and near Duluth, and the aberrations of the mariner's compass are such that navigation is rendered somewhat difficult, and even dangerous, at times. In this connection it may be stated that the first wireless telegraphy was done in Ontonagon county, Michigan, by Ayers Stockley, shortly after the laying of the first successful Atlantic cable in 1866. Mr. Stockley used crude home-made apparatus, but succeeded in transmitting telegraphic messages correctly, for a distance of nine miles, by utilizing the magnetic earth currents traversing the cupriferous strata.

While practically the entire copper production of Michigan is from the native metal, nearly all of the principal commercial copper ores are found in the native copper district, and copper ores are found in many other counties of the Upper Peninsula of Michigan. The list of Michigan copper ores includes cuprite, melaconite, azurite, malachite, chalcocite, bornite, chalcopyrite, chrysocolla, algodonite, domeykite, whitneyite, mohawkite and keweenawite.

The active copper mines of Michigan are in the three counties of Keweenaw, Houghton and Ontonagon, with a considerable number of old and idle mines in Isle Royale county. The Keweenawan copper belt extends to the Wisconsin boundary through Gogebic county, and small quantities of chalcopyrite are noted in several of the iron mines of this county.

In Baraga county there is an isolated outlier of the Keweenawan formation, known as Silver Mountain, and the same formation, carrying native copper, is noted on the Huron Islands.

Native copper is said to have been found near Perkins, Delta county, but the discovery does not seem of commercial importance.

Native copper, evidently brought by glacial action from the Keweenawan measures to the north, has been found in drift above the iron ore body of the Cyclops mine, at Norway, Dickinson county, and chalcopyrite is noted in small quanties in connection with hematite in the Emmett mine, and also in the Chapin mine at Iron Mountain, in this county.

Copper ore has been reported from the vicinity of St. Ignace, Mackinaw county, but the occurrence has not been fully verified.

In Marquette county chalcopyrite and native copper occur on Presque Isle, in the city of Marquette and chalcocite is noted on Mount Mesnard and on the Chocolay river, near the same town, while a variety of copper ores occur near Sauks Head. Small quantities of copper sulphides are found in the gold mines north of Ishpeming, and the granite rocks extending from the serpentine lying north of Ishpeming to the shore of Lake Superior show numerous gash veins carrying copper ores and other minerals.

In Menominee county copper ores have been found near Carney, and some attempts at mining have been made thereon.

MINNESOTA. The western continuation of the Keweenawan cupriferous series extends from the Upper Peninsula of Michigan across northern Wisconsin into Minnesota. The northern fold of the Keweenawan syncline is noted in Cook and St. Louis counties, north of Duluth, where attempts at mining have been made. There also are promising bodies of sulphide copper ore, near Lake Superior, in this county. In St. Louis county, in 1900, a mass of native copper in sheet form, weighing about 100 pounds, was found embedded in iron ore, at a depth of 300 feet below the surface, in the Montana shaft of the Minnesota Iron Co.

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The southern fold of the Keweenawan syncline extends into Pine and Chisago counties, shortly north of St. Paul and Minneapolis, and several tentative efforts at mining have been made in these counties, native copper being found near Hinckley, Pine county, and native copper and malachite occurring in Chisago county.

MISSOURI. This state has a producing copper mine in Madison county, and has old mines or attempts at mines in the counties of Benton, Clare, Cole, Cooper, Crawford, Dade, Dallas, Dent, Franklin, Greene, Iron, Lawrence, Maries, Ste. Genevieve, St. Francois, Shannon and Washington, and also shows copper ores in the counties of Jasper, Jefferson and Wright. Copper ores are noted mainly along the Ozark uplift, in the southern part of the state, and in the lead district of southeastern Missouri.

The first copper production of Missouri was made in 1837, from carbonate ores, and at various times smelters have been erected in Crawford, Madison, Ste. Genevieve and Shannon counties. Franklin county once had a small copper producer, near Sullivan, but the output was very small. Native copper and various ores are found in the Stanton mine in this county.

In the Circle Diggings of Cole county, malachite, azurite and chalcopyrite are found, and a limited production has been made from this district.

The Collins mine, in Cooper county, shows chalcopyrite and carbonate ores.

The Cherry Valley mines of Crawford county have produced a small quantity of malachite.

In the zinc and lead mines of Jasper county a little chalcopyrite and occasional native copper occur in connection with sphalerite.

In Ste. Genevieve county, near the Mississippi river, attempts at mining were made previous to the American Civil War.

Shannon county has sulphide copper ores and in 1901 was the scene of a short-lived copper boom.

The principal copper mining operations of both past and present are noted in Madison county, in southeastern Missouri, which long has been an important lead field, being the site of the Mine La Motte, the oldest American lead mine west of the Alleghany Mountains. In 1863 copper mines were opened at Cornwall on parallel blanket veins of disseminated chalcopyrite with cherty gangue, having a country rock of Silurian limestone, and some little production was secured from this property. Chalcopyrite is noted occasionally in connection with sphalerite, pyrite and small quantities of nickel and cobalt sulphides, in the Mine La Motte. To the southward of the Mine La Motte, and about two miles east of Fredericktown, is the Buckeye mine of the North American Lead Co. On this tract the Buckeye copper mine was opened in early days, and produced a little ore. The present company opened a new mine, for lead, but at depth this has yielded an increasing quantity of chalcopyrite, and this ore became so common that a smelter has been erected for its treatment. The chalcopyrite averages about 6 per cent. copper after selection, and carries combined nickel and cobalt values, mainly the latter, to the extent of about 3 per cent. The country rock in the vicinity of Fredericktown is limestone, of various ages from Carboniferous to Cretaceous, with bosses of intrusive granite-porphyry, the ore occurring as irregular contact deposits, in limestone, near the contact with igneous intrusives. I have found copper ore in

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