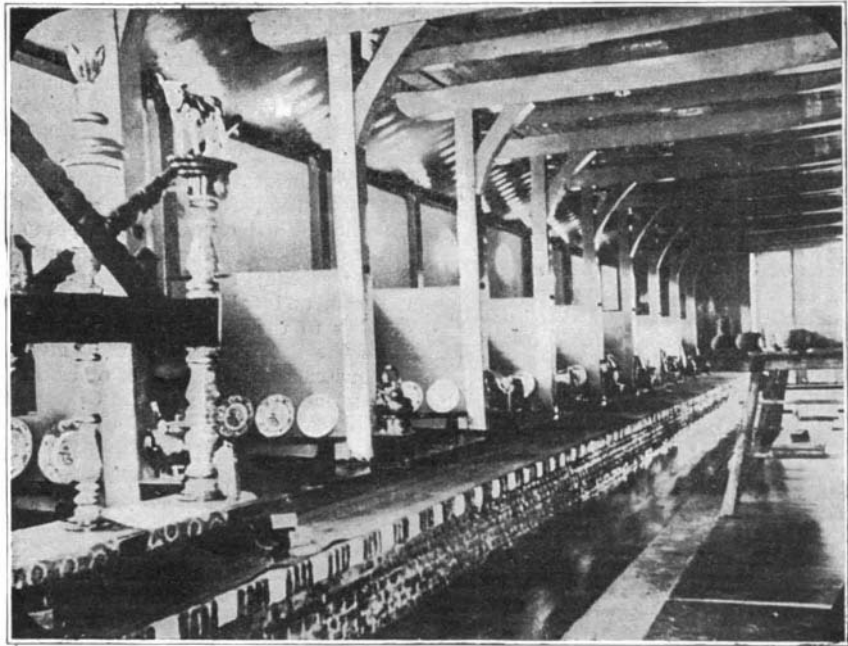
By HENRY E. ALVORD, Chief of the Dairy Division, Bureau of Animal Industry.

INTRODUCTION.

TO those engaged in dairy farming in the United States or interested in this industry, and who have given no particular attention to dairying in other lands, it may be interesting—in some degree instructive and perhaps encouraging—to compare the means, methods, and practices of the dairy in Europe with those of our own country. For this purpose it may be assumed that the conditions under which dairying is conducted in America are well understood by the reader. The several breeds of cattle best adapted to the dairy, their history and characteristics; the average dairy cow and the most approved methods of housing, feeding, and caring for her; that most important and delicate operation of milking; the care of milk on the farm with modern appliances; the making of choice butter and the shipping of market milk—all these matters are familiar in their detail and have been made the subject of popular publications. Issues in the Farmers' Bulletin series and other bulletins of the Department of Agriculture cover this ground thoroughly. The practice and general problem of the milk supply and milk service of large towns and cities, while less familiar to dairy farmers generally, is better known to a different class of men; but, interesting and important as the subject is, it is not proposed for special presentation in this paper. Cheese making has so nearly ceased as a farm or domestic industry and has been so generally transferred to the factory, that this branch of dairying is a comparative novelty to most American dairymen of the present day. This will therefore be referred to, although in very general terms. On the other hand, it may be assumed that the scenes and circumstances of dairying in the Old World are familiar to comparatively few, and that the opinions of one who has recently studied

there are cattle in other countries which would improve our dairy herds or be a valuable acquisition to the variety we now possess. Although others may hold different views, it is the belief of the writer that the only countries to which any attention can profitably be given, in this connection, are Denmark, France, and Switzerland. The first named furnishes the best example in the world of dairying as a national specialty, of rapid development, and of present high average production and excellence. Here we find the Red Danish cattle to be the standard stock, and very satisfactory business cows they are, of a pronounced dairy type. But they lack uniformity, except in color, particularly in udder development and other dairy points, and in the show ring the very best of them could not hope to compete with the best of any one of the four leading dairy breeds of this country. As dairy performers they are good, but not remarkable; the best yearly records the writer has seen show an average production of 8,000 to 8,800 pounds of milk per cow, in herds of 11 to 19 animals of all ages, with an average fat content of about 3¼ per cent, an equivalent of 290 to 325 pounds of butter per year. A very celebrated herd of 70 cows averaged 7,150 pounds of milk a year. In Jutland there is a distinctively dairy race of sharply defined black and white markings in appearance reminding one of Holland cattle, and still more of Brittanies, although between these two races in size. They are very attractive cows, of rather less than medium size, and excellent milkers. Both these races of Danish cattle may be credited with being economical producers; yet none of them are wanted here, for superlative excellence seems to be lacking on the one hand, while on the other they appear predisposed to tuberculosis and very generally tainted with this insidious and dread disease.

France is a dairying country and possesses a large number of so-called breeds of cattle. One can hardly say "different" or "distinct" breeds, because they seem to be largely of common origin locally differen-



INTERIOR OF COW STABLE, HOLLAND. (IN SUMMER.)

them in person will be accepted kindly and at their face value.

DAIRY CATTLE IN THE UNITED STATES.

Dairy cattle constitute the foundation and all-important factor of the industry. We have no dairy cattle of our own in America; we have adopted those originated in and brought from other countries. Even our "native" or "common" stock, or "scrubs," are but mongrels of the breeds of another continent. It is impossible to estimate the debt of the dairy farmers of this country to the breeders of Ayrshires and Guernseys and Holstein-Friesians and Jerseys, in their native lands. These are the four races of cattle upon which mainly rest the present and future prosperity and progress of dairying in America. Yet we must not forget to note the blood of the good old milking strains of Shorthorns as an excellent foundation upon which to build up profitable dairy herds. It is needless to enlarge upon the good qualities and characteristics of these distinctively dairy breeds, but it is worth noting that all of them have improved upon our hands. It may not be that the average quality of any of these breeds as they now exist in the United States is above the average of the same race upon its native pastures, but in all of them there are now on this continent animals superior to the best on the other side of the Atlantic. The breeding and management have been so good here that the cows imported and their descendants have made indisputable records as dairy performers, excelling any known in the countries from which they came. Personal observation has convinced us that we now have dairy cattle in the United States so good that nothing can be gained beyond the fancy or satisfaction in new blood by further importations from Ayrshire or any part of Great Britain, the Channel Islands, or the Netherlands.

COUNTRIES TO BE LOOKED TO FOR IMPROVEMENT OF DAIRY HERDS.

We may very properly inquire, however, whether

tiated and belonging to geographic districts, along the borders of which they blend in a perplexing way. Nearly all of them are what would be called in this country "dual-purpose" cattle. France prides herself upon producing all her own beef, and depends largely upon oxen for farm labor. With few exceptions her cattle are bred primarily for labor, to ultimately become (poor) beef, and dairy quality is at least a secondary consideration only incidental in some of the breeds. Fine veal is a specialty in France, so that cattle which produce large, thrifty, quick-growing, and easy-fattening calves are particularly sought and are highly profitable. There are but three races of French cattle which seem to deserve consideration as dairy stock. Near the Belgian border, in French Flanders, there is a large, rather rangy cow of a pronounced dairy type and a generous and profitable producer of a medium quality of milk. These "Flamandes" are of a solid dark-brown color, sometimes reddish, and often almost black. They carry no spare flesh, have shiny coats, indicative of health, are good feeders, active, and docile. In size they are above the average, and in some respects suggest the milking Shorthorns. These cattle very justly won the sweepstake prize for dairy animals at the live-stock show of the Paris Exposition in 1900. But it is said that, although rugged enough at home, they become delicate and always deteriorate rapidly when moved away from the comparatively small district in which they had their origin or development. This accounts for the Flamandes being so little known elsewhere. In Brittany are found the pretty, active, little black and white cattle of marked dairy characteristics, producing often an astonishing quantity of milk for their size, rich in butter fat. This is a true breed, a good one of its kind, and an old one. Its blood undoubtedly entered largely into the foundation stock of the highly-prized Jersey; yet it is a race of even smaller size, some strains really diminutive. For the United States they are too small for anything but playthings. In many respects, markings excepted, they remind one more of the

* From Year Book of Department of Agriculture.

French Canadian dairy cattle, which have lately come into prominence, than of anything else in America. Normandy has long been noted for its dairying, and the breed of cattle carrying the provincial name has a great reputation in France. The choicest of this race is the "Cotentin" strain, to be found pretty near the coast, from Cherbourg well down toward Brittany. In color they are red, brown, and white, spotted and patched, from two-thirds white to brindle. The best of them are large-framed, big-boned, coarse, homely creatures, fleshy, without finish or good beef form, lacking in uniformity, and generally devoid of the most highly-prized dairy characteristics. They have udders of all shapes, but few really good ones; yet some are capacious, and good cows average 8 to 10 quarts of milk a day for nine or ten months, or 5,000 to 6,000 pounds per year. It requires at least 12 quarts of milk in the winter and 14 or 15 in the summer to make a pound of butter. The annual butter product is, therefore, 200 to 225 pounds per cow; ordinarily 100 pounds a week from 20 cows, rising at times to 125 or 130 pounds. A few specimens of this breed have reached America and found favor in some quarters. But after some time spent in Normandy and an examination of many noted herds, they were decided to be a mixed, irregular, rough-looking lot of cattle, with no indications of economic dairy quality, and hardly attractive as "dual-purpose" animals. Careful comparative trials of dairy cows made in France have proved the "Normandes" to be inferior in every respect to the Brown Swiss.

The cattle of the several cantons of Switzerland noted for their dairying differ mainly in color and name. The Bernoise, Fribourgeoise, and Simmenthal cattle are all spotted, and have yellows, reds, and browns mixed with white in varying degrees and an infinity of patterns. Those with red or yellow spots usually have light muzzles and switches, while black noses and tails accompany the brown and black spots. The Schwyz breed, better known as the Brown Swiss, has been established in the United States for about thirty years. All of these Swiss cattle are exceedingly coarse boned, large framed, and heavy. They are exceedingly active for their size, famous mountain climbers, but carry a great superfluity of flesh for dairy animals, hardly compensated for by their performances at the pail. The Simmenthals are the largest, and by some preferred for milch stock, but unbiased judges generally give the Brown Swiss first place for dairy purposes. In America the last-named race has included cows which have made famous records in milk and butter production; but, as a whole, all Swiss cattle must be here regarded as of the "dual-purpose" kind, and this means that they are not expected to add much to the value of our dairy stock.

HOUSING AND CARE OF DAIRY COWS.

In the housing and general care of dairy cows no foreign country shows, as a rule, in general practice, any methods or conditions better than those of America. The average conditions everywhere are bad enough, with opportunities for very great improvement; but such improvement is being made as rapidly in this country as anywhere. Nowhere else is there a better appreciation of the importance and economy of abundant room, light, air, dryness, comfort, and cleanliness for cows. One hears much of the close relations between the dairy cows and the families of their owners in Holland and Switzerland, connecting apartments, under the same roof, etc.; but the stables which are seen in summer converted into conservatories and rooms for weaving and cheese curing are the exceptional and show places. Even the best of these, when visited in midwinter, with the cattle in place, are often found dark, close, ill ventilated, crowded, and unsanitary in many respects, although frequently kept clean. The construction of cow stables generally in the dairy regions of the Old World is of a substantial kind, but with little regard to light and ventilation, convenience of arrangement, or ease in cleaning. The labor necessary to keep them in decent condition would be regarded as impossible in this country. The cow houses of Denmark average the best of all in Europe, but they are no better in any respect than the average of those in the distinctively dairy districts of this country, and there is here far more regard for economy of labor in management. Danish stables are generally kept clean—probably cleaner than in America—but at the cost of a vast amount of very cheap labor. In other countries, as well as Denmark, much attention is paid to cleaning the cow stables, but the conclusion has been forced upon us that this is done more from an appreciation of the value of all farm manurial matter and the fixed habit of saving it than from any knowledge or intention of cleanliness as of prime importance in dairying. This is especially shown by the fact that cows are milked in just about as careless and uncleanly a manner in Great Britain and all over Europe as, it must unfortunately be confessed, is the common practice in the United States. The very general use of women as milkers in all foreign dairy districts is a decided advantage; they are gentler and cleaner than men, and vastly better than the average farm laborer, who does all sorts of work during the day. Much attention is being given, especially in England, to perpetuate the custom of employing women instead of men for milkers, and to maintain the efficiency of milkmaids; the popular public milking contests at the dairy shows are useful and commendable. Many parts of Europe have the additional advantage of keeping the cows in the fields continuously the greater part of the year and

milking them in the open air. This practice does much to insure clean milk and pure products.

FEEDING DAIRY COWS.

Very skillful feeding may be observed in many of the dairying districts of foreign countries. The owners seem to know how to obtain the maximum product from their cows with the minimum expenditure of forage. From Norway to Italy and from Ireland to Siberia, dairymen, including the poorest peasants, do not hesitate to buy concentrated cattle foods when necessary to supplement home supplies; the purchases are made judiciously, and the feeding is equally so. But this skillful practice is almost all based upon "the rule of thumb," learned of sire by son, and passed from generation to generation. We believe that, at the present day, there is much more general knowledge of the differences and comparative value of feeds and of correct principles of feeding in this country than anywhere else, Denmark not excepted. And yet there is probably more careless and wasteful feeding of dairy cattle and animals of all kinds in America than anywhere else in the world.

THE CARE OF MILK ON THE FARM.

The care which is given to milk on the farm where produced, whether it is to go to a milk market or to be made into butter or cheese, with the location, construction, and arrangement of dairies or milk rooms, their equipment and management, show great variety and lack of uniformity in every country. The good, the bad, and the indifferent are common to all. Good milk rooms, well located, thoroughly built, shaded, cool, and well kept, are not hard to find in any dairy district. Construction is heavier and more durable in Europe; convenience and ease of management are common in America. Excepting Denmark and Sweden, no country compares with America in the general appreciation and use of cold water and ice in the care of milk. The almost entire absence of refrigeration in France, and the general ignoring of the value of cold in dairying, is truly astonishing. In the matter of dairy appliances and equipment, the United States is surpassed by no other country, although Denmark and parts of Great Britain stand about as well.

THE CITY MILK SUPPLY AND SERVICE.

The business of transporting, caring for, and distributing milk for consumption in its natural state and for household purposes seems to be in every possible stage of development in different parts of the world. Cows or their substitutes are driven through the streets and milked at customers' doors in British India and the West Indies. Milch goats are managed in the same way even in the best streets of Paris and of Rome. The milk service of villages and small towns is conducted in an exceedingly crude, yet often picturesque, manner in some of the oldest dairying regions of Europe. In Scotland, Holland, Denmark, and Switzerland milk is still carried in wooden vessels and retailed from them in towns and cities. The local milk service in similar places in the United States is often poor enough, with little regard for care or cleanliness, but nowhere as crudely performed. In most of the big cities of Europe there are large market-milk establishments, admirably conducted. There are fine ones in London, better in Copenhagen, and the biggest and best of all in Berlin. Paris probably has the poorest milk service of any of the large cities. There was a time, not many years ago, when a few foreign milk-supply establishments far exceeded in many respects the best of like character to be found in America. But at the present time, although some of these European milk companies do a larger business and have more extensive and costly plants, it is the opinion of the writer that we have in the United States a considerable number of establishments for city milk supply which are superior in many respects. Some might be named, in several different States, which are better than anything in Europe in their buildings and equipment, the efficiency of their management, and in the purity and high average quality of milk and cream served to their customers. Nowhere in the world is the important business of milk supply and milk service making such rapid and commendable progress as in the United States.

It is well worthy of note that at a special show of perishable dairy products held as an annex to the Paris Exposition, in July, 1900, just outside of the city limits, where French producers had every opportunity of exhibiting their goods in the best possible shape (although under unfavorable local conditions after reaching the exhibit), there was a large collection of natural milk and cream. But the only samples of these products, absolutely free from chemical preservatives and uncooked, which were sweet and palatable after noon of the exhibition day, were from dairies in New York and New Jersey, then eighteen days from the cow! There was also in the United States dairy exhibit natural milk and cream from a farm in central Illinois, in bottles exactly as sent daily to Chicago families, which was only very slightly acid, although twenty days old. It had kept sweet until the day before this show, and even later it was better than the best normal French milk only twelve to twenty-four hours after milking.*

The American products had been preserved solely by

* These circumstances have been stated in substantially the same language, during a speech in the Senate of France, by a senator who was president of the international jury on dairy products at the Paris Exposition, and by another person in a report to the National Agricultural Society of France.

cleanliness and cold; and the statement may be ventured that no milk-supply company in Europe could duplicate this performance.

BUTTER MAKING AND BUTTER MARKETS.

In butter making and the butter markets of the Old World an American dairyman may find many interesting features, but very little that is really instructive and worthy of adoption in this country. Private dairies make choice butter in Great Britain, the Channel Islands, Belgium, Denmark, and Sweden, and to a rather less degree in parts of Germany, France, and Switzerland. In Holland butter is now so commonly adulterated and the spurious article so often passed as the genuine that the product of that country has lost its commercial standing. In nearly all other parts of Europe laws restricting and regulating "margarin" in all its forms, are strict and fairly well enforced, although there is a laxity at times in some countries. Such was the case in France during the last exposition period. The fact that fresh Normandy rolls sell at the very highest price in the London market must be recognized, and superior butter is made elsewhere in France in limited quantity; yet the average quality of French butter is not high, as a whole; it should be classed at best as second-rate. Belgium is a grade higher, while Germany, Switzerland, and Italy are lower. Sweden and Finland may be placed still higher, and Denmark easily holds the position of honor. The high rank of Danish butter, due full as much to most remarkable uniformity as to superior quality, results from the general adoption of the associated or creamery system of manufacture (upon the co-operative plan), and the active aid of the government in criticism, instruction, and supervision, amounting almost to control. Creameries are nearly as successful in Sweden and Finland. Those in Belgium, and especially in Luxemburg, are of more recent origin, but meritorious in management and production. Creameries lately established upon Danish models, and rapidly multiplying in Russia and in Ireland, are doing well, but their product ranks in quality next below those already mentioned. There are several hundred comparatively new creameries, mainly co-operative, in France and Germany, but they are of lower grade, although showing steady improvement. In considering the world's supply of factory-made or creamery butter, the excellent and increasing product of Australia and of Canada must be mentioned, both ranking but little below Danish in quality, and Argentina and Siberia are new producing territories which will make themselves felt in the near future.

In the United States there are many private dairies that make butter as fine as any in the world, and the same is true of our best creameries. The best American creamery butter is quite the equal of the best Danish, but there is no such uniformity of product, and a greater proportion of it is inferior in quality. This results from the wide extent of territory and variety in climate and local conditions which affect the 8,000 or more creameries, and the still greater differences in methods and management. There is ample room for improvement in American creameries, but the only foreign country from which they can profitably learn is Denmark. The best creameries there are models of cleanliness and good order and systematic management. They have also taught their patrons to properly care for the milk and deliver it at the factory in prime condition. The control of bacterial growth, the practice of pasteurization, and the use of artificial as well as natural cultures and ferments have been advanced well toward perfection by Danish creamerymen. All of this tends to insure the clean, mild, and delicate flavor and wonderful general uniformity which characterize Danish butter. Yet, these results are largely accomplished in Denmark through an attention to detail and an expenditure of labor which would appal an American creamery manager. It is not an uncommon thing for six or eight persons to be constantly employed there through a day of long hours in turning out a quantity of butter which is ordinarily made in this country by a man and a boy, who have all their work finished daily at 3 or 4 o'clock in the afternoon.

CHEESE MAKING.

Cheese making is a branch of dairying in which it is impossible to draw any close comparisons between the methods and results in this country and those abroad. For the production of large quantities of cheese of uniform excellence it is believed the American factory system, common to the United States and Canada, is superior to anything elsewhere, and more systematically and economically conducted. The average Cheddar cheese of the Cheddar Valley itself, of Somersetshire in general, and of the best producing districts of England and Scotland, are no better than those of New York and Wisconsin and the best of Canada. In variety and fancy cheese this continent cannot yet attempt to compete with the Old World. If one would learn the bottom facts about making any of the famous specialties in cheese he must go to the locality where they originated, and where alone, often within very narrow limits, they are still made in perfection. This applies to the English Stilton, the French Roquefort and its close kinsman, the Italian Gorgonzola, the Edam and Gouda of Holland, the Gruyère and Emmenthal of France and Switzerland, the Parmesan of Italy, and the Camembert, Brie, Neuchâtel, and hundred and one other small and soft and high-flavored varieties of France and other parts of Europe, including, of course, Limburger.

FAIRS AND MARKETS.

In several foreign countries there are "fairs" and

markets, some only annual or occasional and others frequent and periodical, which afford novel scenes to an American. Although curious and entertaining, with many features which are commendable when local conditions are considered, there is little about these commercial methods or systems which could be advantageously adopted in this country. As examples of these unique dairy markets may be mentioned the great mart or butter exchange of Cork, Ireland, the daily auction sales of butter at the Central Markets of Paris, and the market days in many little towns and villages in Normandy, when the wives and daughters of the farmers and peasants assemble by the hundred in the parks or along the streets and sell their "mottes" of butter, often aggregating several tons a day in a single village, to the representatives of those immense blending-butter factories in the Isigny district of La Manche. The cheese fairs at Frome, England, and Kilmarnock, Scotland, and the street markets at Alkmaar, Hoorn, and Utrecht, Holland, are similarly interesting in connection with cheese.

CONCLUSIONS.

The foregoing facts and conditions as to dairying in the Old World apply mainly to countries (and districts in them) where dairying has been for several centuries one of the leading agricultural industries, if not the principal one. American dairying has been developed wholly within one century, and all of its notable progress has been within fifty years. The comparisons made show that there is little for us to learn from foreign countries to improve our dairying. Our cattle are far better adapted to their special work and more economical as dairy animals than any of the European breeds not common here. As a rule, they are better housed, fed, and cared for, with greater economy of labor, although in many instances foreign dairy-men are exceedingly skillful feeders. The rents which are almost universally paid for farms in all the foreign countries named would be regarded as impossible in this country; on the other hand, hired labor for farm and dairy costs there but a fraction of what it does here. In dairy utensils and equipment ours are superior, and our methods are more generally founded upon principles which are understood and known to be correct. Butter is more economically produced in the United States, and so far as the product of the creamery system is concerned, it is of higher average quality than that of any other country except Denmark; the same cannot be said, however, of the farm dairy butter of this country. Europe offers a very much greater variety of cheese, including some of unsurpassed reputation, and a much more general appreciation of this product as an article of food prevails abroad. Notwithstanding the excellence of much of the European cheese, the facilities and processes of making and curing are comparatively crude. The factory system of cheese making as at present organized and conducted in America exhibits greater economy, equal skill, and more intelligence. In the important business of making milk for market, and all through the different grades of milk service, the United States is well abreast of Europe. This is true, not only in comparing averages, but, as already stated, our best establishments and most approved practices are superior to the best elsewhere in production, quality, purity, preparation, transportation, and delivery.

While too much cannot be said in praise of the industry, frugality, and thrift of most of the dairymen of Europe, a close comparison leads one to feel that the conditions of this industry in the United States are decidedly more satisfactory in almost every particular.

GEOGRAPHY IN THE UNITED STATES.*

By W. M. DAVIS.

For twenty years past our section has acknowledged in its name an equal rank for geology and geography, but not one of the vice-presidential addresses during that period, or indeed since the foundation of the Association, more than fifty years ago, has been concerned with the subject second named. I propose to depart from all precedents, and, even though geologists may form the majority in this gathering, consider the standing of geography among the sciences of the United States—how it has reached the place it now occupies, and what the prospects are for its further advance. As early as in 1851 there was a section of geology and physical geography, and another of ethnology and geography, in the American Association, but that classification did not endure. Once only, in 1853, did geography stand by itself as a sectional heading, but at many meetings physics of the globe and meteorology had places to themselves. Through the 60's and 70's geography was sometimes coupled with geology, but the latter more often stood alone or with palæontology, and it was not until the Montreal meeting of 1882 that Section E was definitely organized with the title that it now bears.

During the fifty-three years of the life of the Association there have been but ten papers delivered on the geography of foreign lands, and even geological essays on foreign regions have been few in number. Much valuable geographical work in our own domains has been done by our members, but the results have not been published in the proceedings of the Association. In spite of the geographical work done by State and national geological surveys, the Weather Bureau,

the Coast Survey, and other public and private organizations, we have not made great contributions to the full-fledged science of geography. There are few steps toward scientific geography of greater value than good maps, but for the geographer to stop with the production of good maps is as if the botanist were to stop with the collection of dried plants.

Geography has suffered greatly from being traditionally a school subject in its educational relations; the subject as a whole has been almost everywhere omitted from the later years of college and university training, although certain of its component parts have received some attention in college years. Again, geography as a whole leads to no professional career outside of school teaching; it is perhaps chiefly on that account that our colleges and universities can give little time to it. Finally, there is not to-day in this country an organized body of mature geographical experts at all comparable in rank to the bodies of physicists or of zoologists which are organized into effective working societies; in the absence of such an organization geography suffers greatly for the lack of that aid which comes from mutual encouragement among its workers. How can we remove these impediments of low educational rank, no professional career, and no professional organization?

Physical geography is slowly winning a more respected place than it has ever had among the subjects on which examinations are set for admission to college. Commercial or economic geology is destined to attract increasing attention from mature teachers and nearly mature students. The general geography of various parts of the world must receive more and more consideration in our colleges in the century that opens with the outgrowth of our home country. Just as soon as mature teachers of mature geography can make their lectures of value to the young men of to-day, who are to be the leaders of enterprise to-morrow, place will be found for geographical courses in our higher institutions of learning.

The study of geography is not likely soon to lead to a large, independent career, but it may be made useful in many careers. It will be made particularly serviceable to a class of men that is now of small but increasing numbers, namely, those who travel about the world seeking fortune, entertainment, or novelty.

The third impediment to the maturing of geography, namely, the absence of a society of mature geographical experts, is the fault of the experts themselves. Such a society, in which membership shall be open only to those whose interests are primarily geographical and whose capacity for geographical work has been proved, would be of the greatest aid to the science.

Close scrutiny of what is commonly called geography will certainly be beneficial in bringing forward the essence of the subject, and in regulating irrelevant topics to the background; but it is not to be expected that any precise agreement will soon be reached as to what constitutes geography strictly interpreted. Opinions on the subject, gathered from different parts of the country, even if gathered from persons entitled to speak with what is called "authority," would probably differ as widely as did the nomenclatures of the leading physiographic divisions of North America as proposed in a symposium a few years ago, but if careful consideration and free discussion are given to the subject, unity of opinion will in due time be approached as closely as is desirable.

As a contribution toward this collection of opinions, let me state my own view: The essential in geography is a relation between the elements of terrestrial environment and the items of organic response; this being only a modernized extension of Ritter's view. Everything that involves such a relationship is to that extent geographic. Anything in which such a relationship is wanting is to that extent not geographic.

The location of a manufacturing village at a point where a stream affords water power is an example of the kind of relation that is meant, and if this example is accepted, then the reasonable principle of continuity will guide us to include under geography every other example in which the way that organic forms have of doing things is conditioned by their inorganic environment. The organic part of geography must not be limited to man, because the time is now past when man is studied altogether apart from the other forms of life on the earth. The colonies of ants on our Western deserts, with their burrows, their hills, their roads, and their threshing floors, exhibit responses to elements of environment found in soil and climate as clearly as a manufacturing village exhibits a response to water power. The different coloration of the dorsal and ventral parts of fish is a response to the external illumination of our non-luminous earth.

The word "arrive" is a persistent memorial of the importance long ago attached to a successful crossing of the shore line that separates sea and land. It is not significant whether the relation and the element that enters into it are of easy or difficult understanding, nor whether they are what we call important or unimportant, familiar or unfamiliar. The essential quality of geography is that it involves relations of things organic and inorganic; and the entire content of geography would include all such relations.

A large library would be required to hold a full statement of so broad a subject, but elementary text-books of geography may be made by selecting from the whole content such relations as are elementary, and serviceable handbooks may be made by selecting such relations as seem important from their frequency or their significance. The essential throughout would, however, still be a relation of earth and life, practically as Ritter phrased it when he took the important step

of introducing the causal notion as a geographical principle.

Thus defined, geography has two chief divisions. Everything about the earth or any inorganic part of it, considered as an element of the environment by which the organic inhabitants are conditioned, belongs under physical geography or physiography. Every item in which the organic inhabitants of the earth—plant, animal, or man—show a response to the elements of environment, belongs under organic geography. Geography proper involves a consideration of revelation in which the things that belong under its two divisions are involved.

The validity of these propositions may be illustrated by a concrete case. The location and growth of Memphis, Helena, and Vicksburg are manifestly dependent on the places where the Mississippi River swings against the bluffs of the uplands on the east and west of its flood plain. The mere existence and location of the cities, stated independently of their controlling environment, are empirical items of the organic part of geography, and these items fail to become truly geographic as long as they are stated without reference to their cause. The mere course of the Mississippi, independent of the organic consequences which it controls, is an empirical element of the inorganic part of geography, but it fails to become truly geographic as long as it is treated alone. The two kinds of facts must be combined in order to gain the real geographic flavor.

Geography is therefore not simply a description of places; it is not simply an account of the earth and of its inhabitants, each described independent of the other; it involves a relation of some element of physical geography to some item of organic geography; and nothing from which this relation is absent possesses the essential quality of geographical discipline. The location of a cape or of a city is an elementary fact which may be built up with other facts into a relation of full geographic meaning; but taken alone it has about the same rank in geography that spelling has in language.

A map has about the same place in geography that a dictionary has in literature. The mean annual temperature of a given station and the occurrence of a certain plant in a certain locality are facts of kinds that must enter extensively into the relationships with which geography deals; but these facts, standing alone, are wanting in the essential quality of mature geographical science. Not only so; many facts of these kinds may, when treated in other relations, enter into other sciences; for it is not so much the thing that is studied as the relation in which it is studied that determines the science to which it belongs.

I therefore emphasize again the broad general principle that mature scientific geography is essentially concerned with the relations among its inorganic and organic elements; among the elements of physical and of organic geography; or, as might be said more briefly, among the elements of physiography and of—let me confess to the most indulgent part of this audience that I have invented a one-word name for the organic part of geography, and have found it useful in thinking and writing and teaching; but inasmuch as ten, or at the outside twelve, new words that I have introduced as technical terms into the growing subject of physiography have given me with some geological critics the reputation of being reckless in regard to terminology, it will be the part of prudence not to mention the new name for organic geography here, where my audience probably consists for the most part of geologists.*

There can be no just complaint of narrowness in a science that has charge of all the relations among the elements of terrestrial environment and the items of organic response. Indeed, the criticism usually made upon the subject thus defined is, as has already been pointed out, that it is too broad, too vaguely limited, and too much concerned with all sorts of things to have sufficient unity and coherence for a real science. Some persons indeed object that geography has no right to existence as a separate science; that it is chiefly a compound of parts of other sciences; but if it be defined as concerned with the relationships that have been just specified, these objections have little force. It is true indeed that the things with which geography must deal are dealt with in other sciences as well, but this is also the case with astronomy, physics, chemistry, geology, botany, zoology, history, economics.

There is no subject of study whose facts are independent of all other subjects; not only are the same things studied under different sciences, but every science employs some of the methods and results of other sciences. The individuality of a science depends not on its having to do with things that are cared for by no other science, or on its employing methods that are used in no other science, but on its studying these things and employing these methods in order to gain its own well-defined object. Chemistry, for example, is concerned with the study of material substances in relation to their constitution, but it constantly and most properly employs physical and mathematical methods in reaching its ends.

Botanists and zoologists are much interested in the chemical composition and physical action of plants and animals, because the facts of composition and action enter largely into the understanding of plants and animals considered as living beings. Overlappings of the kind thus indicated are common enough, and

* Abstract of the address delivered by Prof. Davis as the retiring vice-president and chairman of Section E (geology and geography), American Association for the Advancement of Science, at St. Louis, December 28, 1903.

*The new term is "ontography."