'Uniformity in Geological Reports' (1917) by Josef Theodor Erb, petroleum geologist and manager (1874–1934)

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Abstract: One hundred years ago, standards in geological report writing were formalized within the Royal Dutch Shell Group. Chief Geologist Josef Theodor Erb defined these standards in an internal report aimed at geologists working for Shell subsidiaries. His purpose was to raise the level of scientific reporting and to provide a measure of uniformity in geological reports sent to head office from all parts of the world. Ultimately, 'Uniformity in Geological Reports' was to allow the chief geologist to readily identify and follow-up on the better business opportunities. With time, Erb's report developed into the Shell 'Standard Legend'. Erb's career is symptomatic of a developing company culture, which he embraced as his life's goal. Realizing the shortcomings of this narrow personal philosophy of life may have been at the root of the mental problems that led to his death.

An account of the career of Josef Theodor Erb (Fig. 1) has been given in the form of an Obituary and a Memorial by, respectively, H. Hirschi (1935) and W. van Waterschoot van der Gracht (1935). Here, the life of this Swiss geologist, turned member of the board of directors of the Royal Dutch Shell Group, is considered in more detail (see also Jonker & van Zanden 2007 and Gisler 2014).

Born on 23 February 1874, Erb entered the Swiss Polytechnic School in Zürich at the age of 19 and pursued studies in natural history sciences. In December 1899, he completed a doctorate in geology at the University of Zürich, where he studied under Professors A. Heim and U. Grubenmann; his dissertation was about volcanic rocks ('Die vulkanischen Auswurfsmassen des Höhgaus'). It was during his formative years that the oil industry experienced its first boom and fuelled the nascent car industry.

His university studies completed, Erb entered into short-term employment with the Koninklijke Nederlandsche Petroleum Maatschappij as one of its first recruits and was sent to Sumatra on a mission in May 1900. After three years of fieldwork in the jungle, mapping geological formations and learning about the search and production of oil, Erb fell ill with malaria and was sent back to Europe on medical grounds. While convalescent, he wrote an account of his observations on the geology and coastal morphology of SW Sumatra (Erb 1905) and followed a course in economic geology. In 1905, fully recovered from the bout of malaria, Erb was sent to Java on a six-month mission.

Over the period 1907–11, working now on behalf of the newly formed oil and production company Bataafsche Petroleum Maatschappij (BPM), Erb was as much a world-travelling geologist as one can be today! Employed as a freelancer and hired from one assignment to the next, he visited the main oil-producing regions of the globe to assess prospective sweet spots, scout for concessions and companies, buy properties, and start operations. In a few years, Erb had travelled through Europe (Romania, Poland and Ukraine), North Africa (Egypt), North America (Oklahoma, Mexico), Russia and the Far East again. At the time, the demand for oil was increasing exponentially due, in large part, to the booming automobile industry; by 1910, nearly half a million cars were already on the streets in the USA, up from a mere 8000 in 1910 (US Department of Transportation 1997).

To give today's reader a flavour of what travelling was like for Erb, let us consider his 1909 journey from London to Miri in Borneo, as he accompanied Charles Hose, Resident (Chief Officer) of the Fourth Division of Sarawak. Departing from London, it took 16 days of uninterrupted rail travel, crossing Siberia, to reach Shanghai. From there, a further two weeks of various boat journeys were needed to eventually reach Miri. Inevitably, unexpected things happened: as Erb and Hose travelled on the Trans-Siberian Railway, they shared a compartment with

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Fig. 1. Portrait of Josef Theodor Erb, generally referred to as Dr Erb.

two sleeping berths. Having stopped in Irkutsk for two days, Hose decided to purchase three live seals from Lake Baikal, had them packed in osier cages and then put them on the luggage racks in their cabin. Hose reported (Hose 1927) that Erb 'for one moment … seemed perturbed, but he was a polite man and a good friend of mine'. Later, apparently, 'Erb now showed himself a whole-hearted supporter of the scheme and positively welcomed our strange fellow-passengers'. The three seals died shortly after: Hose skinned them on the go and threw their flesh out of the train window.

In 1910, the Miri oil field (Sarawak, Borneo) was discovered based on Erb's geological mapping and selection of a drilling location (Sorkhabi 2010; Wannier *et al.* 2011). This significant discovery led to the establishment of a new company, the Sarawak Oilfield Ltd. The Miri Field was eventually described as 'the most prolific oil-field in the whole of the British Empire' (Hose 1929), a pompous and self-gratifying comment by the person who alerted the Shell Group to the oil potential in Miri.

In January 1911, recognizing his outstanding services and noting that he was seriously overworked, Henri Deterding, Chairman of the Royal Dutch Shell Group, granted Erb a formal position in the company ('definite arrangement') and at the same time asked him to take four months' leave.

With its business rapidly expanding and more geologists being employed, BPM established a Central Geological Department in 1912, which was headed by Erb. Both the creation of a geological department and that of a chief geologist position at its head were ground-breaking new institutions in the oil industry. In his new role, a pressing issue for Erb was to ensure business continuity in the central office when chief experts were engaged on surveys and visits abroad. During the summer of 1913, between two visits to the Middle East, Erb set up a small department in The Hague in the Netherlands to address this bottleneck. This new department initially concentrated on exploration activities, but with time, as the know-how was expanding, it devoted also much of its activities to development work in producing fields (Jonker & van Zanden 2007).

In 1915, Erb acted as chief negotiator for the Shell Group to acquire private holdings in the Oklahoma Healdton Field. His frequent travels abroad made it difficult to supervise the new staff required by the expanding central geological department. One area of special concern were the shortcomings in the preparedness of geology students and young engineers freshly recruited from universities, which required the company to give them practical training for at least another year. Throughout his tenure as chief geologist and while in central office, Erb personally guided young recruits and company geologists in the practical aspects of petroleum geology.

At the time, a fundamental issue for Erb was the task of evaluating in a coherent manner the largely unstructured and often incomplete geological reports arriving at the central geological department from all parts of the globe. The lack of systematic criteria in compiling geological and petroleum data hampered comparisons between opportunities; it made it difficult for informed decisions to be made and for the better investment proposals to be followed through. It is Erb's greatest technical legacy to have single-handedly defined reporting standards in geological reports: initially published in 1917, his company report 'Uniformity in Geological Reports' was sent to all Shell subsidiaries, eventually leading to streamlined communication with the central office.

By the end of World War I, the number of staff of BPM amounted to nearly 460 and Erb's geological department was the only fully functional unit within the entire Royal Dutch Shell Group (Jonker & van Zanden 2007), proof of his organizational skills. This largely enabled BPM to achieve the extraordinary growth that the company experienced in the 1920s.

In April 1921, in recognition for his outstanding services over 20 years, Erb was elected as one of four new managing directors of the Royal Dutch Shell Group and he took up Dutch nationality on that occasion. In his new capacity, he pursued the application of emerging new technologies to support the search for oil. Following a trip to Germany in 1921, Erb introduced the torsion balance into the

Shell Group as a new geophysical tool to identify subsurface structures. The company organized training in the use of the torsion balance, and survey teams were deployed in all main areas of operation. The use of a torsion balance to detect buried structures with no surface expression was particularly successful in Brunei, where the initial result 'seems to indicate at least one anticline below the swamp deposits' (Harper 1975). This led to the discovery of the giant Seria oil field in 1929. Soon after the introduction of torsion balances in the company, other exploration techniques were introduced through the Central Geological Department in Shell: micropaleontology became an established tool in the early 1920s, formalized in a sub-department in 1924 (Jonker & van Zanden 2007); the refraction seismograph was tested as early as 1923, but was replaced by the reflection seismograph in 1929; the magnetometer and the gravimeter were used in the early 1930s, as was the electrical well-logging method (Beaton 1957).

In 1929, Erb resigned from his position in order to join the supervisory board of the Royal Dutch Shell Group. This required him to travel frequently, particularly to the USA, Mexico and Venezuela, but also to the East Indies and Sarawak. Developing mental problems, leading progressively to a state of depression, marked his final years. The severe economic downturn and financial crisis of the 1930s may have added to his woes. Erb passed away on 24 October 1934, aged 60, while on service in The Hague.

'Uniformity in Geological Reports' (1917)

In his Memorial to Erb, W. van Waterschoot van der Gracht (1935, p. 309) wrote:

> It is greatly to be regretted that a practical scientist of such ability and exceptional experience as Dr. Erb, had practically no opportunity to leave publications accessible to the public.

Indeed, mainly because of his position, Erb was bound by confidentiality and, having only authored internal company reports, his scientific legacy remains unknown. Besides 'Uniformity in Geological Reports', Erb's only other report available in the Shell technical archives is a geological and commercial evaluation of the Wyoming oil fields (Erb 1918). Both of these documents have been 'unearthed' as part of a personal project to unravel Erb's career. Other reports authored by Erb (e.g. on the Miri oil field) are no longer in the company's archives.

Here, his report 'Uniformity in Geological Reports' (1917) is brought to light for the first time; in some way, it is a precursor to the Shell 'Standard Legend', but the emphasis is less on the use of symbols than it is on the organized structure of technical reports and their content. Following the 1917 publication by Erb, Shell issued the 'Standard Legend for Field Sections' (1932), the 'Standard Legend, Exploration and Production Departments' (1954), and further publications of the same with addendums and updates in 1956, 1958, 1976, 1995, 2002, 2012 and 2014.

Erb's report is an internal company document, machine-typed, 37 pages long with 13 folded plates, following American spelling (e.g. 'color', 'organization', etc.). Surprisingly, he finished writing it in Nyon, a town near Geneva, on 17 April 1917 while World War I was still being fought.

The content includes an introduction, a chapter about 'the written report', a 29 page-long chapter about maps, sections and other graphic representations (topographical base maps; representation of geological features on the map; symbols for marking local features on geological maps; local and generalized stratigraphic sections, structure and well sections; diagrams and photographs), and conclusions. As an example of Erb's writing, p. 19 of the report is reproduced in Figure 2.

The 13 tables cover the colour scheme, patterns and abbreviations for time- and rock-stratigraphic units (plates I–IV), symbols for fossils, hydrocarbon (HC) indications, structural geology and wells (plates V–VII: see Figs 3 & 4), examples of a generalized stratigraphic chart, a well penetration log (plates VII–X), examples of production curves of wells, total output, and wells per field and production diagrams (plates XI–XIII: see Fig. 5).

In this publication, Erb defines the editing and geological standards which BPM technical staff should follow while preparing internal company reports. At that time, BPM was rapidly expanding its businesses and the staff at headquarters were trying to keep abreast of technical reports coming from 'all countries where oil is known to exist' (Erb 1917). BPM had five separate operations in the Dutch East Indies, three in Russia, one in Egypt, one in Romania, and five on the North and South American continents.

Erb's report also offers insight into operational procedures in BPM, on the mind-set and the business drivers of this emerging international oil corporation, and its efforts to set up a global geological control-and-command centre in the head offices. We are also reminded that at the time, 'petroleum geologists or oil geologists' were labelled 'economic geologists or practical geologists'!

In the following sections, excerpts from Erb's 'Uniformity in Geological Reports' are quoted that summarize his main recommendations on writing company reports.

Case for standards

> Although confined to one particular branch of the applied sciences, the geological service of our

If any one using the lists should feel inclined to substitute the proposed symbol by one of his own designs, he should remember that it is less important to use the most characteristic symbol than to adhere to standards, which will obviate confusion in the minds of readers, who necessarily have to deal with reports from many sources. Suggestions for better adapted markings might be forwarded to headquarters and we shall be pleased to consider them in a later edition of the Standards.

1) Plate III. Formations and other units of rocks distinguished on the map. It has become general practice to indicate formations and groups of igneous rocks by capital letters. Sub-groups are then characterized by an index to this letter, which index may be either again a letter or a combination of such or a figure. In cases where a formation has become subdivided into well established units and general consent has assigned to the individual groups special letters--like Greek characters for the units of the main Jurassic divisions--such letter should be employed. Where on the other hand the stratigraphical or petrographic unit bears a local name, the letters attached to the capital letter for the formation should be an abbreviation of that local name. "Isl" will thus designate the San Louis group of the Jurassic system in California. "Ilo" the lowermost stage of the Lias on the European Continent. The indexes to the letters for formations on Plate III are of course only examples which shall indicate the principle and they must be varied according to local needs. To fix standards for the thousands of stratigraphical units would, of course, be an impossible task.

2) Plate IV. Sediments. An exploration party in a new district will seldom be in a position to assign at once the strata encountered to

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Fig. 2. An example of Erb's writing (p. 19 of Erb's report).

Company has doubtless become the most extensive or universal organization in the world and it is almost impossible for a few individuals to properly digest the huge amount of interesting and valuable information gathered all over the world by the field staff. Everyone will realize the necessity that certain rules and regulations must be laid down as to the most efficient way to present observations and views of the field geologists to the directors and their advisors. It would otherwise be impossible at headquarters to keep track of the exploration work of the staff, to the detriment not only of the Company, but of the reporting geologist himself.

Only in case the forthcoming information is properly presented the geological department at The Hague will be able to fulfill its most important task, namely to act as a clearing house for general rules governing oil deposits.

The same need for a certain degree of uniformity has been felt long ago by other large geological organizations, particularly that huge Governmental institution, the United States Geological Survey. A good deal of the suggestions below has been adapted from the seasoned principles and methods of that service and from other American sources.

There is however a great difference between the work of an official in a Government geological institution or of another scientific body and the task of an economic or practical geologist, employed by a commercial concern.

The purely scientific worker tends towards a well-rounded complete discussion of the district or problem under review, regardless of the time when his report will be completed.

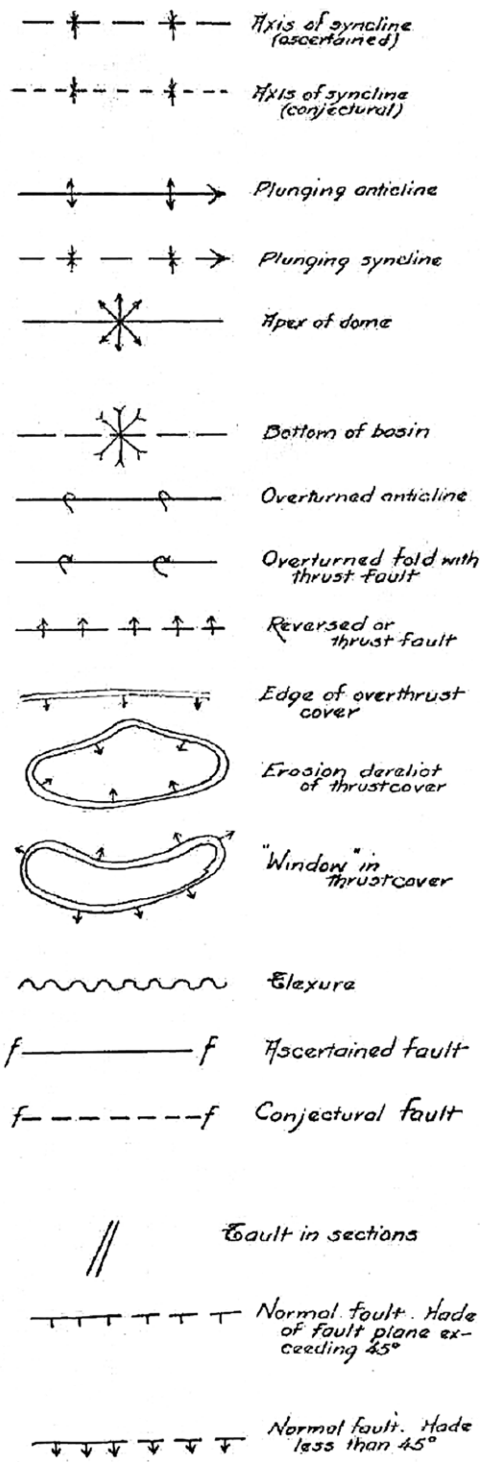

Fig. 3. Structural geology symbols (plate VI of Erb's report).

Fig. 4. Well symbols (plate VII of Erb's report).

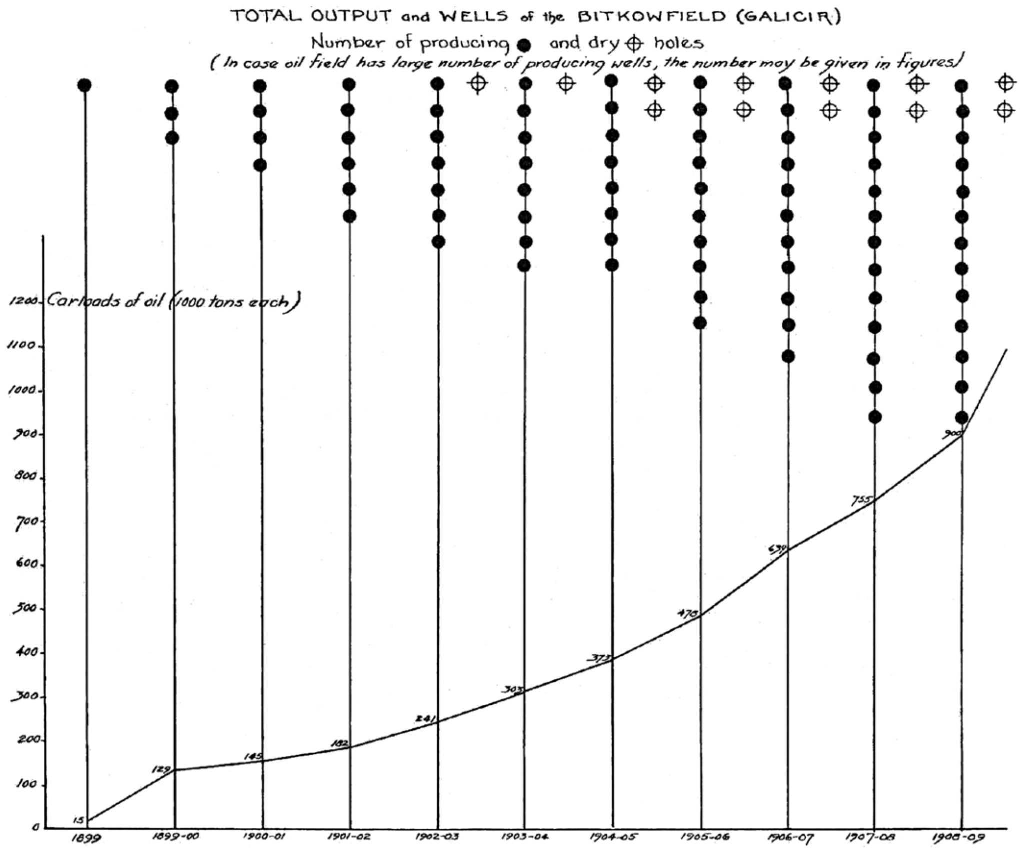

Fig. 5. Graphical display of a field production profile, showing the number of wells producing through time (plate XII of Erb's report).

The practical geologist working for a commercial enterprise must always bear in mind that the company is not entitled to spend money for the advancement of science, but that geology is only a means to secure better financial results. The geological reports are of ephemeral interest rather than being compiled for lasting scientific value. The information which they contain should be available to the managing people as early as possible after the field work is completed and be presented in such a form that it may be accessible not only to the trained geologist but also to commercial and technical people with but a smatter in geology.

Whereas the purely scientific account may only be read by small group of persons interested in the same lines of research, the economic report must necessarily be studied by all the people to whom the task falls to direct the technical work or to act as advisors on the funds appropriated for it.

How to structure a report

The majority of the reports presented to an Oil Company are of a descriptive and geographical nature, being accounts of observations on the geological conditions and oil possibilities of a certain district.

The long established form for such descriptive treatises is well known to any scientific worker, and everyone is also well aware of its shortcomings. The reader with a specific object in mind or searching for some particular information is compelled to read through pages of heterogeneous descriptions in order to sift the information, which he requires, from the bulk of the descriptions, not essential for is purpose. It has therefore become customary that the scientist places at the end of his publications a short summary of the results of his investigations, leaving it usually to the reader to search the whole paper for the pages, where that particular subject is treated.

The only way out of these difficulties is an author's review of his own report, preceding the latter, wherein the writer presents in easily legible form, digestible also for laymen, a short synopsis of his work. The writer should bear in mind that the purpose of such a synopsis is purely economical and that only those facts and observations should find a place therein, which are essential to grasp the practical conclusions, equally presented. Such a review will thus be more comprehensive than the usual summary at the end of a report; and a good plan would be to annotate it with the number of those pages, of the main account, where a more complete treatment of the individual subject may be found … In adopting this scheme it will become unnecessary for the average reader to plough through the whole report and the latter may then be a complete descriptive account of all the observations made and the views entertained by its writer.

Where however the investigations have brought together a large amount of facts, they should be classed under different headings, such as topography, stratigraphy, structure, oil deposits, etc. and merely the essential observations given in extenso.

The various subjects should equally be balanced and be in harmony with the economic purpose of the account … Long reports should always be accompanied by a 'Table of Contents', so as to facilitate their consulting.

Standard illustrations

Another point of difference (distinguishing the economic report from the scientific publications) refers to its illustrative parts: maps, sections, etc. The economic report is but seldom printed, the number of copies being too limited. It can therefore be more profusely illustrated than a scientific paper, provided that the graphic representations are of such a nature that they may be manifolded by simple methods. Illustrations have moreover the great advantage over the written words, that they are intelligible even to the layman, whose knowledge of technical terms may be limited.

Geological maps

The size of maps should not exceed 1 × 1.5 meters. In case maps are larger they should be presented in sections.

The groups of rocks distinguished in a territory should be recognizable without difficulty on the plan, the map should be easily legible and the method employed should render quick and accurate reproductions possible.

A third requirement of a geological map or rather of any graphic representation is good taste in its execution and it is in the geologist's own interest that the results of his labors be presented in a pleasing and attractive manner.

A most important rule, which no compiler of a map should forget, requires each unit of strata or group of rocks distinguished on the map to be indicated not only by a color or a separate pattern, but also by a letter or combination of letters to be marked in the legend as well as distributed over the area constituted by it.

Wherever time permits the geologist should endeavor to increase the legibility of the map and section, and avail himself of colors; 'Red' to indicate anticlines (an almost universal association) and for marking strikes and dip of strata, 'Green' – instead of blue, so as not to confound it with water courses – for the axis of a syncline.

In order to show the internal structure of an area the geological plans and maps must be accompanied by sections through the earth's crust.

Columnar stratigraphic sections

The columnar section is a generalization of the various local vertical cuts and intends to show the general sequence and thickness of stratigraphical (…) units of a district. The composition of the rocks is shown by suitable patterns, their petrographic names are marked, the established or proposed designations of the individual groups and the names of the formation, whereof they constitute subdivisions, must also be indicated. Being a generalized picture of the composition of the district also other stratigraphic features like breaks and unconformities may not be omitted.

For the reader with mainly economic interest such columnar sections are most valuable, because they show at a glance in graphic form what otherwise had to be gleaned from tedious reading through pages of descriptions.

In mountainous countries or in desert regions strata weather out from their enclosing rocks in typical form and this feature may become useful in their recognition. The resistance against weathering may then be rendered in the columnar section by drawing it in a step-like arrangement, the steepness of the steps being proportionate to their resistance against atmospheric influences.

Where great changes in the thickness and composition of strata occur in a district, more than one columnar section is needed in order to show also the lateral variation in the stratigraphical conditions.

Structural geology sections

The structure-section, being a generalization from small local exposures, is already more hypothetical than the geological picture of the earth's surface on the map. Its theoretical part lies mainly in the reconstruction of the eroded portion of the surface and in the prolongation of the strata down to depths beyond the range of actual observations. To do both successfully requires a thorough knowledge of the geology of that district as well as general experience in tectonics. It is evident that the oil geologists are practically interested in the continuation of the bedding planes of the strata down to the depth where oil is found.

Well penetration sections

The value of trustworthy well-sections is seldom appreciated. The driller to whom falls the task to collect and preserve the rock samples from the hole considers this work generally a useless and troublesome addition to his daily duties, and the geologist seeing how little reliance can be put on the material, reluctantly collected by untrained people, is often discouraged in their compilation and use. And yet reliable well-sections are the only means to complete the observations at the surface and to carry them down to those depths, where oil-bearing deposits occur. It requires some good will on both sides – the drillers' as well as the geologists' – in order to develop the feeling among the technical staff that a thorough knowledge of underground conditions is necessary for a sound exploitation and that the geologist has the training and wide experience necessary to promote this knowledge. To take successfully rock-samples from a boring is, however, a difficult matter. The instruction usually given state that either samples should be collected as often as the rock drilled through changes or that bits of the formation should be preserved at regular intervals (in meters, sagenes or feet drilled). In the first instance it is left to the driller, with little or no training in the recognition and determination of rocks, to distinguish between various formations, and thus sandstone and limestone of the same color or shales and slates are become often mixed up. In the second case not only important boundaries of strata might be overlooked, but thin and often most typical beds may be passed without recognition. The first named advice is, therefore, the more preferable one, provided that the attention of the technical staff is directed and trained in the distinction of a least the local formation by supervision on the part of the geologist.

An attentive and trained driller will moreover often be able to complete the data from the samples by carefully watching his progress while drilling or the behavior of his tools and the geologist will be glad to avail himself of this knowledge.

Diagrams

Besides maps and sections, there are however other economic features, which must be set forth by the practical geologist and in many cases the written word can advantageously be supplemented or replaced by graphic methods. To them belong large tables or long lists showing the variations in the yield of a well, a field or a district during certain periods, statements regarding drilling progress, lists of figures demonstrating the chemical composition of either the crude or water found in connection with oil. Such series of figures make seldom interesting reading and it usually causes more difficulties to draw from them general conclusions than from diagrams.

If, however, a graphic representation shall be effective it must fulfill the following requirements: (1) It may not be intricate, as it otherwise misses its essential point to be easily legible; (2) all the factors of which the diagram is the result must be embodied therein and their influence be evident from the graphic representation. In case – for example – the yield of a plot or a field is represented by a production curve, the diagram would be of little value if not combined with some kind of graphic display of the variations in the number of wells, which are yielding the oil.

Photographs

In natural science, photography has to a large degree replaced the art of drawing and sketching and an easily portable camera is now-a-day an essential part in the outfit of the traveling geologist. For geographical purposes – the representation of topographical features – the camera is indeed unequalled, furnishing an absolutely true picture of the earth's surface.

In geology, however, it has its shortcomings, because the photographic lense cannot discriminate between essential geological facts and accidental topographical detail or the covering vegetation, both of which may come out more prominent on the pictures than they appeared to the observer in nature.

Artistic qualities are not required from a geologist's photographs. All that is needed is a judicious selection of the point from which the picture is taken, and a great distinctness in its execution.

The photograph itself should bear not only the title of the picture, but the viewer's attention should be directed in a foot-note to its essential points and further mention may therein be made of the point where taken and other photographic details.

Should the picture of an outcrop be less conspicuous than desired, the transparent water colors or indelible inks might advantageously be used to enhance the distinctions. To color the photograph itself is better than a 'retouché' of the negative, because the latter may not be recognizable in the print.'

Conclusions

In conclusion the writer trusts that every reader and every member of our staff will realize the necessity that a considerable degree of uniformity in the geological reports has become necessary through the enormous flight, which our enterprise has taken. To comply in this respect with the proposals contained in the preceding pages will serve to further advance the interests of the Bataafsche and its affiliated concerns. To carry out the wishes and directions of the Central Geological Department will of course no more interfere with the scientific independence of the individual geologist than the submission of a literary worker to the rules of spelling diminishes the value of his production.

Epilogue

'Uniformity in Geological Reports' is in some ways a precursor to the Shell 'Standard Legend' (Shell 1995) but the purpose of these two documents is quite different. Erb's report sets standards about the framing of geological reports, such that data pertaining to the stratigraphy, the tectonic history and the oil manifestations are treated exhaustively in separate chapters, backed up by standard illustrations. Uniformity in the structure of reports sent to head office made it easier for reviewers to focus on the salient strong and weak points of proposals. This purpose is entirely different to that of the Shell 'Standard Legend', which is a collection of symbols to ensure the standardization of data in map form.

It is unclear for how long the reporting standards established by Erb were enforced after he left his position as Head of the Geological Department; while the 1917 version of his 'Uniformity in Geological Reports' had initially been sent to all Shell subsidiaries, we have no information on how this reference publication was disseminated throughout the Shell Group in the 1920s. When issued, Erb's report was part of a process driven by necessity, as surface geology and oil seeps were the only defining criteria to guide exploration efforts. The relevance of these factors faded through time as the oil industry experienced a profound transformation with the advent of seismic, a new technique that provided an image of the subsurface, based on which targets could be defined and measured with accuracy ahead of the drill. Decentralization of the company structure and the creation of largely autonomous operating companies relaxed further the need for uniformity in reporting as defined by Erb.

As stated by W. van Waterschoot van der Gracht (1935, p. 309), Erb:

> grew up with an entirely new science, petroleum geology, and was largely instrumental in establishing it, by the very personal guidance he gave to all the geologists of his company, which was a pioneer in scientific exploration.

In a larger sense, Erb's legacy is more about ensuring focus of economic value while evaluating exploration opportunities, based on the application of sound geological principles backed by technology. His focus on rigorous economics is also reflected in the way he evaluated the purchase of producing fields for Shell and in his recommendations to create new asset-based companies. In so doing, Erb successively guided and directed the company's extraordinary business expansion in the wake of World War I.

In analysing his life and career, Erb appears as the archetype of the stalwart company man, unfaltering to duty, committed to any tasks, ready for all personal sacrifices and giving due deference to his boss, Henry Deterding. Although he had, by all accounts, an extremely successful career in Shell, recognition for his dedication was not fairly translated into monies. As Shell experienced an inordinate phase of growth after World War I, Deterding turned more and more into a despot: board profit-share splitting in 1923 was nearly 97% in favour of Deterding. In 1929, Deterding received 2.3 million guilders in a Royal Dutch bonus, leaving a pitiful 3700 guilders for Erb (Jonker & van Zanden 2007). Fortunately, Erb 'knew how to maintain his attitude under sometimes difficult circumstances, which required great tact and diplomacy, as insiders realize' (van Waterschoot van der Gracht 1935, p. 310).

So little is known about Erb's private life that he remains an obscure character, difficult to decipher. He was described as friendly but had few close friends, and these were mainly other Shell employees; he never married. He liked to be called 'Doctor Erb' and signed his papers as Dr J. Erb. Besides German and Dutch, he could converse in English, French, Malay, Romanian, Spanish and Russian. His hobby was to collect crystals and he assembled a large collection of precious minerals. He made generous donations to geological societies, notably in Switzerland.

Although endowed with immense intellectual powers, an analytical mind and the ability to think strategically, his personal drivers in life remain mysterious. He was so fully embedded into a company culture that the world outside this bubble seems to have had little presence in his daily life. Perhaps, it was the progressive realization of the futility of his all-encompassing dedication to one company that led, ultimately, to a state of deep depression and probable dementia.

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