Evolution of Gas.—Regarding gas-shows Craig has written: "Though there may be steady and brisk flows of gas or gas-wells at a locality it does not necessarily prove that oil can be obtained by drilling there; but should the gas be heavy, with a fair percentage and a strong odour of hydrocarbons higher in the series than methane, the prospector will be justified in concluding that a body of liquid hydrocarbon is somewhere in the neighbourhood." By this standard the Tokomaru Subdivision of the East Coast ought to contain oil, for there is a belt of gas-shows, and the gas is "wet." As yet only one sample has been analysed; it shows 9·2 per cent. ethane. The gas from the others smells of petrol. Analyses recorded in Bulletin No. 21 show that out of seven samples collected in Gisborne Subdivision five are "wet" gas, containing 9 to 14·6 per cent. ethane. As a caution Craig states, "the evidence of a gas-show must be considered along with other facts, such as geological structure, if its value as an indication is to be appreciated correctly."

Outcrops of Bituminous Strata.—Craig has pointed out that paraffin oils do not afford good evidence in this respect, as they leave no residue. He wrote: "A faint odour of vaseline is often the only evidence that can be obtained." In the Tokomaru Subdivision rocks smelling of oil have been found in many places along a well-defined belt, and include fine dark shale, blue mudstone, calcareous concretions in blue mudstone, glauconitic greensand, grey sandstone, grit, and conglomerate.

Veins of Manjak or Ozokerite.—Ozokerite or mineral wax is the solid residue from the inspissation of paraffin oil beneath the surface. Within the Tokomaru Subdivision so far examined no ozokerite is known; but it is recorded that from Rotokautuku several tons of a substance which in part was possibly ozokerite were exported.*

Besides these important indications Craig discusses as of less significance the frequent occurrence of sulphuretted hydrogen and salt-water springs in oilfields. Many sulphuretted-hydrogen vents have been found in the Tokomaru Subdivision; and in the Gisborne – East Coast district many brine springs occur.

2. *Oil-zones.*

The dark shales above the blue mudstone in the Middle Cretaceous smell of benzine, but are not rich enough in carbonaceous compounds to burn. Within the area covered no oil or gas was seen coming from these beds; but at Rotokautuku, according to McKay, oil and gas were found in these rocks, and at Makarika gas is escaping from them. There are no sandstones or other porous rocks with these bituminous shales, and the oil-material is still in the shales.

The more prominent oil-zone is at the Cretaceous-Tertiary boundary, the gas generally coming from the Cretaceous beds, but in some cases coming through a thin cover of Tertiary strata. The oil-smelling beds include light-blue shale 50 ft. or more thick, dark shale 70 ft. thick, glauconitic greensandstone and grit 20 ft. thick, several bands of grey sandstone up to 20 ft. thick, and conglomerate up to 25 ft. thick. The oil in the more porous beds—the sandstones, grits, and conglomerates—has evidently migrated from its place of origin. These rocks have yet to be tested for porosity and suitability as reservoir rocks.

3. *Oil-sands.*

Traces of oil and gas in small quantity are found almost everywhere, but payable accumulations of oil are rare; and in any field it is necessary to find whether the oil has been concentrated into porous beds. Former observers have mentioned several beds as lithologically possible for reservoir beds in which the oil could accumulate; but no one has previously found definite evidence of oil in the sandstones, grits, and conglomerates of the Gisborne – East Cape district. The occurrence of oil in these coarser-grained rocks indicates that the oil has migrated. When the oil migrated it necessarily moved into the more porous rocks; and the movements would in large part be controlled by structure. Hence it is desirable to find oil-sands with suitable structure.

In the Tokomaru Subdivision possible oil-sands giving a smell of oil at the outcrop have been found in several places. At the lower oil-horizon there are no known porous beds associated with the dark bituminous shales. At the upper horizon in the Ihungia River a conglomerate more than 20 ft. thick has been found, in which the pebbles are generally about 1 in. diameter. None of these rocks has yet been tested for porosity; but there is only a little mud in the matrix of this conglomerate, and as it smells strongly of oil it is apparently an "oil-sand."† Near it occur several bands of fine grit and coarse greensand also smelling strongly of oil. These are friable and contain very little clay, and certainly will serve as oil-sands.

In the upper part of Makarika Stream and its tributary the Orua a brown sandstone enclosed in shale smells of oil. The sandstone appears to have a fair proportion of clay in the matrix, but it is more porous than the enclosing beds, and may serve as a reservoir for the oil. Another friable grey sandstone in the Mata River smells of oil, and from it oil has been extracted with chloroform. A greensandstone from the Mata also gives an oil-smell.

It is probable that other beds suitable as reservoir rocks occur, for the beds vary greatly from place to place, and outcrops in many places are separated by wide intervening stretches without outcrop.

4. *Structure.*

The most important information about any prospective oilfield is its geological structure, for, although oilfields have been developed without the structure being known, modern oilfield practice is

* According to W. Skey the material was dopplerite, an oxygenated hydrocarbon compound. See Trans. N.Z. Inst., vol. 14, pp. 397–99, 1882.

† Any rock which is capable of containing oil in quantity, and yielding it when tapped by a bore or otherwise, is technically an "oil-sand."