1888,' by Dr. Wirt Johnson, secretary Mississippi State Board of Health; 'The Problems of Yellow-Fever Epidemics,' by Dr. Jerome Cochran, State health-officer of Alabama; and 'Some Personal Observations on Yellow-Fever and its Habitudes as Opposed to the Fallacies and Dangers of Personal Quarantine,' by Dr. A. N. Bell, Brooklyn, N.Y.

The paper by Dr. Cochran was one of the best of the entire session, and was most enthusiastically received. Dr. Cochran had just come from Decatur, and his views were the result of years of experience with yellow-fever. It was a concise and pithy statement of his opinions, and any abstract that we could now give would be entirely inadequate. We shall hereafter give a full report of it.

The closing session of the association for scientific business was occupied by the reading of the following papers: 'Tuberculosis, its Origin, Detection, and Control,' by D. E. Salmon, D.V.M., chief of the Bureau of Animal Industry, Washington, D.C.; 'Some Observations on the Origin and Sources of Disease Germ,' by Theobald Smith, M.D., of the Bacteriological Laboratory of the Bureau of Animal Industry, Washington, D.C.; and 'Meteorological Observations as respects Disease Prevalence,' by Prof. W. W. Payne, director of the Observatory, Northfield, Minn.

The interest in many of the papers was greatly increased by illustrations thrown on the screen by lantern-projection.

Chairman C. A. Lindsley of the Lomb prize committee announced the award of the first prize, five hundred dollars, to the essay on hygienic dietetics superscribed with the motto 'Five Food Products illustrated by Practical Recipes.' On opening the sealed envelope, it was found that the successful author was Mary J. Hinman, wife of John J. Abel, now resident at Strasburg, Germany, where husband and wife are attending the university. Of the sixty-nine other essays, not one was deemed worthy of being awarded the second prize.

A resolution was unanimously adopted recommending the passage by Congress of an act to establish a national health bureau in the Department of the Interior.

The following officers were elected for the ensuing year: Dr. Hosmer A. Johnson, Chicago, president; Dr. Jerome Cochran of Alabama, first vice-president; and Dr. F. Montizambert of Canada, second vice-president. The secretary, Dr. Irving A. Watson of New Hampshire, and the treasurer, Dr. J. B. Lindsley of Tennessee, were re-elected. The association will hold its next annual meeting in Brooklyn, N.Y.

SURVEYS, THEIR KINDS AND PURPOSES.

MR. MARCUS BAKER read a paper on the above subject before the National Geological Society of Washington, Nov. 2, 1888. He classified surveys as follows: —

I. Surveys for general purposes, or information surveys: 1. Geodetic; 2. Geologic; 3. Topographic (ordinary and military); 4. Agricultural; 5. Magnetic; 6. Nautical (hydrographic and physical).

II. Surveys for jurisdictional purposes, or boundary surveys: 1. For defining boundaries of nations, states, counties, towns, etc; 2. For defining property boundaries (cadastral, and partition of land for sale).

III. Surveys for construction purposes, or improvement surveys: 1. For constructing works, forts, arsenals, navy-yards, lighthouses, fishways, etc.; 2. For constructing routes of communication, roads, railroads, electric lines, pipe-lines, canals, etc.; 3. For reclamation of land, flood-plains, arid swamps, etc.; 4. For improvement of natural waterways; 5. For water-supply to centres of population; 6. For disposal of sewage from centres of population.

Surveys are of various kinds, are made for various purposes, and the results are exhibited in various ways. The kind of survey to be undertaken in any given case, the mode of conducting it and of exhibiting the results obtained, must depend primarily upon its purpose.

Numerous surveys are now in progress in the United States under the auspices of the general government, of individual States, of corporations, and of individuals. Large sums of money are annually expended upon them, and the outcome is of practical moment to many people.

It is conceived, therefore, that it will be of scientific value and of practical importance to take a general view of surveys, to enumerate and to classify them, and to set forth their purposes. It is of scientific value, because the bringing-together of a considerable number of related facts or phenomena under one general view gives rise to comparison, to study, and to deduction of general principles; and it is of practical importance, because the purpose for which any work is undertaken should be clearly formulated, that the work may be so done as to well and economically serve its purpose.

Surveys must be of various kinds, because they are made to serve various purposes. A classification of kinds is, then, a classification by purposes. The tentative schedule here suggested is one of the various possible modes of classification. Whether better or worse than other schemes of classification, is not important for the present purpose. It may serve for enumeration, and afford the basis for some study of the different kinds of surveys as determined by their purposes.

Now, the purpose of all surveys is twofold: viz., first, to acquire certain information relating to the earth; and, second, to spread this information among the people for whom it is acquired. To disseminate the information obtained among those for whom it has been obtained, the results are set forth (*a*) in the manuscript or printed page, accompanied by illustrations, diagrams, profiles, sketches, photographs, etc., and (*b*) in maps. The results of certain surveys are almost completely exhibited without the aid of maps, while in others the entire result of the survey is a map. Between these extremes we have surveys whose results require joint use of text and map in varying proportions.

In a geodetic survey the results are set forth in the printed text, in tables, and in diagram or sketch of the triangulation. In a topographic survey the result is a topographic map, and, if the survey be purely topographic, the map is the only result. These two kinds of survey, therefore, stand at the two extremes in manner of exhibiting results. In a purely topographic survey all the results are exhibited on the map; in the geodetic survey all the results are exhibited in the printed text and tables.

Surveys may be conveniently grouped into three great divisions: viz., I. Those made for general purposes, or information surveys; II. Those made for jurisdictional purposes, or boundary surveys; III. Those made for construction purposes, or improvement surveys. And these again may be usefully subdivided into several smaller groups, as set forth in the above schedule.

The well-being and prosperity of a community is intimately related to and dependent upon the resources of the region in which it lives. Recognizing this fact, civilized communities study their surroundings and resources, in order, that, by a better knowledge of and mastery over them, they may improve their condition.

The general study of the earth, its size and shape, its structure, its surface form, its surface quality, its forces, is the object and purpose of information surveys. The organization of such surveys is a matter of comparatively modern times, and an accompaniment only of the highest civilization.

When civilized man reaches that stage of development in which he recognizes that his advantage over the semi-civilized or barbarous was due to his better acquaintance with, and mastery over, nature, then was he stimulated to further study and research. Research by single individuals, in private laboratories, led to discoveries of interesting and useful facts and principles. It led, further, to the suggestion of principles of wide application, but which could only be tested by the study of many and widely separated localities. Such study being often beyond the power of the individual, and its outcome being of interest to the entire community in its organized capacity to test, the State took it up, and organized expeditions to travel in distant parts, and collect information for the benefit of the whole community. Such expeditions brought back information respecting distant parts, that served to throw light upon little-understood phenomena at home; to establish principles of higher value than the individual facts from which they had been derived; and led to the establishment of some, and rejection of other, generalizations, based upon a knowledge of only a limited area. The interesting, instructive, and useful facts brought to light by such systematic exploration and general survey showed the practical importance and value of pushing studies of the earth still farther over all areas, and in greater detail.

From this it was seen that there would come additional isolated pieces of information useful to the world, but especially the discovery of general principles.

Thus arose exploring expeditions; and thus arose great government surveys and international surveys, — surveys organized and conducted systematically to study a great area, and to collect and diffuse information for the benefit of the people.

The general study of the earth as it has advanced has differentiated itself into several special lines of study, and has been classified under six heads, as follows: —

Geodetic Surveys.

The primary object of a geodetic survey is the determination of the size and shape of the earth, or, as is preferable to say in this connection, the geoid. Secondarily and incidentally it accomplishes much besides. It determines with highest precision the co-ordinates, latitude, longitude, and altitude, of prominent land-marks over the surface of a country. But this is not essential to its geodetic character. The earliest geodetic surveys by the French Government in France, Lapland, and Peru, measured bases, executed triangulation, and made astronomical observations, solely to determine the size and shape of the earth.

If a scheme of triangulation were planned solely with reference to the measurement of an arc of a parallel, or an arc of a meridian, then the longest lines and the fewest stations and triangles consistent with the required accuracy would be chosen. If the object were the secondary one, of locating points upon which to base other surveys, then the number, location, and accuracy of location would be made dependent upon this secondary condition.

The distinction here suggested is one not anywhere carried into effect; but by geodetic survey is usually understood a survey in which long lines are measured with high precision, and are accompanied by astronomical and gravity determinations. Measures of gravity, in so far as they contribute to a knowledge of the form of the earth, naturally belong with geodetic surveys. In so far as they relate to density and distribution of matter within the earth, they form part of a geological survey. The methods and instruments used, however, in the gravity, or gravimetric survey, closely ally it to the geodetic survey, of which it properly forms a part. Thus a geodetic survey will serve the double purpose of precisely determining the latitude, longitude, and altitude of points for practical use, and of contributing to the general stock of knowledge respecting the form, size, density, and distribution of matter of the earth. And the conduct of the survey will vary according to the prominence attached by the patrons of the survey to the one or the other of these purposes. A very rigid adherence to the "practical" aspect of the case will lead to the rejection of all plans for work not promising "practical" results, while a more liberal policy will go further, and, in addition to the immediate practical results, will aim to deduce general principles and increase the sum of human knowledge.

Geological Surveys.

While geodetic surveys are concerned with the size and shape of the earth, geological surveys deal with its structure, composition, and history. The well-being of man is most intimately dependent upon his power to forecast the future. To forecast the future requires knowledge of general principles or laws, and these general laws are derived by inference from what has been and is. To read the story of the rocks aright; to interpret their history; to establish the principles, more enduring than the rocks themselves, by which from that which has been may be correctly inferred that which shall be, — this is the great geological problem not to be solved by one geologist, or one survey, or one generation, but by the accumulated results of the studies of many men, through many generations. So conceived, it is clear that the work of the geodesist and geologist will not be finished; their work will not be perfect or complete; but each survey and each surveyor will do more or less of good work or bad as his contribution to the world's knowledge. The greatest and best results of a geological investigation or survey may finally be summed up in the general principles deduced,— principles capable of direct application to practical affairs. May we not hope some day to understand volcanic and earthquake phenomena, and, foreknowing destructive earthquakes, escape the dreaded results?

The answer seems certainly to be worth the seeking; and the seeking must needs be made by studying the earth's crust. This is the field of the geologist and the geological survey.

The clay, the marble, the gold, the coal, the granite, the iron, — these and many more in greater or less abundance, and very unevenly distributed, are useful to man. Are there not other unknown natural products useful to man? The geological surveys should seek them. From the clay comes the porcelain and the bricks; from the marble, lime; and from the coal and iron ore, the steel. Are there not hidden from our view yet many more useful products? It seems highly probable, and therefore wise economy, that the State should, for the common good, systematically collect, publish, and distribute the data and information which render such discoveries possible. That the prosperity of a community depends upon the amount and distribution of its natural resources is so obvious, that the systematic study of them is early entered upon in most civilized communities. Such systematic study is the first, the greatest, and the most important work of a geological survey: it is the foundation, and in many minds is conceived to be the only proper work, of the survey.

The purpose of a geological survey may be defined to be, to collect, to systematically arrange, to publish, and to distribute, useful information respecting the earth in general and its crust in particular.

Respecting information not yet obtained, it may not be easy to decide whether it be useful or useless. Is it of any use to know the geological structure of the region about the north pole? It may be a frozen ocean, or a bleak, rocky region, fabulously rich in gold-deposits, or, —who knows? — perhaps a knowledge of so exceptional a locality may furnish the key that will unlock unsuspected resources at our very doors. A wise policy in the conduct of a geological survey will ever seek useful information; but a wiser one will add to this search a deeper research into the unknown — far beyond the limits of immediate pecuniary returns — for the discovery of principles irrespective of immediate practical application.

Topographic Surveys.

The surface of the earth presents a great variety of forms and features. Land is flat, undulating, broken, hilly, mountainous, swampy, desert, etc. The free movement of men and traffic over this uneven surface is much affected by its form: hence, for the general information of those interested directly or indirectly in travel or transportation, a knowledge of surface form is valuable. Hence arise topographic surveys organized and carried on for the purpose of collecting, publishing, and distributing information respecting the surface forms and features of a country; i.e., respecting its topography.

'Topography' is a word used sometimes in a broad sense to indicate a description of a place or region not very large, and sometimes in a more restricted or technical sense to mean simply the surface form, the ups and downs, the hills and hollows. In the early use of the term, its meaning was the general, unrestricted one. It is now used in both senses. If English catalogues of topographical books are examined, they will be found to consist of lists of local town and county histories, local hand-books, guide-books, gazetteers, accounts of noted buildings and persons, and of events connected with local history. Maps or pictures may or may not accompany such topographical descriptions. This is the early English use of the word, — a use which still survives.

Along with this early use of the word, large-scale maps of limited areas were made, — maps which exhibited the hedgerows and highways, the orchards and ditches, the parks and houses, the streams, stone walls, gardens; in brief, all the minor details of the landscape except the surface form. The features were exhibited usually by conventional signs, but the surface form was not revealed on these maps. The horizontal plan alone appeared. The element of relief was wanting. The scales of such maps, however, were so large, that they permitted the exhibition of a large number of small features; and as such, they were called 'topographic' in distinction from 'chorographic' maps, which, on smaller scales, embraced in one map a much wider field, from which all minor features had been of necessity excluded.

The value and importance of these topographical maps for military purposes were brought into great prominence during the Napoleonic wars. Napoleon, recognizing their importance and value, gave a powerful stimulus to military surveying. He also clearly perceived the value and importance of representing the hitherto unrepresented element of surface form, and to him is said to be due the introduction on topographic maps of a representation of the relief. Then arose systems of different kinds for showing form as well as feature, and thereafter the exhibition of the relief came to be regarded as essential to a topographic map. Thus the word 'topography' underwent a change, an extension of meaning, — an extension to be followed later by a restriction of meaning. When usage had established that by 'topography' both the form and the features of the surface were implied, then the need of distinct terms expressing these two elements arose. Very soon we find 'topography' being unconsciously used to imply surface form alone, and this unconscious use has now become conscious and established. A new word or phrase is therefore needed to express the features, but we have no such term. Thus at first 'topography' relates to surface features, and chiefly artificial ones, villages, roads, cities, orchards, walls, gardens, buildings of various sorts, etc., and all water bodies; later the term is expanded to mean all these, and in addition the surface form; and finally, before losing this extended signification, it is restricted, and used to signify surface form only. Primarily it related to features only: it is now used to relate to surface form. At the same time the earlier, but not earliest, use survives, and is used to imply both forms and features: hence have arisen apparent disagreement and discussion from confusion of meaning of the word.

The features exhibited on maps called topographic may be conveniently grouped into three heads: (*a*) the water features, — ponds, streams, lakes, etc.; (*b*) the surface form, — hills, valleys, plains, etc.; (*c*) the features constructed by man, — cities, villages, roads, etc.; and, if need be, general terms might be coined to express these three classes of phenomena.

The description of water features would naturally be the 'hydrography;' the description of the form, 'cidography;' and the description of the constructed features, the 'tectography.'

This seeming long digression into the meaning of the term 'topography' is only seeming. As a piece of word-history, it is not pertinent; but, as a prerequisite to a clearly defined comprehension of the subject rather than the word, it is of first importance. The proper conduct of a topographic survey requires a clear understanding of what it is, what it is not, and why it is made. What, then, is the object and purpose of topographical surveys?

The object and purpose of topographical surveys is, as I conceive it, the production of topographical maps, — a definition which, without a definition of 'topographical map,' appears meaningless. But even before defining that particular species of map called 'topographic,' it appears that the aim of the survey is solely to produce a map. Its purpose is not the erection or refined location of monuments, nor the tracing of boundary-lines, public or private, nor the establishment of bench-marks. The doing or not doing of these things does not destroy the essential character of the survey, which is the production of a topographical map, — a map which shall exhibit, with an accuracy and detail sufficient for all general purposes, the relation of the features of a country to one another, and to the form of the surface upon which they are. The erection, description, and location of boundary-marks is the special work of the boundary survey; the erection, description, and precise determination of bench-marks — as permanent reference-marks — is the work of the geodetic survey; while the less precise determination of many unmarked stations for temporary use in map-making is the work of the topographic survey.

The topographic survey, like all others in our first category, — the geodetic, geologic, etc., — is not special, but general. It is not made for the purpose of constructing railroads, though a very valuable aid in projecting railroads. It is not made for the specific purpose of reclaiming swamp-land, or arid land, or flood-plain land; but it furnishes general information essential to a preliminary study and plan for improvement. It is not made specifically for war purposes, though useful for such purposes, and serving as a basis for special surveys for military purposes. It is not made for any one specific purpose, any more than a jack-knife is; but, like the jack-knife, it serves many purposes, even though it serve some of them less well than a special tool constructed for the special purpose.

The outcome of a topographic survey, being a topographic map, should be judged by the map; and the map, being for general purposes, should be judged by the manner in which it serves the general rather than the special purpose. And, further, of two maps, or works of any kind, made for the same purpose, and serving that purpose equally well, that one is best which is the cheapest, — a well-recognized principle, especially among engineers.

In the conduct of a topographical survey, one most important question must be decided in advance; viz., the scale to be adopted. Almost all questions of detail hinge upon this. Large-scale maps permit the exhibition of many and small details, and of the relation of objects to one another, with greater precision than small-scale maps, just as a high-power microscope reveals details not to be seen with lower power. For certain purposes microscopes of only very low power serve best; for others, those of moderate power; and for still others and special purposes very high powers serve best. So, also, for many purposes maps of small scale are desirable; for others, maps of moderate scale; while for other and special purposes maps of very large scale serve best. What the best scale is for general purposes has been the subject of very animated and even heated discussion in European countries, particularly in England, where, in connection with the Ordnance Survey, the "battle of the scales" was fought with great vigor some thirty-five years ago. And, as is apt to be the case in such controversies, there were good reasons on both sides, — good reasons for making the scales large, and other good reasons for making them small. The best scale to adopt, therefore, all things considered, was a matter of judgment, and hence the diverse views.

There seems to be no better way of getting at general opinion upon the subject of scales than to see what, as a result of study and experience, various map-making nations have adopted.

The following table, therefore, is presented, showing the scales upon which fourteen foreign states are constructing, or have constructed, general topographic maps of their areas: —

PUBLICATION SCALES OF STANDARD TOPOGRAPHIC MAPS OF FOREIGN STATES.

India	1 : 253,440
Russia	1 : 126,000
Germany	1 : 100,000
Norway	1 : 100,000
Portugal	1 : 100,000
France	1 : 80,000
Austro-Hungary	1 : 75,000
Great Britain	1 : 63,360
Sweden	1 : 50,000 and 1 : 100,000
Italy	1 : 50,000
Spain	1 : 50,000
Denmark	1 : 40,000 and 1 : 80,000
Switzerland	1 : 25,000 and 1 : 50,000
Belgium	1 : 20,000 and 1 : 40,000

These scales all cluster around one mile to an inch. In countries of small extent and of dense population the scales are larger. In countries of larger extent and sparser population the scales are smaller. The lesson taught by this table is conceived to be of great value in determining the scale or scales that should be adopted for a general topographical map of the United States.

A statement recently published, that "maps upon a scale of less than two inches to one mile are of but little use for definite purposes," is therefore an individual opinion, which contrasts with the general opinion in such matters, as inferred from the scale in use by nations conducting topographic surveys.

Topographic surveys may be conveniently classified under two heads having reference to their purpose. If made for general use and information, they constitute the ordinary or usual topographic survey; while, if made for war purposes, they are military topographic surveys. Most of the great militant nations make special surveys and maps, which are unpublished, and are kept secret in the archives of the War Department. The changes in the mode of conducting wars incident to improvement in fire-arms and explosives necessitate corresponding changes in the military maps.

Agricultural Surveys.

Special studies of the character and distribution of soils, and of related phenomena having an immediate bearing upon the cultivation of useful crops, are known as agricultural surveys. The classification of land into groups, as desert, grazing, mining, forest, swamp, etc.; the classification and properties of various soils, as marl, loam, sand, clay, hammock, adobe, etc.; the study of climate as related to crops; the study of animal life, and especially the distribution of animal life, beneficial or injurious to agriculture, — all these, with related phenomena, involve special examination and study in the field, and together form the special work of the agricultural survey. The special results of the distinctively surveying part are classification and distribution, — results exhibited on maps — or topographic maps — prepared for general purposes. The work carried on, and the results obtained, at agricultural experiment stations, are an important, indeed essential adjunct, but do not of themselves constitute an agricultural survey.

Magnetic Surveys.

The earth is a magnetic body. When magnetized bodies, such as compass-needles (free to turn horizontally) or dipping-needles (free to turn vertically), are so suspended as to yield to the influence of the magnetic earth, they move in response to its magnetic force, and take up certain positions or directions. These directions vary with time and with place; also the intensity of the magnetic force exerted by the earth is found to be different in different places, and not to be constant at the same place.

Magnetic surveys are therefore organized to obtain observations of these magnetic phenomena in various places and at divers times, to study them, and to publish the results for general information, the purpose being twofold: viz., first, to ascertain for the general and practical use of persons using the compass, etc., magnetic declination or "variation of the compass" at any point of the earth's surface at any time; and, second, the observation and study of all terrestrial magnetic phenomena with a view to the perfection of a theory whereby all such phenomena may be predicted. As already suggested, the magnetic declination varies with time and with place; the dip also varies with time and with place, and the force varies with time and with place. A knowledge of the declination is of immediate practical use to many people; a knowledge of the dip and intensity, however, is of less immediate practical utility. But for a bettering of our knowledge of the whole subject of terrestrial magnetism, for the establishment of principles respecting it, all its manifestations should be investigated by the magnetic survey.

If a magnetic survey of a State were undertaken for the purpose of producing an isogonic map, or map showing by curves or shading the declination at all points in the State, for the practical use of compass-users, different plans might be used for the purpose.

A few stations widely separated and scattered over the State might be selected, and a precise determination made at each by using sufficient time, care, and delicacy of instrument. This would give refined results and few stations.

On the other hand, by using much less time at each station, and less delicate instruments, more stations could be occupied, and a greater number of less precise determinations obtained in the same time. This latter would have the advantage of showing distribution better than the former.

For showing distribution of rainfall, it would seem that observations at five hundred stations, giving results accurate within one or two inches, would be for many, if not for most, purposes better than the results from fifty stations accurate within one or two tenths of an inch, or ten times as accurate as the former. Similarly, if for the purpose of constructing an isogonic map we have our choice between determinations of declination at one hundred stations accurate within one or two minutes, and determinations at one thousand stations accurate to within ten to twenty minutes, it may not be easy to decide which to choose. Surveys have been tried in the United States by both methods, neither of which completely satisfied the parties conducting them. The latter method has not been sufficiently tested experimentally to prove its quality. But, for the purpose of producing an isogonic map for a given epoch, the writer considers it better to go rapidly over the area to be mapped, securing a very large number of observations at many stations and of only a moderate degree of accuracy, than to have highly refined and precise measures made at only a few stations.

Nautical Surveys.

As the object and purpose of a topographical survey is the production of a map, so the object and purpose of a nautical survey is the production of a chart. Such has been the only purpose until recent years, when the ocean, its movements, its inhabitants, its depths, have become subjects of special study. This special field, under whatsoever name included, — whether 'ocean physics,' 'thalassography,' or 'physical hydrography,'— is only indirectly and remotely connected with nautical surveying as usually understood: hence we may regard the term 'nautical surveying' as embracing ordinary hydrographic and physical hydrographic surveys; the object of the first being chart-making, and of the second an investigation of the oceans and great water bodies for purposes connected more or less indirectly with navigation. The chart produced by the nautical surveyor is usually supplemented by some form of directory, or hand-book, or coast-pilot, giving certain data useful to the mariner in addition to that afforded by the chart.

Similarly, the map produced by the topographic surveyor may be usefully supplemented by some form of guide-book, gazetteer, or geographical dictionary, affording certain useful data supplemental to that contained on the maps.

Tidal observation and current observation form proper parts of ordinary nautical surveys. The purpose of such observations is the immediate and direct one of aiding navigation: hence the selection of stations, and the character and extent of the observations, will be made to accomplish this purpose. If, however, the tidal observations are made for obtaining data whereby the theory of the tides may be perfected, if the current observations are made to discover the general laws of oceanic circulation and their results, then these considerations will lead to a choice of stations and methods, and amount of observation, which gives promise of best serving that purpose.

We have now briefly reviewed and commented on six species of information surveys, — geodetic, geologic, topographic, agricultural, magnetic, and nautical. These surveys are all national works, covering wide areas and long periods for their execution. Moreover, most of them cannot be done once for all, but must be repeated from time to time. The best and completest and most perfect work of the eighteenth century does not satisfy the demands of the nineteenth; and the surveys of the nineteenth will serve their purpose, even if the twentieth century finds it necessary for its purposes to make new and better surveys. The object of a survey is not the attainment of the highest possible precision. Great accuracy is needful for the accomplishment of certain purposes. Such accuracy, however, is not itself the purpose: it is only the means to the end. What the purpose of information surveys are, we have tried to set forth. If correctly set forth, these purposes will furnish the criteria for judging of the precision which should be striven for in any work; and it will thus appear, that, if an accuracy less than the greatest will serve a specified purpose, the greatest accuracy and the cost of securing it are unnecessary. The work done should be sufficiently good for its purpose.

Boundary Surveys.

The second great division in our enumeration consists of boundary surveys, and these may be conveniently grouped under two heads: first, those lines which separate communities or jurisdictions, such as towns, counties, states, and nations; and, second, property boundaries, or boundaries of private ownership. Perhaps the terms 'public boundaries' and 'private boundaries' might be used to indicate these two groups.

Boundary surveys differ from information surveys in this: they deal with lines, information surveys deal with areas. The problems presented by the boundary survey are generally more definite and explicit than those of surface surveys, and there is correspondingly less opportunity for display of judgment and skill in their conduct.

The purpose of a boundary survey is to mark out a line on the earth's surface. As the marks placed by such survey are subject to loss, removal, or obliteration through neglect or malice, it is essential that a record be made giving all needful details for restoring lost marks. The making of the record, however, though an important matter for practical reasons, is a secondary matter to the surface marks which define the boundary. It is the loss of the ground marks, and not the loss of the record, that makes boundary re-surveying necessary. Few if any boundaries are ever so perfectly or completely marked out that subsequent surveys are not necessary. Much of the work of the boundary surveyor, therefore, consists in the retracing of lines, or, what is the same thing, the recovery of old marks. The law, decree, or what not, which prescribes the boundary is the guide for the first survey. Subsequent surveys have the same law and the old notes by which to recover the line as first marked. And as successive surveys, more or less well or ill done, in the course of years accumulate records of more or less obscurity, the work of the surveyor comes to be more and more a study of law and the untangling and interpretation of records.

The language defining a boundary is often such as to be incapable of interpretation, or it prescribes impossible conditions. The north-eastern boundary of Massachusetts has been, and the south-eastern boundary of Alaska may be, in dispute for the same reason. Each requires a line parallel to the winding of a coast or stream.

The partition of the public lands for sale is a particular case of boundary-surveying. These surveys, executed in the wilderness in advance of settlement, were for the purpose of staking out the ground for farmers.

From the nature of the case, much of this surveying was rough and poor. But though roughly and badly done, though the quarter-sections often differ materially from the one hundred and sixty acres, though the rough records show illiteracy or are obscure, nevertheless, whenever the staking-out of the lines on the ground was well done, the survey was well done, for it achieved its chief purpose. But in many places the staking-out was badly done or not done at all; a burnt match passing for a charred stake, and a pebble for a stone monument. In such places the local surveyor will find employment in recovering old land-lines.

The importance of having boundaries well and clearly defined need not be dwelt upon. The perpetual litigation over property boundaries, the litigation in which decisions involve question of boundary, the irritation and occasional wars between nations over boundary questions, sufficiently emphasize the importance of such surveys. The practical need is not merely that a boundary-line should be once surveyed and marked, but that it should be continually marked. The lines should be therefore re-examined from time to time, and lost marks renewed. It appears obvious that such work should be continuously in charge of an officer or little corps of boundary surveyors, who, in an office for the purpose, accumulate the records of all boundaries under their jurisdiction, and who are charged with the maintenance of boundaries. The general government might appropriately undertake the task of marking and maintaining the boundaries of the States, while the individual States might assume control of all boundary-lines within the State. The successful and economical mode of performing such work would seem to consist in abandoning the job or contract system, and substituting a permanent organization, — an organization in which special aptitude, special knowledge, experience, and fidelity would be required. Entrance to such an organization should be solely on account of such qualities, and permanence of tenure in such work is essential to its success. Under such a system, both the States and the United States can economically undertake the work of establishing and maintaining their ancient land-marks.

Improvement Surveys.

The last great division in our classification is that of surveys made as a preliminary or basis for the construction of works or improvement surveys. These surveys may be generally characterized as special. They are made for some one specified purpose; and that purpose, being construction of some sort, almost if not quite universally demands large-scale maps. All improvement surveys may be regarded as 'special' in distinction from 'information' surveys, which are made for general purposes. The general survey is therefore the natural and economic forerunner of, but not a substitute for, the construction survey.

If a canal or railroad is to be constructed to connect the Gulf of Mexico with the Pacific Ocean, a general topographic map of the region exhibiting the drainage and surface form would at once narrow the question of location down to a very few alternative propositions, or might even completely determine the location. But such general map, even if on a very large scale, and very detailed and very accurate, does not obviate the need of construction surveys. The construction of railroads from the south-eastern Atlantic seaboard into and across the Appalachian Mountain system into the Mississippi basin, is greatly facilitated by the aid of general topographic maps,— maps which, even on moderate or small scales, obviate almost or quite completely the need of trial or random lines or preliminary surveys. To attempt to make a general topographic map with such minuteness of detail, with such precision and on such a scale as to permit its economic use for construction purposes, is to undertake a work that will in general fail of its purpose: construction surveys will still be needed. The information survey affords the material for intelligent and economical planning of improvements; the construction survey furnishes the working drawings and details. The information survey for general purposes takes cognizance of the larger and more permanent features; the construction must take account of much smaller and more ephemeral features. And because construction surveys require information respecting ephemeral features, it is not economical to have such surveys completed long in advance of construction.

As the scale of a general topographic map is increased, the amount of detail shown is increased. And it is possible so to enlarge the scale, and so to multiply the amount of detail shown, as to lay plans for improvements with great definiteness, and even in some cases to begin simple construction works without further information than that afforded by such maps. But, by reason of rapid change of small features, construction must in general follow very quickly after the execution of the survey; and the usefulness of the maps for most purposes declines rapidly with the lapse of time. Large-scale and detail maps of the suburbs of growing cities and towns become quickly antiquated: they serve temporary needs, and are replaced by new ones similarly serving temporary purposes. This being the case, good economy requires that they be made quickly and cheaply.

As topographic maps on very large scales may be made in certain cases to a limited extent for construction purposes, the purposes of topographic surveys, and of surveys for constructive purposes, are sometimes confused. Some engineers demand that a topographic map shall not only serve the general purpose of giving topographic (that is, eidographic) information, but shall also give all details needful for completely planning the construction of works. Such demand implies a confusion of the purposes of information surveys as above set forth,— a confusion through which nearly all map-making nations have passed. Topographic map-making on any extended scale is comparatively new in this country, and the general ideas prevailing respecting them are those which were held in Europe forty or more years ago. At that time it was held that a single map could be made to serve all purposes; and this, of course, required large scales. Then the work progressed slowly, and became very expensive. Moreover, such maps very soon fell in arrears, and were presently hopelessly in arrears. Out of this experience was slowly evolved the principle that maps, and the surveys needful to make them, should fall in three great categories: viz., (*a*) general or chorographic maps, i.e., on a small scale (from $\frac{1}{200000}$ downward), covering the grand features of an area of considerable extent; (*b*) special or topographic maps, i.e., maps on moderate scales (from $\frac{1}{200000}$ to $\frac{1}{20000}$), covering a correspondingly smaller area, and exhibiting all the natural and prominent artificial features of which the scale admits; and (*c*) very large scale plans or diagrams (from $\frac{1}{20000}$ upward), such as parish plans, town plans, cadastral maps, or land-office plats, etc. Between these categories, sharply defined lines do not exist. But the experience of the European nations has in the course of time brought clearly to view the practical importance of differentiating these three classes. And so it has happened that nations formerly making a general topographic map on very large scales are now making them, or have completed them, on greatly reduced scales.

We have subdivided construction surveys into six groups, which do not need special characterization. The special purpose of each is indicated by its name. The special mode of conducting each for accomplishing its purpose will depend upon many details beyond the scope of this discussion.

HEALTH MATTERS.

Distribution of Consumption in New Hampshire.

THE extent and distribution of consumption in New Hampshire are admirably set forth in a paper by Dr. Irving A. Watson, the secretary of the board of health of that State. The prevalence and fatality of this disease are illustrated by a number of diagrams. From the figures quoted by the author of the paper, it appears that during the three years 1885-87 there were in the State 2,432 deaths from consumption. It is interesting to compare with this the deaths from other forms of disease. From heart-disease there were 1,536 deaths; pneumonia, 1,526; apoplexy and paralysis, 1,421; old age, 1,347; cholera infantum, 918; cancer, 637; typhoid-fever, 464; diphtheria, 411.

From a careful study of consumption in New Hampshire for the past six years, but more especially from the registration returns of the years 1885, 1886, and 1887, the following conclusions are arrived at: —

1. The disease prevails in all parts of the State, but is apparently influenced by topographical conditions, being greater at a low elevation with a maximum soil-moisture, than in the higher elevations with a less moist soil. The prevalence of other diseases also affects the death-rate from consumption.

2. That the season has only a small influence upon the mortality from this disease. The popular idea that the fatality is greatest in the winter is shown to be erroneous, the greatest number of deaths occurring in May.

3. That the mortality is considerably greater in the female sex.

4. That no age is exempt from this disease, but that the least liability of its development exists between the ages of two and fifteen, and the greatest between twenty and thirty. Advanced age does not assure any immunity from the disease, as is generally supposed, but the smaller number of decedents is due to the fewer living persons of that advanced period of life.

5. The death-rate from pulmonary consumption is relatively much the larger among the foreign-born.

6. The average death-rate from consumption for the years 1885, 1886, and 1887, is 12.86 per cent of the total mortality of the State. In Massachusetts, for the ten years ending 1886, deaths from consumption averaged 16.10 per cent of the total mortality; and in Rhode Island, for a period of twenty-five years, ending 1884, 16.30 per cent. This shows a greater freedom from the disease in New Hampshire than in the two States mentioned.

ALCOHOLISM. — Dr. Lewis D. Mason discusses, in the *Quarterly Journal of Inebriety*, the etiology of dipsomania and heredity of alcoholic inebriety. He has collated a large amount of testimony bearing on this subject; and from this, and from his own experience, which has been very large, he draws the following conclusions: first, alcoholism in parents produces a degenerate nervous system in their children, and subjects them to all forms of neuroses, — epilepsy, chorea, paralysis, mental degeneracy, from slight enfeeblement to complete idiocy and insanity; second, alcoholism in parents produces a form of inebriety in their children known as dipsomania, which in the large majority of cases is inherited in the same manner that other diseases are inherited, and we can with propriety and correctness use the term 'alcoholic or inebriate diathesis' in the same sense that we use the term 'tubercular diathesis,' or other terms indicating special tendencies to other inheritable diseases.

TOBACCO-SMOKE AS A DISINFECTANT. — It has long been a cherished theory, at least of smokers, that the fumes of tobacco were to a certain degree disinfecting in their action. To put this theory to a test, Dr. Vincenzo Tessarini, of the University of Pisa, has recently conducted an investigation into the action of tobacco-smoke upon micro-organisms. He devised an apparatus consisting of two funnels placed with their mouths opposed, and sealed with paraffine. To each small end of the funnels tubes were attached, suitably arranged so that a cigar could be placed in one end, while the bacteriological smoker inspired at the other. The smoke was thus drawn into the large space made by the funnels, in which was a plate with various cultures of micro-organisms; control cultures were also used. The microbes were subjected to the smoke for from thirty to thirty-five minutes, during which time from $3\frac{1}{2}$ to $4\frac{1}{2}$ grams of tobacco were used. The micro-organisms tested were the *spirillum choleræ Asiaticæ*, *spirillum* Finkler and Prior, *bacillus anthracis*, *bacillus typhi abdominalis*, *bacillus pneumoniæ*, *staphylococcus pyogeneus aureus*, and *bacillus prodigiosus*. The kinds of tobacco used were the large Virginia cigars, the large Cavour cigars, the small Cavour cigars, the best cigarette tobacco. The results show that tobacco-smoke has the effect of preventing the development of some micro-organisms entirely, and of retarding that of others. The Virginia cigars seemed to have the most powerful effect, while cigarette-smoke had only a retarding influence, and did not entirely check the growth of any form. By first drawing the tobacco-smoke through water, it was found to have lost its germicidal properties.

FATIGUE FROM USE OF THE TELEPHONE. — At the meeting of the American Otological Society in Washington, Dr. Clarence J. Blake of Boston read a paper on the influence of the use of the telephone on hearing-power. He thinks that this influence must be injurious, because the extremely low intensity, as demonstrated by experiment, of the sounds to be caught from the telephone, compelled a strain of the ear which soon fatigued it, and made it especially liable to injury by the accidental sounds of comparatively high intensity, which were constantly liable to be heard. Dr. C. H. Burnett said he had seen several patients who believed that the continued use of the telephone had impaired their hearing. Dr. O. D. Pomeroy gave the case of a patient who said the use of the telephone fatigued her very much, and she thought had made her decidedly worse.

DISINFECTING LETTERS. — The *American Analyst* describes as follows the method adopted by the United States Government for the disinfection of letters coming from districts in which yellow-fever prevails. Letters from the stricken section are fumigated in a novel way, so that there is little or no chance for the disease being brought northward. The letters are all stopped when they reach the quarantine lines. Each letter is put under a machine with a long arm attached, and this is provided with little teeth punctured at the ends. A powder that is used for fumigating purposes is forced through the arm and down through the teeth. The arm comes down on each letter, and, while the little teeth are perforating the letter, the powder is blown in between the sheets, disinfecting the letter thoroughly. We had understood that after the perforations were made the letters were exposed to the fumes of burning sulphur. If the *Analyst* is correct in its statement, it would be a satisfaction to know what the powder is which thus disinfects the letters so thoroughly. So far as we know, there is no powder which has this power when employed in the manner described, and, until we receive further information, we shall look upon the whole process with distrust.

CIGARETTE-SMOKING. — The poisonous effects of cigarette-smoking have been experimentally determined by William L. Dudley, M.D., professor of chemistry in the Vanderbilt University at Nashville. He describes his methods in the *Medical News* of Sept. 15, 1888. The fact that cigarette-smoking produces physiological effects differing to some extent from those of the cigar led him to make his experiments. The frequently ascribed causes of the difference — that of the adulteration of cigarette tobacco with opium and other drugs, and also the presence of arsenic in the paper — are for many reasons unsatisfactory and insufficient. It is true, no doubt, that the tobacco in many of the less expensive brands is adulterated with cheap drugs and artificial flavors, and that in the more expensive grades opium may be used; but it is equally true that many cigarettes are made of tobacco which is free from sophistication. The presence of arsenic in the paper is entirely out of the question. There is a difference in the methods of