26

T A S M A N I A.

MINES DEPARTMENT CIRCULAR

No. 5.

# THE APPLICATION OF GEOLOGY TO THE DEVELOPMENT OF THE NATURAL RESOURCES OF TASMANIA

by

Loftus Hills, M.B.E., M.Sc., Government Geologist.

-------

Issued under the authority of

The Honourable Sir Neil Elliott Lewis, K.C.M.G.

Minister for Mines for Tasmania.

--------

1 9 2 0.

## TABLE OF CONTENTS.

-------

# THE APPLICATION OF GEOLOGY TO THE DEVELOPMENT OF THE NATURAL RESOURCES OF TASMANIA.

---

## I. OBJECT OF THIS CIRCULAR.

The circumstances which have given rise to the preparation and issue of this circular are these:- (1) The realisation of the fact that the general public are more or less completely ignorant of the great importance of the application of geology to the development of our natural resources; (2) The decision by those conversant with the facts that it is desirable that the public should know what has been done and is actually being done by the important Government Department known as the Geological Survey of Tasmania, and the possibility of much greater scope and utility of that Department which will result from the more general dissemination of the knowledge of what geology actually is and what it is capable of doing.

Although all nations with any pretentions at all to civilisation now possess completely equipped Geological Surveys, yet it is a surprising fact that the general public are almost completely ignorant of the work and usefulness of such organisations. This applies with perhaps more than average force to Tasmania, and it is the object of this circular to explain what the work and usefulness of the Geological Survey really is. To accomplish this successfully it is necessary to explain what Geology is and what kind of work a Geologist undertakes and carries out. In addition, examples should be given of serious mistakes and waste of money which have resulted from the failure to apply geological knowledge to engineering and mining propositions. Following this should also be given illustrations of the benefits which geology has actually been proved to confer on industrial undertakings of many kinds.

Having thus demonstrated the necessity of the utilisation of geological knowledge, the method in vogue in Tasmania of applying modern economic geology will be described in some detail and full instructions will be given as to when geological advice is necessary and how to go about the obtaining of such advice.

Fortified with the knowledge thus presented, public bodies, private firms and individuals will be able to realise when the advice of the Geological Survey is needed and what it is necessary to do to obtain that advice. In this way the field of activity of the Geological Survey will be enlarged and the development of the natural resources of Tasmania will then proceed on a more scientific basis and on sounder lines altogether than in the past and progress will thus be assured. It is especially desirable that the scientific knowledge which is available and which is so essential to the development of our natural resources should be applied to the fullest extent during the next few years, because we are now at the critical stage when every effort of the community should be concentrated on the rapid development of all our natural resources. The matter is urgent both to immediately increase our production and wealth and also to ensure that our birthright of the greatest facilities for manufacturing of any State of the Commonwealth shall not be snatched from us, as a punishment for our dilatoriness in the past, by schemes in other States which, while not so ideal or advantageous, yet may have the inducement of being ready for immediate utilisation as the result of more rapid development than our own.

The mining public of the State may are convinced? and they have shown by repeated applications for the Geologists services that they thoroughly understand the aims and objects of the Geol Survey.

## II. - WHAT IS GEOLOGY?

-------

Geology deals with the materials of which the Earth is composed. It investigates their composition, structure and mode of origin, and determines the amount and distribution of all of these materials whether they be rocks, metallic ores, oil or underground waters.

In addition, Geology studies the development of life on the Earth as decipherable from the remains of animal and vegetable organisms preserved in rocks, and it thus supplies the History of Life on the Earth. The knowledge thus gained of the History of Life enables conclusions to be drawn as to the geography of the earth in pre-historic ages, or in other words, to trace the changes in the relative positions of land and sea. This information is applied to the investigations as to the origin and extent of the respective materials - - constituting the crust of the Earth and is of indispensable value in that connection as will be explained in a later chapter of this circular.

Geology endeavours to explain the origin of the Earth; it seeks to account for its varied surface features, for its atmosphere, the distribution of land and water, its rivers, lakes and seas, its mountains and plains. Geology is in fact a history, the documents upon which such history is based being written in the rocks of the earth itself and the forms of its surface features.

The material treated in Geology is thus of wide extent and embraces a great variety of subjects. As the science developed so there has arisen the necessity of dividing the Science of Geology into different branches geological sciences. Some of the more important of these are as follow:-

Mineralogy - Under this subject is included the study and investigation of composition, properties and origin of definite chemical compounds known as Minerals.

Petrology - The science of petrology treats of the origin, properties and relations of the material forming the- - various rock masses which are component parts of the earth's - - crust. Petrography is that branch of petrology which embraces the study of the internal structure of rocks by means of the - - examination by the microscope of thin translucent slices cut from them.

Paleontology. - This science deals with the life of past ages, as shown by the remains or natural molds and imprints of plants and animals called fossils which have been preserved, enclosed in the rocks.

Physiography. - This branch of geology treats of the present surface of the earth and seeks to understand the causes of its relief features and the nature of the various agencies which are at work modifying them.

All of these geological sciences, together with other similar branches, are embraced under two main divisions:-

(1) Physical Geology which includes Dynamical Geology or the study of the facts and principles concerning the various agents such as wind, running water, moving ice, volcanic - -- activities, &c., which operate upon the earth and modify its outer

This information can be obtained from any text book on Geology.

portion, and Structural Geology which deals exhaustively with the architecture and material of the outer shell of the earth.

(2) Historical Geology which is a review of the sequence of the events which have happened to the earth in the past as revealed by the rocks and fossils.

From the industrial point of view the most important type of Geologist is he who marshalls all of the above-mentioned branches and divisions of geology to his service, uses them in all such ways as he deems desirable or necessary and evolves a system of their application to practical problems which is known as Economic Geology. It could just as appropriately be called Applied Geology, but the former is the title - - - universally adopted. Economic Geology deals with the use of the materials of the Earth's surface in the service of mankind and in the application of geological facts and principles in obtaining them. It makes a special study of mineral or ore deposits - their composition, extent, distribution, mode of origin, value and persistency. It investigates coal-fields, determines their distribution and extent, and locates their undiscovered continuations or separated portions. It determines the location and extent of deposits of limestone, shale, clay, &c.,&c., suitable for cement making, pottery, porcelain &c. It directs search for these ore and rock deposits and coal-fields, and it decides whether there exist underground supplies of artesian or sub-artesian water sufficient to justify boring. In addition, Economic Geology applies an intimate knowledge of all branches of Geology in advising on the effect of the - - geological composition and structure on the suitability of the proposed sites for engineering works such as reservoirs, dams, harbours &c. Finally it supplies indispensable information in regard to the character of the sub-soil in connection with agricultural industries.

It has been contended in the past that Economic Geology as compared with general Geology occupied a somewhat lower plane where the pure light of science is slightly dimmed by the smoke of commercialism, but at the present day it may rather be regarded as on a higher plane where the light of pure science is rendered brilliant by the effulgence which emanates from commercial activities and developments directed by the guiding hand of applied science.

## III. - WHAT IS A GEOLOGICAL SURVEY?

----------

Having assimilated the information contained in the preceding chapter as to what Geology really is, the reader is now directed towards the further enquiry as to what is a Geological Survey. The meaning of the word Survey is that commonly implied by its customary use, and the conclusion naturally results that a Geological Survey is a measurement and mapping of the geology of any country. The term has a - - further application in that it is used to indicate the - - - organisation which carries out that measurement and mapping of the geological composition and structure of a country.

A geological survey investigates the details of the geological structure of the State or Country in which its - - operations are carried on. It superimposes on the maps - - - produced by the ordinary survey of the State (if these happen to be in existence, failing which it produces both the ordinary and geological maps) the details of the geology, and as a - - result evolves complete geological maps of the State. It uses the information thus obtained, in the investigations and research in the economic geology of the State, the complete elucidation of which is its ultimate aim and the main reason for its - - - existence.

Economic Geology is pre-eminently an appropriate field for Government activity. The cost of comprehensive studies of mining districts and of the proper presentation of the results is such that, if left to private enterprise, the investigations would necessarily be sporadic, unsystematic and incomplete. The results of thorough economic studies, - - moreover, are of recognised value to the community and that value must always largely depend upon a well-founded confidence in the integrity, impartiality and ability of the members of the scientific corps having the work in charge. That is why a Geological Survey should necessarily be a Government Department. The American people, particularly in mining regions, and in the great arid tracts of the West where Geology is being applied with such signal success to the problems of irrigation, have recognised these facts and have thereby advanced the science of Geology as well as their own interests.

The officers of a State Geological Survey are men of integrity and special training and experience in Geology, mining and engineering, and are debarred from having any financial interest in mining or any operations in which the work of the Geological Survey plays a part. Their work, therefore, is unbiassed and impartial, and the results of their investigations published and issued by the Government can be accepted as authoritative, impartial statements.

## IV. - HOW A GEOLOGIST IS TRAINED.

----------

A modern economic geologist acquires his special - - knowledge by a long process of study, experience and research. His work demands a detailed and exact knowledge of Geology in all its subdivisions and branches, a considerable knowledge of surveying, mining engineering, metallurgy and industrial - - chemistry, as well as a thorough grounding in mathematics, physics and chemistry in addition to some acquaintance with the subjects of botany and zoology. Finally he should be equipped with the capacity of using the English language efficiently and must possess some literary ability, as well as a knowledge of foreign languages, especially French and German.

The training of a Geologist begins, therefore, at school with a general secondary education, special attention being paid to the mathematics and science side. In this way a good foundation is laid for the more specialised training to be received at the University.

At the University the student takes a course lasting from three to four years in those subjects which qualify him for a degree in Science or Engineering. During this course he completes the acquisition of the necessary amount of knowledge of mathematics, physics and chemistry. He also studies closely the subjects of surveying and the several branches of engineering, but his special objective is a detailed and exact knowledge of all branches of Geology, theoretical and practical, together with metallurgy and industrial chemistry, and during the final years of his course specialises in these three subjects.

On the completion of the University course, and on the attainment of his degree, he is what may be termed an - - embryonic geologist; he has acquired the basic foundation upon which his professional knowledge can be erected as a sound and complete edifice. He has in fact learned how to learn and has been specially trained in the methods of scientific research.

The embryonic geologist then enters upon the - - - acquisition of practical experience by working in all kinds of capacities in metallurgical, mining, chemical and geological organisations or works. Concurrently he is extending his knowledge of his specialisation and keeping abreast of current developments in geology and developing his skill in research by the investigations of particular problems arising within his sphere of activities.

After some years devoted to such experience and study there developes from the chrysalis stage the fully developed economic geologist adorned with a thorough knowledge of his specialised subject of geology and all its practical applications, showing a high capacity and skill in conducting researches on a scientific basis, possessed of a serviceable acquaintance with metallurgical and general manufacturing processes and having at his service some knowledge of men and affairs.

## V. - WHAT A MODERN ECONOMIC GEOLOGIST KNOWS AND THE WORK HE CAN UNDERTAKE.

----------

The reader who has perused the preceding chapters will have acquired a general conception of the character of the - - information possessed by an economic geologist. It is desirable, however, at the present stage to summarise his attainments whilst proceeding to indicate the kind of work which he can undertake.

A modern economic geologist possesses a detailed - - knowledge of the materials of the earth's crust whether these be rocks, minerals, soils, oil or water. He has a general conception of the architecture of that crust, and an understanding of the causes which have brought about the existing structural arrangements. He can, therefore, apply to any particular area his knowledge of these general principles, and his investigation results in the elucidation of the structural relations of the materials constituting the crust of the earth in that locality, their origin and therefore their extent and value. Particularly he has a special knowledge of the composition, structural - - relations and origin of all of those materials which are of - - service to mankind, - Ore Deposits, coal-seams, oil-shale, oil, brick, pottery, porcelaim and china clays, limestone, cement materials, ornamental and building stones, sands for glass making and foundry purposes, underground waters - all of these the econbmic geologist has intimately studied and knows their modes of occurrence, origin and general character , and particularly the signs by which their presence may be ascertained and their extent predicted. He is conversant with the value of these materials and the cost of extracting them from the earth and of converting them into finished products and is therefore able to formulate a reliable estimate of their value from a commercial and industrial point of view. To do this he calls to his service the knowledge he acquired during his training, and subsequently thereto as described in the preceding chapter, of surveying, metallurgy, mining engineering and industrial chemistry. His knowledge of mathematics and physics are used as essential - - factors in all of these technical subjects, and his acquaintance with botany and zoology is indispensable in the palaeontological department of his main subject. His knowledge of foreign - - languages enables him to read at first hand the results of - - coincident researches in other lands as this is necessary to - - enable him to keep abreast of modern progress, and he does this by constant study of the published accounts of it in his own language and that of the more progressive of foreign countries.

It is not realised by the general public that a - - - geologist is a specially trained professional man in every way comparable with a medical practitioner. Just as the latter is able, by a comparatively short examination, to diagnose the complaint of his patient, so the economic geologist can often ascertain the salient features of an occurrence and form an estimate of its value after a very short examination. This is because both are professional men specially trained in what to observe and the logical deductions to be made from the - - observations.

The modern economic geologist can therefore undertake the examination of all mineral and rock deposits, form an - - estimate of their potential value, and indicate the best methods of their utilisation. He can advise on the suitability of proposed sites for engineering undertakings and give warning of the difficulties to be anticipated. He can determine the existence of underground water supplies and can direct boring operations therefor. He can supply the agriculturist with the essential information in regard to the character of the sub-soil and underlying rock and their bearing on the nature and enduring properties of the soil, which is coming into greater demand as the development of agriculture on scientific lines proceeds. Finally his knowledge of the component materials of the earth's crust enables him to compile statistics as to the mineral resources of his country, their rate of exhaustion and the best means desirable for their conservation.

This is the duty of the agricultural department

# VI. - THE NECESSITY OF THE UTILISATION OF THE GEOLOGICAL KNOWLEDGE IN THE DEVELOPMENT OF A COUNTRY.

--------

The development of any country depends on the - - development of its natural resources. All of the natural resources are derived from the soil, sub-soil and underlying rocks of the earth's crust. This will be perfectly - - understood by the reader in regard to minerals, rocks, clays, oil, underground water, &c., but may not seem so obvious in the case of timber, wool, wheat and agricultural products in general. When it is remembered, however, that all of these owe their existence and growth to the soil and sub-soil it will be readily agreed that practically all of our natural resources are either part of the earth's crust, or are - - dependent upon it for their food, nourishment and growth.

Since geology deals with the materials of the earth's crust in all their variations, so it is obvious that in the development of our natural resources, geology must play a very important part. Whether it be a consideration of the - - - character of the soil and sub-soil as affecting the advisability of irrigation, the suitability of the rock formation as a - - foundation of a proposed dam, the hardness and general - - - character of the rock to be excavated in a railway cutting or tunnel, the extent and value of a coal field, the possibility of obtaining artesian water, the size, value and permanency of an ore-deposit, it is the geologist who must deal with the - - question and apply his knowledge of the principles of geology. It is clear, therefore, that the proper development of our natural resources cannot take place without the application of geological knowledge.

# VII. - ILLUSTRATIONS OF THE WASTE OF TIME AND MONEY BECAUSE OF THE FAILURE TO UTILISE GEOLOGICAL KNOWLEDGE.

-----------

It will serve a useful purpose at the present stage to indicate some cases in which failure to apply geological knowledge has led to disastrous results and failures. Many scores of cases could be quoted but a few will be given to illustrate the range of activities in which the application of geology is essential and failure to apply it is courting disaster.

(1) The attempt to locate oil by boring on Bruni Island in recent years in spite of the advice of geologists that there was no chance of oil being found. Money was wasted on this attempt which could advantageously have been spent on other ventures.

(2) Some years ago a considerable sum of money was spent at Railton boring for coal. The bores were put down in Silurian Limestone which underlies all coal-measures showing that if geological advice had been sought that sum of money would have been saved.

(3) During boring operations in the Mersey Shale Field, bores were located on Pre-Cambrian Schists which the Geologist knows carries no shale and has no shale beneath it. Much money was thus wasted.

(4) Certain individuals have spent much time searching for coal in the vicinity of Launceston. A knowledge of the geology of the district shows this search to be quite hopeless.

(5) Fruitless efforts have been made to locate in - - various localities the source of alluvial deposits in places where no veins occur, through failure to recognise the changes in geography in the evolution of the river systems.

(6) Much time and money have been wasted on the West Coast of Tasmania in searching for the gold reefs which were supposed to give rise to the alluvial gold found there, whereas the origin of that gold is in the sulphide ore-bodies.

(7) In several mining districts in Tasmania remains of batteries and smelting plants are to be seen which were - - erected to treat tin or copper ores of which quantities - - available were altogether insufficient to justify the erection of smelters or machinery. The application of the knowledge of geology would have prevented most of these disasters.

(8) Much time and money has been spent in prospecting for coal seams in the Cambrian rocks of South Australia which could all have been saved by calling in the Geologist..

(9) The present trouble in regard to the Ridgeway - - - Reservoir in Hobart would not have arisen if the Geologist had been consulted in regard to the dam site, for he certainly would have condemned it.

?

(10). The trouble with many railway cuttings in Tasmania could have been avoided if the Geological Survey had been consulted. A noteworthy example is the cutting between Devonport and Lillico. In addition much trouble has arisen in regard to harder rock being encountered in cuttings &c. than was expected, which would have been foreseen by the Geologist.

(11) The great failure of the dock at Fremantle could have been avoided if geological advice had been obtained.

(12) The number of dry wells throughout the Commonwealth testify to the failure to apply geological knowledge and - - carry out geological investigations in regard to water-supply.

(13) The failure of irrigation in certain parts of - - California owing to the lack of preliminary investigation of all the facts of soil, sub-soil, water analysis &c. was a salutary lesson.

These examples could be elaborated upon indefinitely from all parts of the world, but the above will suffice to indicate the failures and waste of money and time owing to the essential geological knowledge not having been applied to the problems.

## VIII. - ILLUSTRATIONS OF THE BENEFITS AND SUCCESS THAT HAVE RESULTED FROM THE APPLICATION OF GEOLOGY TO PRACTICAL PROBLEMS.

-----------

Pages could be filled descriptive of the benefits that have accrued by applying geology to practical problems, but it will suffice for the purposes of this publication to indicate a few of the more prominent achievements of economic geology together with a few Tasmanian examples.

(1). In England the underground extension of the Midland Coal-field beneath the younger rocks was deduced as the result of geological research and subsequently proved by boring. This result was of paramount importance to the industrial welfare of Great Britain. The South Eastern coalfield near Dover was similarly discovered as the result of geological research where the surface indications gave no indication of coal whatever.

(2). The Pas-de-Calais Coal-field in France was discovered and has been explored purely as the result of geological - - investigations.

(3). The tracing eastward and southward of the Rand banket (gold-bearing bed) of South Africa under a cover of 12,000 feet of totally dissimilar beds was the outcome of a systematic - - geological survey of the whole area.

(4). The description of the characteristic features and mode of origin of the silver lodes of Cobalt in Canada written right at the beginning of the mining operations had a very great influence on the history of the field and was of untold value.

(5). The work done by Van Hise and Leith on the Iron-ore Deposits of the Lake Superior District U.S.A. in regard to their extent and origin is largely responsible for the position that district occupies to-day in the iron and steel production of the United States.

(6). The work done by the United States Geological Survey in water-supply and irrigation is recognised throughout the States as of the greatest value and as quite indispensable.

(7). The application of Geology to the problem of driving the Simplon and other tunnels has been the means of making their completion possible as the engineers were thus able to know exactly what was ahead of them and the difficulties they had to provide for and deal with.

(8). The systematic investigations made in connection with the Catskill water-supply of New York in regard to the dam sites and storage basins saved many hundred of thousands of dollars, as has been proved by the failure of dams under similar -- - - conditions erected without geological advice.

(9). The operations of cutting the Panama Canal were - - materially assisted by the results of the investigations of the staff of Geologists employed.

(10). The discovery of the Coal-field under Sydney was the direct outcome of the geological survey carried out by Professor T.W.Edgeworth David.

(11). The investigation of the Mersey Shale-field by the late W.H.Twelvetrees disclosed the true nature of the oil-shale and made it possible for the first time to estimate tonnages.

(12). The exposure by A.Montgomery of the Huxley Fraud saved a loss of much greater magnitude than actually occurred.

?

(13). The examination and demonstration of the true nature of the occurrence of bornite at Bridgewater in the Permo-Carboniferous Conglomerates saved the useless expenditure of capital.

(14). The examination of the King Island Steelite - - - deposits by L.L.Waterhouse disclosed their true value and - - initiated a profitable mining enterprise.

?

(15). The examination of cement-making materials has - - supplied the requisite data on which manufacturing enterprises can be based. The Ida Bay Cement Company has been initiated as the result of such investigations and reports.

## IX. - THE ORGANISATION AND EQUIPMENT OF THE GEOLOGICAL SURVEY OF TASMANIA.

---

The Geological Survey of Tasmania is a branch of the Mines Department. It is in charge of the Government Geologist who acts as Director and who is responsible to the Permanent Head of the Mines Department - the Secretary for Mines.

The Geological Staff consists, in addition to the - - - Government Geologist, of three assistant Geologists. These are designated as Assistant Government Geologists and are responsible officers carrying out their investigations with the aid of field assistants who are engaged on the fields being examined. They work under the general direction of the Government Geologist, but being highly qualified and trained Geologists considerable responsibility is delegated to them.

The Laboratory Staff consists of an Analytical Chemist and an Assistant designated respectively Government Assayer and - - - - Laboratory Assistant. The Government Assayer is responsible to the Government Geologist and is in charge of the laboratory under the general direction of the latter.

The Drafting Staff consists of the Government Assayer whose full designation is Government Assayer and Draftsman. At present all the Assistant Geologists do their own drafting.

The Clerical Staff consists of a Clerk and Typiste - - - entrusted with the carrying out of all clerical work and typing,&c.

The Geological Survey possesses a technical staff with a wide range of experience, and are qualified and sound guides in the various geological, mineralogical, metallurgical, chemical, and industrial problems which present themselves for solution.

The Geological Survey is located in Launceston in the Public Buildings. The total accomodation occupied there consists of eleven rooms. Five of these are on the first floor and here the geological and clerical staff are located. The whole of the top floor is taken up by the Laboratory which is complete and up-to-date in every particular, including complete mechanically driven crushing and grinding apparatus, motor-driven blow pipes &c., and contains a well equipped photographic dark-room fitted with micro-photographic camera.

There is an up-to-date library consisting of about 6,000 volumes of works on all branches of geology, metallurgy, chemistry,&c

The geological survey collections of rock, minerals &c. are displayed at the Victoria Museum,Launceston. These are the type collections for Tasmania. Such an arrangement has been made - - - possible by the assistance of the Launceston Municipal Council in - - - permitting the Geological Survey to utilise part of their Museum and some of their show cases.

The Survey is well equipped with microscopes, surveying instruments, drawing instruments, a large drawing table measuring 18 feet by 4 feet 6 inches, rock breaker, mineral cabinets,&c.

## X. - THE WORK THE GEOLOGICAL SURVEY UNDERTAKES AND HOW IT SETS ABOUT THE SOLUTION OF PARTICULAR PROBLEMS.

Having indicated in the previous chapters what the organisation and equipment of the Geological Survey of Tasmania are, and also what the scope of geology in general is, and what special knowledge a geologist possesses, we can now proceed to describe what are the specific activities of the Geological Survey. When these have been presented there will be given a typical subject for investigation, and the manner of undertaking it and the carrying of it out will be described. This will serve as an illustration of the methods used and the - - - - interdependence of all branches of geology and the necessity of their utilisation in solving practical problems.

The following are the various investigations and - - researches undertaken by the Geological Survey.

### A. - Ore Deposits and Mining.

The widest scope for the services of the Geological Survey is in the field of mine development, and the prospecting for and search for ore deposits of all kinds. The geologist is becoming more and more necessary to the everyday business of developing mining properties. No efficient mine manager can as a matter of fact neglect to recognise the value of his - - services. His is the duty of replacing the "divining rod" and the rule of thumb of the mine foreman; of saving the - - foolish expenditure of money in useless driving of tunnels and levels and of sinking costly shafts in a vain attempt to fathom Nature's secrets by force of drill and explosive, with no - - knowledge of the fundamental laws governing the deposition of the minerals and metals in the earth's surface, in rocks, in veins or in irregular deposits.

There seems, therefore, no question as to the place in the economy of mining which the geologist has earned for himself. He is no longer a luxury, he is a necessity. This fact is recognised by a considerable number of the largest mines of the world as is shown by the fact that they employ a special geological staff which directs all exploratory and prospecting work. The sooner the mining community as a whole realise this and adopt a similar practice, the better for the interests both of themselves and of the industry.

The feeling, amounting even to suspicion with which geology used to be and still is regarded by some so-called "practical men", is perhaps due to the following causes:- First, there are the nonsensical reports on mines and prospecting shows, made by charlatans who by the use of an obscure geological - - phraseology seek to impose their trite conclusions on the - - - credulity of their employers. Then there are the wearisome lucubrations of the irresponsible faddist who uses the columns of the press to ventilate absurd geological theories. However, geology is not the only science or profession to suffer from the ignoramus and the bore.

The economic geologist studies an ore deposit, its lithological environment, its enrichments and impoverishments and their cause, and finally the faults and dykes that traverse it and their effect. The mining geologist is thus able to trace and define the ore-shoots; to predict their downward extension; to outline the scheme of development and method of mining best suited to their slope, size and trend and structure; to determine the amount and value of ore immediately or - - prospectively available; and to give an opinion based on mineral composition in regard to the most suitable metallurgical treatment.

It is not the policy of the Geological Survey, however, to undertake investigations of particular mines. Its function is to undertake the complete investigation of the ore-deposits of a definite district containing a series of deposits which are sufficiently similar to enable them to be classified as - - - - constituting one group or a series of groups. In order to do this a complete geological and topographic survey of the whole district is necessary which includes the detailed examination and survey of all mine workings and of the ore deposits disclosed therein. In this way the origin of the ore-bodies is discovered and conclusions can then be drawn as to their size, extent and persistency. The effect of these conclusions on the prospects of the several mines can then be discussed and the data in regard to the factors controlling ore-deposition are then in the hands of the geologist directing prospecting and exploratory operations on the particular mines.

The dominating intention, however, is to treat the deposits as a whole, irrespective of artificial boundaries of leases and to arrive at a definite determination of the value of the ore occurrences so that the community as a whole may possess accurate information of the general prospects of the field as a whole. The appraising of the value of a particular property is left to the consulting mining engineer who will have at his disposal the general conclusions made by the Geological Survey.

It is only by proceeding with these investigations in such a systematic way that definite conclusions can be arrived at, so the work of the Geological Survey in developing the mining industry can be best performed by thus carrying out complete investigations of the geology and ore deposits of definite mining districts.

Elucidating as it is doing the whole of the facts- - regarding the origin, mode of occurrence and extent of our ore deposits of all our mining fields, the Geological Survey is - - obviously the body to be entrusted with the prospecting of the future. It will indicate which areas are specially worthy of attention and will see to it that the searching is in the hands of properly trained and qualified men. The Geological Survey has the greatest respect and admiration for those big-hearted prospectors who located our mineral fields, but it is perfectly clear to those conversant with the facts that much of their labour could have been more wisely applied. To minimise this waste of effort and money the direction of future prospecting should be in the hands of the Geological Survey.

## B. - COAL, OIL AND NATURAL GAS.

The complete survey of our coal-fields and the ---- - - calculation of the reserves of coal possessed by the State is an important function of the Geological Survey. Our coal-fields are little known, and there are many problems connected with the determination of the actual area occupied by the coal-seams which are purely geological and which must be solved before a correct estimate can be made of the amount of coal available in Tasmania.

Research for oil and natural gas is one which - - - - necessitates a thorough knowledge of the structural geology of the country and therefore the services of the Geological Survey are essential in this connection.

### C. - Artesian and Sub-Artesian Water-Supplies.

In considering the supplying of the relatively dry Midlands and the East Coast with water for general purposes and for irrigation, the possibility exists of the existence of - - underground water utilisable in this connection. The thorough investigation of this is a necessity before any commitment be made in regard to bringing water from the Central Plateau. The Geological Survey is the organisation qualified to carry out such work, and in other parts of the world the investigation of underground water-supplies is an important function of the Geological Surveys, and it must inevitably be so in Tasmania also.

### D. - Soil Survey and Irrigation.

The investigation of the soils and sub-soils as regards chemical and mechanical composition and mode of origin is one which comes within the scope of the Geological Survey. The existence of a map showing the character of the soils throughout the State is badly needed and the want of it is very badly felt. It should be the function of the Geological Survey working in conjunction with the Department of Agriculture to prepare such a map.

No

The success or failure of irrigating dry areas is dependent on the character of the soil and sub-soil. Before any area is irrigated, therefore, on a large scale where large sums are involved, a geological survey of the soil and sub-soil should take place. This is the practice adopted in the United States, India and other places after many disastrous failures had demonstrated its necessity.

Outside the present scope of the Dept

### E. - Engineering Undertakings.

To place any engineering work on a proper basis for the calculation of cost the geological factors as affecting the proposal must be known. If a dam is to be constructed it must be known whether the bed-rocks forming the foundation are strong enough to sustain the load without giving way. If it is - - - proposed to store water behind the dam it should be known whether the rocks constituting the bottom and sides of the storage basin will carry water without appreciable leakage. If a tunnel, a canal or a railway cutting is to be made, information should be in the hands of the engineer as to the exact character of the rock which it will be necessary to penetrate and excavate, as otherwise he cannot even approximately estimate costs. In harbour works, as in all excavations of any magnitude, an - - - investigation as to the liability of land slides should be made.

In all of these activities therefore - dam construction, railway projects, water storage and water supply, harbour - - - construction and the erection of large buildings - the services of the Geological Survey are essential and activities in this direction must constitute an important part of its functions.

If the Geol Survey undertake this work it will have very little time for mining geology.

### F. - Teaching of Geology and Geography.

Since the Geological Survey is the organisation which is investigating the geology and geography of the State and is collecting and correlating all the information pertaining - -

thereto, it seems clear that it should play an important part in the teaching of those subjects both in our primary and secondary schools and the University. Very close liaison should exist between the Geological Survey on the one hand and the Education Department and the University on the other. The Geological Survey has available its type and general collections and also all the intimate details of geology and geography which it is not possible to publish, whilst the University can produce students who with the leadership of their lecturer under the general direction of the Geological Survey could do much towards the elucidation of many geological problems. The ideal arrangement would be the combination of a School of Geology at the University with the Geological Survey in the one building and under the one head.

As existing arrangements stand the Geological Survey plays an important part in prescribing details of examinations in Geology by the University, and supplies to all secondary schools in Tasmania complete suits of rock, mineral and fossil specimens for the teaching of geology and geography.

## G. - Statistics of Mineral Resources.

An important function of the Geological Survey is the compilation of the Resources of the State in respect of the various metals and minerals. Possessing as it does the information in regard to the deposits of these minerals, their extent, value and persistency, the Geological Survey is specially equipped and qualified to compile such descriptions and statistics. The importance of such compilations is of inestimable value in taking stock of the resources of the State and in enabling sound decisions to be made in regard to controlling their utilisation and rate of exhaustion.

## H. - Assays and Analyses.

The Geological Survey Laboratory being completely equipped for all classes of inorganic work, the Geological Survey can undertake to make assays of all ores and analyses of all minerals, rocks, clays, water, coal, oil-shale &c. These assays and analyses are made for the nominal fee of one shilling for each determination, the object being to provide an easy means of having everything tested that might possibly be of value.

Tests are also made of the calorific values of coals, and clays are tested in regard to their suitability for porcelain &c. In fact the laboratory is equipped to carry out all analytical and testing work in connection with the work of the Geological Survey and likely to be required by the general public.

Calorific tests are not made. The dept has not yet purchased a calorimeter. Tests of soils, water, manures &c are not made.

Having thus described the work which the Geological Survey can undertake it will be instructive to indicate how a specific geological problem is tackled and the methods used in arriving at a solution. A simple problem will be taken, but the methods used will be indicative of those applied in greater detail and elaboration to complex problems.

Problem. - It was desired to know whether the exepnditure of money for boring for coal at Wynyard was justifiable. Fragments of coal had been found in the neighbourhood in sinking wells, &c., and it was thought that coal-seams underlay the area.

Solution.- The country in the vicinity of Wynyard was examined and mapped out and all the geological formations were determined and entered on the map. It was found that the fragments of coal had been discovered in a deposit of shingle and gravel about ten feet thick which represented a raised beach deposit containing as it did typical beach shingle mingled with broken sea-shells. The coal, therefore, could have come from an out-crop of coal near the beach, or it might have been brought down by rivers from further up country. To determine this point the rock underlying the shingle was - - examined. This was found to consist of a series of - - - - conglomerate beds and mud-stones. The question then arose: Does this conglomerate bed overlie the coal-measures which we know are confined to one definite geological horizon, or is it below the level at which coal-seams occur? It was observed that the conglomerate had contained boulders of granite. This would prove that the conglomerate was younger than the granite mass which supplied the boulders. But as there are two granites in Tasmania of different ages, one very old of Cambro-Ordovician age, and one much younger of Devonian age, it was necessary to determine which of these was present, or whether both were present. Accordingly samples of the boulders were taken and cut down to transparent slides which were examined microscopically by petrographic methods as this is the only way in which they can be differentiated. It was found that both granites were present. The conclusion resulted, therefore, that the conglomerate was younger than the younger granite, that is that it was younger than Devonian, and therefore of Permo-Carboniferous age or less, and might have coal in, immediately under, or above it. No further decision could be made on the evidence of the constituent boulders of the conglomerate.

Accordingly search was made in the mudstones - - - associated with the conglomerate for fossils, with the result that in the mudstones overlying the conglomerate imprints of shells were found. These studied by palaeontological methods were proved to be Spirifera Tasmaniensis and Pleurotomaria Morrisiana which are known to the palaeontologist as being characteristic of the Permo-Carboniferous system which carries coal-seams in its upper beds. Was the conglomerate, therefore, at the bottom or the top of the Permo-Carboniferous System? It was obvious that the fossiliferous beds and the conglomerates were conformable and part of the same series because of their correspondence in dip and the fact that we had already proved the conglomerate to be younger than Devonian, and therefore of Permo-Carboniferous age or less. An examination of the general character of the conglomerate showed that it had all the characteristics of the basal glacial conglomerates which occur at the base of the Permo-Carboniferous system throughout Australia and Tasmania. The evidence was very clear, therefore, that the rock underlying Wynyard was the glacial conglomerates forming the base of the system carrying the coal measures. The country inland from Wynyard was then traversed, and in - - - climbing upwards beds continuously higher in the Permo- - - - Carboniferous system were encountered until twelve miles away at Preolenna the coal seams themselves were encountered thus accounting for the occurrence of coal fragments in the raised beach deposit at Wynyard.

The evidence was thus conclusive that the beds at Wynyard were those which are below the coal seams, and therefore that it was quite hopeless to expect coal in them or below them. Consequently the recommendation was made that the expenditure of public money was not justified.

It is seen in this simple investigation how the -- various branches of geology are applied and utilised in solving a practical problem, and it incidentally serves to show that the searching for fossils so often regarded by the general public as a useless waste of time, has a definite practical value.

## XI. - HOW THE GEOLOGICAL SURVEY PUBLISHES THE RESULTS OF ITS WORK.

---------

Having indicated the character of the work performed by the Geological Survey, it is now desirable to describe how it makes the results of its investigations known to the public. It accomplishes this by preparing descriptions of the - - - investigations and the results thereof which are published in various forms under the general classes of Bulletins, Reports, Records, Mineral Resources, Mines Department Circulars, Press Digests and Assay Certificates. These are printed and - - distributed to the public free on application to the Mines - - Department or the Geological Survey, and in addition are sent to individuals and institutions all over the world to advertise our resources and to obtain valuable publications in exchange.

The general character of each type of publication will now be concisely described.

### A. - Bulletins.

These embody the results of the geological surveys of districts. They are in effect serious monographs on the resources of the districts which they describe, generally containing from 100 to 150 pages of matter. They comprise systematic dissertations on the physiography, stratigraphy, and economic geology of the area, and descriptions of the mining properties. The ore deposits are exhaustively discussed, their structural features, mineralogy, mode of formation and persistency being fully dealt with. The history of mining on the fields receives attention, as also the facilities for - - mining and out-look for the future. These bulletins are - - abundantly illustrated with geological maps and sections, plans of the mines, photomicrographs of ores, photographic views, &c. These works are not ephemeral pamphlets which can be issued in a hurry like an ordinary mining expert's report, but can only be produced by responsible and specially qualified officers working with close and sometimes intense effort; and they possess a permanent value.

It is thought by some that these bulletins contain an unnecessary amount of descriptive and irrelevant matter, but these people are not conversant with the reasons which make it necessary to include all this matter. It must be remembered that a complete and final elucidation of the origin, true - - extent and persistency of ore deposits can only be obtained by the repeated examination of them. If the results of the - - earlier investigations are not put on record they will not be available for future investigations. In addition, if - - - definite statements are made and opinions expressed without giving the grounds on which such opinions are based, then they degenerate into dogmatic assertions which are as valueless to the miner as they are objectionable to the conscientious - - - investigator.

It is realised, however, that a busy man cannot always afford to spend the time necessary to peruse the whole contents of a bulletin, and also that to certain people a great part of it will be more or less unintelligible. In future, therefore, each bulletin will include a concise - - synopsis of its contents and the net results of the - - - - investigation in simple and straightforward language. The main bulletin, however, is available to those who wish to examine and test the justification of the conclusions arrived at.

B. - Reports.

These are descriptions of particular mines or of the more or less complete examination of districts of very limited extent. They are less elaborate than the bulletins. Reports are also sometimes prepared containing an advance statement of the results of the examination of an important mining field which should be made available to the public at the earliest possible moment.

C. - Records.

These deal with matters of purely scientific interest in Tasmanian Geology, but which should be put on record and made available to those carrying out investigations on the subject.

D. - Mineral Resources.

These publications are systematic descriptions of the occurrence of a particular metal or mineral throughout Tasmania. They include descriptions of all the deposits of the mineral or metal, their extent and general character, and the resources of the State in regard to that particular mineral are carefully calculated and clearly indicated.

E. - Mines Department Circulars.

These are designed to indicate to the mining and general public desirable information in regard to certain matters such as the mode of occurrence of and directions for prospecting for certain minerals, or in regard to general questions such as the object of this present circular.

F. - Press Digests.

On the completion of an investigation it is generally desirable to make available through the press the net results of the undertaking to cover the time which will elapse before the complete description can be prepared. These digests are prepared and issued to the press in typed form.

G. - Assay Certificates.

These are issued from the Laboratory to the - - - individuals presenting the samples for assay or analysis, and are treated as confidential by the Geological Survey.

The ~~following is a~~ complete list of the publications of the Geological Survey issued to date is given at the end of this publication. Those marked * are out of print. The others can be had on application to the Director of the Geological Survey.

*No such Officer.*

## XII. - WHAT TO DO IF GEOLOGICAL ADVICE IS DESIRABLE IN MINING, ENGINEERING, MANUFACTURING OR AGRICULTURAL UNDERTAKINGS OR IN REGARD TO UNDERGROUND WATER-SUPPLY.

---------------

Having clearly shown in the preceding pages when and under what conditions such advice is necessary, it now only remains to show the steps to be taken to obtain that advice.

The procedure is this:- Write to the Government Geologist stating the full particulars of the information desired. If the Geological Survey can supply the information without visiting the locality, that information will be supplied in full and definite advice given. If a visit to the locality is necessary you will be written to accordingly and instructed to make an application to the Secretary for Mines for - - - Ministerial authorisation for such investigation. When this authority is granted the investigation will take place and the results and advice trnasmitted to you.

?

XIII. - WHAT TO DO IF A MINERAL OR ROCK IS FOUND, THE NAME OR COMPOSITION OR USE OF WHICH IS UNKNOWN.

-------------

If any substance is found, the nature or use of which you do not know, send it by post to the Government Geologist, Launceston. There is no need to send more than about one pound of any material except in exceptional cases which will be specially dealt with. Mineral and rock determinations are made free of charge. The determination of any metal will cost one shilling. A schedule of charges can be obtained on application to the Geological Survey in addition to the forms to be filled in when the estimation of amount of a metal present is desired.

The result of the determination with the desired advice as to the value of the substance will be posted to you.

Loftus Hills M.B.E., M.Sc.
Government Geologist.

Launceston
27th February 1920

## GEOLOGICAL SURVEY OF TASMANIA

List of Publications.

---

BULLETINS

No. 1.- The Mangana Goldfield, by W.H.Twelvetrees ......... 1907
No. 2.- The Mathinna Goldfield, Part III, by W.H.Twelvetrees 1907
No. 3.- The Mount Farrell Mining Field, by L.Keith Ward, B.A. B.E. ........................................ 1908
* No. 4.- The Lisle Goldfield, by W.H.Twelvetrees .......... 1908
No. 5.- Gunn's Plains, Alma, and other Mining Fields, North-West Coast, by W.H.Twelvetrees ............... 1909
* No. 6.- The Tinfield of North Dundas, by L.Keith Ward, B.A., B.E. ........................................ 1909
No. 7.- Geological Examination of the Zeehan Field, Preliminary Statement, by W.H.Twelvetrees and L. Keith Ward, B.A., B.E. ...................... 1909
No. 8.- The Ore-bodies of the Zeehan Field, by W.H.Twelvetrees and L.Keith Ward, B.A., B.E. ........... 1910
No. 9.- The Scamander Mineral District, by W.H.Twelvetrees 1911
No. 10.- The Mt.Balfour Mining Field, by L.Keith Ward, B.A., B.E. ........................................ 1911
No. 11.- The Tasmanite Shale Fields of the Mersey District, by W.H.Twelvetrees ........................ 1911
No. 12.- The X River Tinfield, by L.Keith Ward, B.A., B.E. 1911
No. 13.- The Preolenna Coalfield and the Geology of the Wynyard District, by Loftus Hills, M.Sc. ..... 1913
No. 14.- The Middlesex and Mt.Claude Mining Field, by W. H. Twelvetrees .............................. 1913
No. 15.- The Stanley River Tinfield, by L.Lawry Waterhouse, B.E. ........................................ 1914
No. 16.- The Jukes-Darwin Mining Field, by Loftus Hills, M.Sc. 1914
No. 17.- The Bald Hill Osmiridium Field, by W.H.Twelvetrees 1914
No. 18.- Geological Reconnaissance of the Country between Cape Sorell and Point Hibbs, by Loftus Hills, M.Sc. ........................................ 1914
No. 19.- The Zinc-Lead Sulphide Deposits of the Read-Rosebery District, Part I (Mount Read Group), by Loftus Hills, M.Sc. ......................... 1914
No. 20.- The Catamaran and Strathblane Coalfields and Coal and Limestone at Ida Bay, Southern Tasmania, by W.H.Twelvetrees ............................ 1915
No. 21.- The South Heemskirk Tinfield, by L.Lawry Waterhouse B.E. ........................................ 1915
No. 22.- Catalogue of Publications issued by the Government of Tasmania relating to the Mines, Minerals and Geology of the State, to 31st December, 1914, compiled by W.H.Twelvetrees ................. 1915
No. 23.- The Zinc-Lead Sulphide Deposits of the Read-Rosebery District, Part II (Rosebery Group), by Loftus Hills, M.Sc. ......................... 1915
No. 24.- Reconnaissance of the Country between Recherche Bay and New River, Southern Tasmania, by W.H.Twelvetrees ........................................ 1915
No. 25.- The Gladstone Mineral District, by W.H.Twelvetrees 1916
No 26.- The Tin Field of North Dundas, by Hartwell Conder, M.A. (Camb), A.R.S.M. (London) .............. 1918
No. 27.- The Bangor Mineral District, by W.H.Twelvetrees .. 1918
No. 28.- The North Pieman, Huskisson, and Sterling Valley Mining Fields, by A.McIntosh Reid ............ 1918
No. 29.- The Mining Fields of Moina, Mt.Claude, and Lorinna, by A.McIntosh Reid ......................... 1919
No. 30.- The Mt.Pelion Mineral District, by A.McIntosh Reid 1919
No. 31.- The Zinc-Lead Sulphide Deposits of the Read-Rosebery District, Part III (Metallurgy and General Review), by Loftus Hills, M.Sc. .............. 1919

## REPORTS



## RECORDS



## MINERAL RESOURCES

MINES DEPARTMENT CIRCULARS.

| | | |
|---|---|---|
| * No.1. | Bauxite. A Source of Aluminium. Information for Prospectors and Others, by W.H.Twelvetrees | 1917 |
| No.2. | The Search for Petroleum in Tasmania, by W.H. Twelvetrees............................ | 1917 |
| No.3. | Prospecting for Mercury in Tasmania, by W.H. Twelvetrees............................ | 1918 |
| No.4. | Diamonds in Tasmania, by W.H.Twelvetrees....... | 1918 |
| No.5. | The Application of Geology to the Development of the Natural Resources of Tasmania, by Loftus Hills M.B.E., M.Sc. | 1920. |

B82831

*Geological Survey Office,*

*Launceston,* 27th Feby., 1920.

W.H.Wallace, Esq.,
Secretary for Mines,
H o b a r t.

MINES DEPARTMENT
97/4443
26 FEB 20
HOBART

Dear Sir/

I beg to submit for publication a Circular dealing with the work and functions of the Geological Survey. This has been prepared in accordance with your letter of 9th Octr. 1919. It is designed to bring the aims and objects and - - usefulness of the Geological Survey Branch of the Mines - - Department prominently before the Public. It has been written in a popular way to make it perfectly intelligible to the - - average public. It explains what Geology is; how the - - Geologist is trained; the work he can undertake; the different types of investigation undertaken by the Geological Survey; the manner in which the results of these are published; and also contains instructions to the general public as to what to do if they require the assistance of the Geological Survey.

I beg to suggest that it be published as a Mines Department Circular. Its distribution will be confined to Tasmania with perhaps a few special copies sent to various parts of the Commonwealth. The Municipal bodies and - - organisations throughout Tasmania, as well as Members of - - Parliament and other prominent people, should each receive copies. The distribution, therefore, will be on a different basis from that of other publications of the Geological Survey. I beg to suggest that between now and the time of its issue the Geological Survey should prepare a list of those to whom it should be sent with most advantage to the Department and the State.

The Circular is, in fact, to act as an advertisement for the Department, and as such the number of copies should not be limited - I would suggest about the same number as our more important Bulletins.

The Manuscript I am forwarding under separate cover.

Yours faithfully,

Loftus Hills
Government Geologist.