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REPORT ON 1964 A.I.M.M. CONFERENCE, WESTERN AUSTRALIA

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The 1964 Annual Conference of the Australasian Institute of Mining and Metallurgy was held in Kalgoorlie on 17th-22nd August and in Perth on 23rd-26th August. After the Conference I took part in a post-Conference tour to the North West of the State from the 27th to 29th August, and later (30th August to 2nd September) inspected some of the manganese deposits in the Pilbara area.

Attendance.

About 440 Senior Delegates and about 80 students attended the Conference.

Kalgoorlie Session (17th-22nd August)

Concurrent technical sessions were held on Mining (in which 6 papers were presented), Metallurgy (5 papers) and Geology (7 papers). The surface and underground operations of the Kalgoorlie and Norseman mines were inspected and a geological excursion around Kalgoorlie district was made.

My remarks will be confined to the Geological sessions since these were the sessions I attended. I have lodged the manuscript of all papers presented at the Conference in the Geological Library.

The seven geological papers presented at Kalgoorlie were:

1. "Structure of the Kalgoorlie Goldfield" by R. Woodall, Assistant Chief Geologist, Western Mining Corporation.

The tight Kalgoorlie syncline and its associated "Boulder Dyke" which are important structures in the localisation of ore bodies in the Kalgoorlie field, were disputed. I think there is good evidence to support that both features are due to multiple strike shearing along the contact of the slate (Black Flag Beds) and greenstones (Golden Mile Dolerite).

2. "Ore penetration into Calc Schist on the Kalgoorlie Goldfield" by K.J. Finucane, Consulting Geologist.

This paper showed that gold ore does penetrate into the less favourable calc schist; most of the ore is mined from the quartz dolerite. Mr. Finucane showed that the lateral penetration (in plan) increased in depth from 800 to about 2,500 feet. However, when viewed in cross section it appears that the penetration is only about a few hundred feet.

3. "Western lode structures and southward extensions on the Boulder Mining Belt", by A.A. Wells, Geologist, Lake View and Star Ltd., Fimston.

4. "Orebodies in the Mt. Charlotte-Hannans North area, Kalgoorlie" by J.A. Haycraft, Chief Geologist, Gold Mines of Kalgoorlie (Aust.) Ltd.

Ore bodies are located in an intensely sheared part of the Kalgoorlie syncline ("Boulder Dyke") and they are the most northerly ore-bodies of any significance which are now worked on the Golden Mile. The orebodies are replacement shear zones which approximate a stock-work pattern;

the shape of the ore body (700 feet long and 180 feet wide) allows the use of large mining equipment (diesel transloaders, front end loaders, and a mobile hydraulic crane). The Mt. Charlotte orebody contains 5,000 tons per vertical foot of qtz-gold ore at a grade of just over 3 dwt per ton.

5. "The gold deposits at Norseman, Western Australia" by H.I.E. Hall (Senior Geologist) and C. Bekker (Geologist, Western Mining Corporation Ltd., Kalgoorlie).

6. "Spodumene-bearing pegmatites in the Mt. Marion and Ravensthorpe areas, Western Australia" by J. Ross, Western Mining Corp. Ltd.

Mt. Marion is 24 miles south of Kalgoorlie.

7. "Igneous activity and sedimentation in the Precambrian rocks between Kalgoorlie and Norseman, Western Australia" by R.C. Horwitz, and I. Sofoulis, Geologists of the Geological Survey of Western Australia.

Regional geological mapping at a scale of 1:250,000 in the Kalgoorlie area suggests that Archaean and Proterzoic rocks are exposed. Most of the area consists of Archaean rocks which are made up of two units both containing basic igneous rocks and sediments, the lower unit being distinguished by acid volcanic flows and sills. The Archaean sedimentation suggests a basin of subsidence flanked on its western and eastern margins by shallow-water depositional ores. The Kalgoorlie line of lode (north-north-west trending), is situated on the hinge zone (or island arc) separating the deep and shallow parts of the basin. The hinge zone is the focus for intense shearing, vulcanism, and serpentine and basic rock intrusions. Archaean granites intrude the lower units in the western and eastern parts of the basin, apparently in old basement highs.

Rocks assigned to the Lower Proterozoic consist of basic dykes and a younger granite (intruded into the eastern edge of the Archaean basin of sedimentation). Flat-lying sediments of Upper Proterozoic age unconformably overlie the Archaean and Lower Proterozoic successions in the south-eastern part of the area.

Briefly the Kalgoorlie geological sessions showed the results of a recently intensified programme of detailed outcrop surface mapping by Western Mining, regional geology by the W.A.G.S., and their effects on the extensive underground mapping. Besides the geological mapping programmes the Kalgoorlie area is also receiving attention from New Consolidated Goldfields - detailed geochemical and geological surveys - and the Bureau - detailed and regional aeromagnetic surveys, and orientation geochemical survey.

I feel that the above activities particularly those by outside companies and the intensified regional mapping by W.A.G.S. in the Kalgoorlie area will lead the way to the discovery of further orebodies in the area.

Perth Session (23rd-26th August)

After a review lecture by the Honourable A.F. Griffith, M.L.C., Minister for Mines on the "Expanding Mineral Industry of W.A." and a film on "Minerals of the North West" produced by the W.A. Government Departments, concurrent sessions were held on Mining and Metallurgy, and Geology, and one session on petroleum. Once again I will confine my remarks to the Geology sessions.

Sixteen geological papers were presented in the 3-day technical session in Perth. They consisted of Precambrian regional geology of the Pilbara-Hamersley area, manganese deposits in W.A., Wittenoom Gorge asbestos, ilmenite beach sand deposits, Darling Range bauxite and coal resources of W.A. The papers presented were:

1. "The Archaean of the Pilbara Block" by G.R. Ryan, Geologist of W.A.G.S.

The paper contains the results of the regional geological mapping by W.A.G.S. of seven 1:250,000 Sheet areas. Frankly the paper was poorly presented, tainted with Elliston's theories of preconsolidation movement and sedimentary ore genesis, and did little justice to the excellent regional maps.

2. "The Proterozoic geology of the North-West Division of W.A." by J.L. Daniels, Geologist of W.A.G.S.

Mr. Daniels described the Proterozoic stratigraphy as mapped recently by W.A.G.S. The succession consists of 5 groups containing mainly interbedded chert, shale, dolomite, banded iron beds, and basalt. The total accumulative thickness of the succession is about 75,000 feet. The Hamersley Group, the second oldest, contains the widespread iron ore deposits (Tom Price and Mt. Newman) and the asbestos deposits of Wittenoom Gorge. Algal structures similar to those found by the Bureau in the Proterozoic sediments of the McArthur River Basin were described.

3. "Discovery of the Hamersley Iron Deposits (Duck Creek - Mt. Pyrton - Mt. Turner area)" by B. Campana, F.E. Hughes, W.G. Burns, I.G. Whitcher, and E. Muceniekas, Geologists of Conzinc Riotinto of Australia Ltd.

This paper was presented by Mr. Hughes and it has been published in A.I.M.M. Proceedings, June 1964, 210. It represents the results of mapping and search for iron ore deposits which began in 1961 by C.R.A., who in April, 1962 were joined by Kaiser Steel Corporation of U.S.A. The mapping resulted in the discovery of some hundreds of million tons of high-grade (60% or better iron content) hematite ore bodies at Mt. Brockman, Mt. Samson, and Mt. Tom Price, and some thousands of million tons of 50 to 57% grade limonite ore in the Duck Creek and Serpentine Creek areas.

4. "A resume of the results of iron ore exploration in W.A." by W.N. Macleod, Supervising Geologist, W.A.G.S.

Dr. Macleod outlined the results of company and W.A.G.S. exploration for ore from 1961 to 1964. Company activities were confined mainly to the detailed work required to test the iron ore deposits and the W.A.G.S. confined its work to regional geological mapping. Exploration during 1961-64 has increased the known iron resources of W.A. from 275 million to about 9,000 million tons of high grade hematite ore. In addition, reserves of lower grade pisolitic limonite ore are estimated to amount to 6,000 million tons.

Dr. Macleod described the origin and classification of the iron ore deposits of W.A.

5. "The Iron Ore Deposits of the Mount Goldsworthy area, Port Headland District, W.A." by R.T. Brandt, Senior Geologist, Mount Goldsworthy Mining Associates.

Dr. Brandt presented the results of exploration activities of Mt. Goldsworthy Mining Associates,a subsidiary of Consolidated Goldfields, Cyprus Mines Corp., & Utah, in the Mt. Goldsworthy area. The Mt. Goldsworthy ore body occurs in a faulted syncline of Archaean banded iron formations.

6. "Pisolitic Limonite Deposits in Northwest Australia" by J.E. Haims and B.D. Morgan, Geologists of Broken Hill Proprietary Co.Ltd.

The paper was presented by Mr. Morgan, who described the Robe River limonite deposits which can be traced over a distance of 130 miles. The deposits represent erosional remnants of old valley fill material,

derived by erosion from pre-existing Archaean and Proterozoic jaspilites. Present quantity of limonite is about 5,000 million tons of which most is in excess of 54 percent Fe.

7. "Bauxite in the Darling Range, W.A." by S.A. Tomich, Consultant Geologist.

Bauxitic laterite covers a broad belt in the Darling Range in the south-west of W.A. Its limits are generally defined by the jarrah forrest. The Darling Range bauxite contains 35 to 45 percent abumina and is not high grade by world standards. Silica and iron are the main impurities. The alumina is in the form of gibbsite (Al_2O_3 $3H_2O$), which allows low temperature digestion in treatment of the ore. The paper described the bauxite deposits held by Alcoa of Aust. who rail the ore 22 miles to their treatment plant at Kwinana on the coast, 10 miles south of Fremantle.

8. "Bauxite in W.A. - the Mt. Saddleback and Bannister Hill Districts" by H.J. Ward, Consultant Geologist.

These bauxite deposits are held by Bauxite Exploration Pty.Ltd. (Australian Mining and Oilfield Services Pty.Ltd.) some 20 miles south of those worked by Alcoa and described by Mr. Tomich above. Alcoa claims grade of their bauxite deposit ranges from 30 to 45 percent Al_2O_3.

9. "The ilmenite deposits of Geo graphe Bay" by B.K. Welch, Assistant Production Manager, Laporte Titanium (Aust.) Ltd.

10., "The Blue Asbestos Deposits of the Hamersley Ranges" by K.J. Finucane, Consultant Geologist.

The blue asbestos - crocidolite - occurs as conformable seams, generally averaging about 2 inches thick, in the Brockman and Marra Mamba Iron Formations. At Wittenoom Gorge the principal bands of asbestos are near the base of the Brockman Formation in hematite quartzite beds and adjacent to beds of dolomite, or to thin beds of a fine-grained riebeckite rock. The favourable structure appears to be broad anticline.

In the discussions that followed evidence was presented by Mr. C. Brooks, Ph.D. Student at Adelaide University, for the presence of volcanic (ash) deposits near the base of the Brockman Formation.

The area about $\frac{1}{2}$ - 1 mile south of the mine at Wittenoom is being actively drilled. The W.A.G.S. has begun a detailed geological mapping programme of the Wittenoom area using enlarged air photographs at a scale of 20 chains to 1 inch. This mapping programme is planned to continue in 1965.

11. "Coal Resources of W.A." by J.H. Lord, Director, W.A.G.S.

In summary the papers presented at the Perth technical session covered most of the major W.A. mineral deposits and the Precambrian Stratigraphy of the State, except the Kimberleys. Perhaps the session on the iron ore could have been improved by reducing the number of papers.

<u>The Petroleum Session</u>.

Five papers were presented in the Petroleum Session in Perth; these were -

1. "The Status of Oil Exploration in W.A." by P.E. Playford, Senior Geologist, W.A.G.S.

This paper reviewed the history of development of oil exploration in W.A. No mention was made of the Bureau's contribution to oil exploration in W.A.

2. "A preliminary investigation of the Jurassic coals of the Perth Basin" by M.H. Johnstone, Geologist,, W.A.P.E.T.

3. "The drilling and evaluation of an exploratory oil well" by R.M.L. Elliott and P.H.J. Hammett, W.A.P.E.T.

This paper was unfortunately read in a mining and metallurgical session, which was held concurrently with the geological session on the iron deposits, and hence I was unable to attend.

4. "Magnetic data interpretation for petroleum exploration in W.A." by R.E. Sheriff, Geophysicist, W.A.P.E.T.

Mr Sheriff presented examples of interpretation of magnetic basement from aero-magnetic data in most of the sedimentary basins in W.A.

5. "Experience with the Vibroseis in W.A." by R.E. Sheriff and R.G. Dennison, Geophysicist, W.A.P.E.T.

W.A.P.E.T. have had about 8 months experience with the vibroseis technique on coastal limestones near the west coast of W.A. Overall the quality of the vibroseis results would be slightly inferior to that of conventional results.

Post Sessional Tour to North-West.

I took part in a 3-day tour from 27th to 29th August to the north-west of W.A. where I visited:-

(i) Mt. Tom Price iron.

(ii) Yampi Sound iron.

(iii) Wittenoom Gorge asbestos.

I spent about 1 hour at Mt. Tom Price, which is a high-grade 600 million-ton hematite deposit about 30 miles south of Hamersley Homestead, and which was described in a paper presented by C.R.A. Ltd. geologist, F. Hughes, at the Perth Technical Session. The company has completed its testing of Mt. Tom Price and most of its present activity in the Hamersley iron ore province is confined to testing of iron ore deposits at Boolgeeda.

After Mt. Tom Price, I flew over the Robe River limonite deposits of B.H.P. which were described by Mr Morgan in the Perth session. B.H.P. are actively engaged testing the deposits to the west of Deepdale Homestead. Reserves at Robe River are estimated by B.H.P. at about 5,000 million tons, most in excess of 54 percent Fe.

I spent about two hours on Cockatoo Island in Yampi Sound, where B.H.P. are currently mining hematite ore, and I flew over neighbouring Koolan Island, which B.H.P. expect to bring into production in 1964. The Yampi hematite ores are of clastic sedimentary origin and occupy a near vertical limb of a syncline. The ore is hard at the surface, but friable at depth. I believe that strike faulting and subsequent supergene enrichment has played an important part in the localisation of the iron ore, as is a common feature in the Hamersley Iron Province.

One day was spent at Wittenoom Gorge asbestos mine inspecting the underground surface geology, and the exploratory surface drilling. The asbestos deposits were described by Mr Finucane during the Perth technical session. Underground I saw evidence for considerable bedding-plane slip, which may have provided openings necessary for the growth of asbestos fibres.

Pilbara Manganese Deposits

After the post-sessional northern tour, I spent two days inspecting some of the manganese deposits in the Pilbara area with Mr L. Delahunty, Geologist of W.A.G.S.

The manganese deposits in the Pilbara area are mostly syngenetic which have been enriched by supergene processes. It appears that weathering (Post Precambrian and Pre-Permian glacials) has played an important part, and the recognition of this old land surface, which has been subsequently modified by the Cainozoic weathering processes, is important in the discovery of manganese ore deposits.

Present mining activity is confined to two deposits, and M.C. 269 by Northern Minerals Syndicate, and M.C. 571 which is being open cut by Bell Bros. for B.H.P. M.C. 269 is an open cut about 500 feet long and more than 50 feet wide. Ore has been mined from a depth of about 90 feet and the manganese content is about 50 percent. Both M.C. 269 and M.C. 571 are located near the faulted contact of the Permian glacials and the Upper Proterozoic succession (mainly dolomite unconformably overlain by the Boorabee sandstone - the youngest unit in the Proterozoic succession). Other particular high-grade manganese deposits are exposed far south along this contact and are worthwhile exploring; the whole Proterozoic/Permian boundary warrants exploring for manganese.

I visited M.C. 532 (Mt. Sydney) and M.C. 268 (Woodie Woodie) in the same general area as M.C. 269 and M.C. 571 or which are being drilled by the W.A. Mines Department partly financed by the Bureau. Two holes, each about 200 feet, drilled alongside the open cut at M.C. 269 have shown that the manganese deposit occupies a flat lying solution cavity or cave in the Carawine Dolomite, which at the drill sites, is capped with about 30 feet of chert breccia. Two holes of about 200 feet each have been sited to test below the open cut at M.C. 532.

In view of the extensive deposits discovered at Groote Eylandt, I suggest that arrangments should be made for an officer of the W.A.G.S. to visit Groote Eylandt; such a visit would enable the W.A. manganese deposits to be viewed in better perspective than previously was possible and it would assist in the understanding of the genesis of the W.A. manganese.

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