ROBERTSON RESEARCH INTERNATIONAL LIMITED

REPORT NO. 4175P

WELLFILE

REPORT ON ANALYSES OF FOUR OIL SAMPLES FROM THE STATOIL 1/9 - 4 WELL, NORWEGIAN NORTH SEA

by

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PROJECT NO. RRI/778/IID/2606

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March, 1978

CONTENTS

TABLES

FIGURES

SUMMARY

Analyses of four DST oils from two chalk reservoirs in the Statoil 1/9-4 Well show the oils to be generally similar in composition i.e. probably generated from the same source rock. Slight differences between the oils are attributed to different levels of source rock maturity at the time of oil emplacement.

I

INTRODUCTION AND ANALYTICAL PROCEDURES

Four samples of oil were received from the Statoil 1/9-4 Well. All were free-flowing liquids with variable amounts of waxy precipitate. DST 1 was dark brown to black, DST 2 orange-brown, DST 3 black and DST 4 a dark orange-brown. Oils DST 1, 2 and 3 are reported to have given API gravities close to 48°. Formation water associated with DST 3 was removed prior to analysis.

The weight percent of wax was determined by filtration through a buchner funnel of a homogenised aliquot of each oil. The results are listed in Table 1. No precipitation of asphaltene or wax occurred when the filtrates were added to an excess of pentane.

The oils were fractionated by silica gel column chromatography using the following eluants; pentane (to elute the saturated hydrocarbons) and 75% pentane/25% toluene (to elute the aromatic hydrocarbons). An asphaltenic residue remained on the column. The results are presented in Table 2.

Gas chromatograms were obtained for the whole oils (Figs. 1 to 4) and the saturated hydrocarbons of the pentane eluates after evaporation to partial volume (Figs. 5 to 8). The following ratios were calculated from the chromatograms; pristane/phytane, C_{17}/pristane, C_{18}/phytane and methyl cyclohexane/benzene (see Table 3).

II

DISCUSSION

The data indicate that all the oils are broadly similar in composition, i.e. probably have a common origin. DST 4 differed from the other oils in having,

(a) a higher proportion of lower molecular weight hydrocarbons.

(b) a higher wax content, and

(c) a higher methyl cyclohexane/benzene ratio

On the other hand, the pristane/phytane, $\underline{n}$-C_{17}/pristane and $\underline{n}$-C_{18}/phytane ratios are similar, as are the relative amounts of saturated and aromatic hydrocarbons (although the relatively low percent-recovery values indicate appreciable losses of light hydrocarbons during analysis).

If the above differences are significant they suggest that a change in migration path following the filling of the lower reservoir resulted in the upper reservoir being filled with oil from a more mature source rock. DST 4 is known to be separated from the other oils by a shaly permeability barrier. The various hydrocarbon molecular ratios (Table 3) also suggest that the source rock for DST 1 was slightly less mature than the source rocks for DST 2 and 3. It must be stressed that this discussion is highly speculative.

The origin of the oils is also uncertain. A geochemical study of the 1/9-4 Well (Report 4162P; Report on a Geochemical Evaluation of the 1/9-4 Well, Norwegian North Sea) concluded that sapropelic source rocks capable of generating significant quantities of oil were absent from the section penetrated. Additionally neither gas-prone nor oil-prone organic matter had reached optimum levels of maturity, although further burial of the majority of these source rocks would probably result in the production of gaseous hydrocarbons.

Similarly the most promising source rocks in wells 1/9-1 and 1/9-2 (Report 4049P; Report on a Geochemical Evaluation of the 1/9-1 Well, Norwegian North Sea; Report 4123P; Report on a Geochemical Evaluation of the 1/9-2 Well, Norwegian North Sea) were Tertiary shales of low maturity whose lateral equivalents at greater depths off-structure could be good source rocks. Nevertheless, a Jurassic source for the oils cannot be ruled out,although there is no development of Upper Jurassic in the analysed sections. Interestingly, the 1/9-4 oils are broadly similar in composition to an oil from the 1/9-1 Well.

TABLE 1

WEIGHT PERCENT OF WAX IN OILS

COMPANY: STATOIL WELL: 1/9-4 LOCATION: NORWEGIAN N.SEA

SAMPLE	PERCENT WAX
DST 1	2.13
DST 2	2.33
DST 3	3.20
DST 4	5.90

TABLE 2

PERCENT SATURATED AND AROMATIC

HYDROCARBONS IN OILS

COMPANY: STATOIL WELL: 1/9-4 LOCATION: NORWEGIAN N.SEA

SAMPLE	SATURATED HYDROCARBONS	AROMATIC HYDROCARBONS
DST 1	39.2	7.7
DST 2	40.9	10.4
DST 3	38.0	5.1
DST 4	44.2	5.7

TABLE 3

$n\text{-}C_{17}$/PRISTANE, $n\text{-}C_{18}$/PHYTANE, PRISTANE/PHYTANE AND METHYL CYCLOHEXANE/BENZENE RATIOS FOR OILS

COMPANY: STATOIL WELL: 1/9-4 LOCATION: NORWEGIAN N.SEA

SAMPLE	C_{17}/pr	C_{18}/ph	pr/ph	mch/bz
DST 1	2.80	3.56	1.67	4.80
DST 2	2.65	3.08	1.42	4.65
DST 3	2.42	2.89	1.41	4.53
DST 4	2.47	2.96	1.38	6.20

FIGURES 1-4

GAS CHROMATOGRAMS OF WHOLE OILS

COMPANY: STATOIL WELL: 1/9-4 LOCATION: NORWEGIAN N. SEA

Fig. 1	DST 1
Fig. 2	DST 2
Fig. 3	DST 3
Fig. 4	DST 4

FIG. 1 STATOIL 1/9-4

DST 1 WHOLE OIL

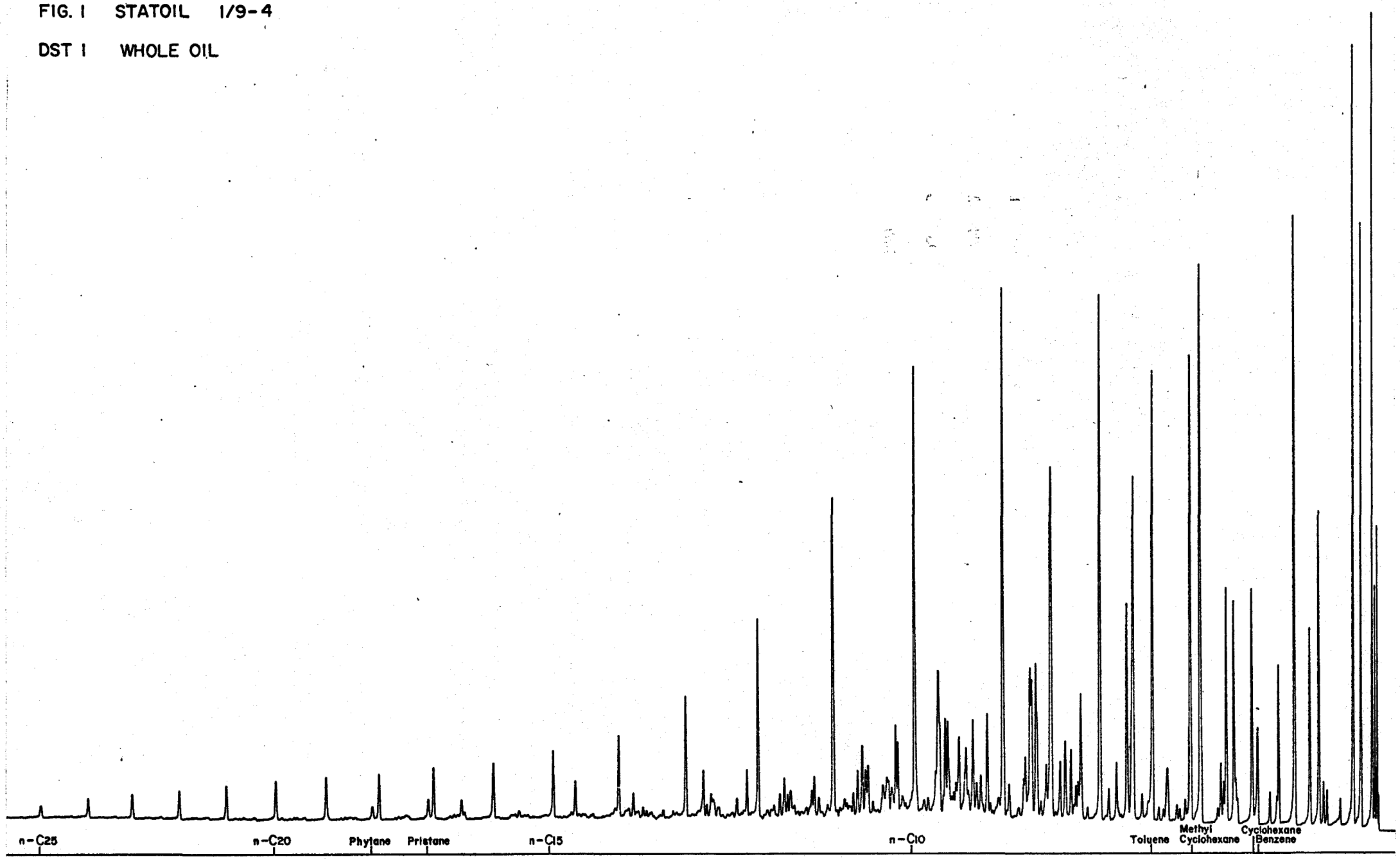


FIG. 2 STATOIL 1/9-4

DST 2 WHOLE OIL

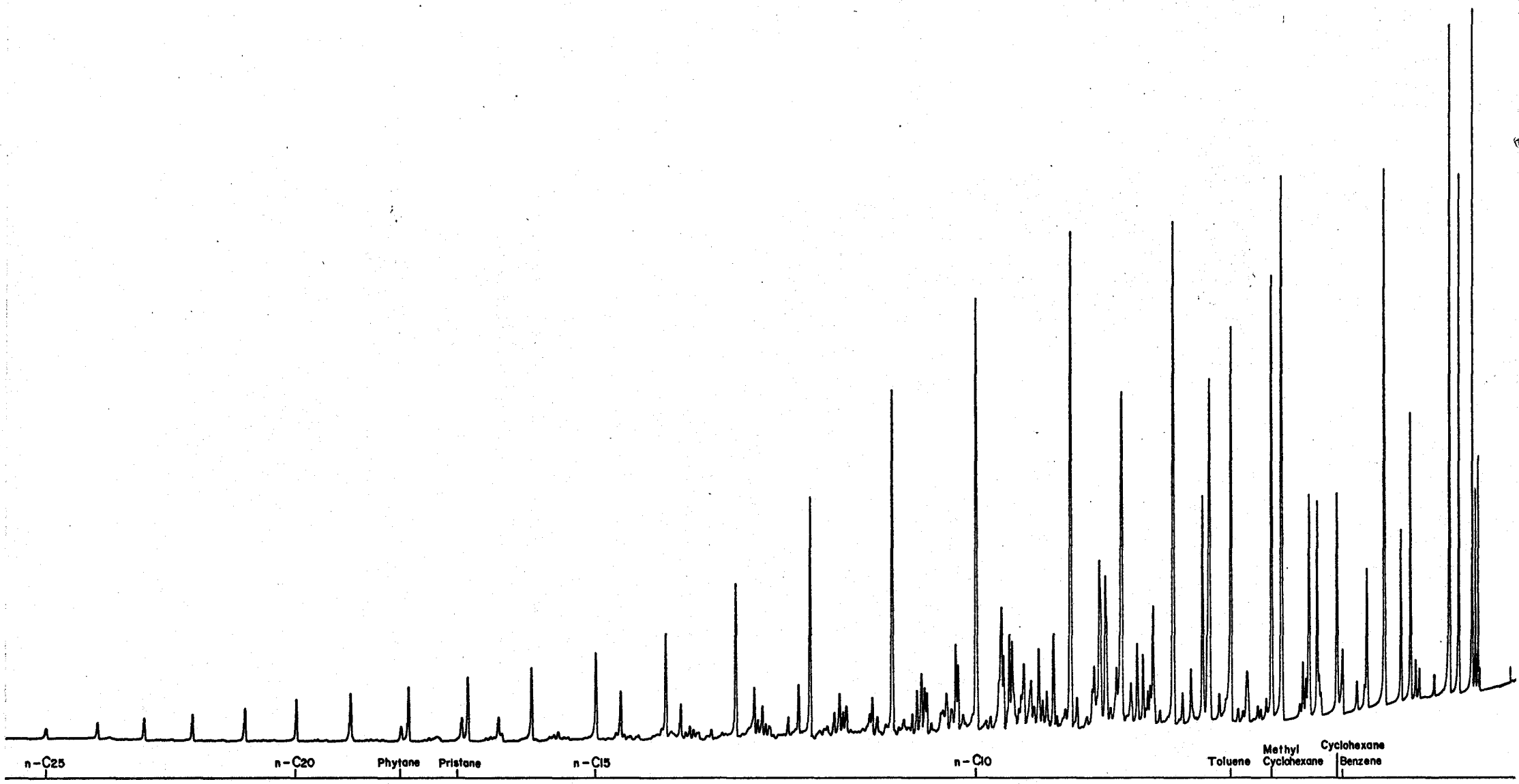


FIG. 3 STATOIL 1/9-4

DST 3 WHOLE OIL

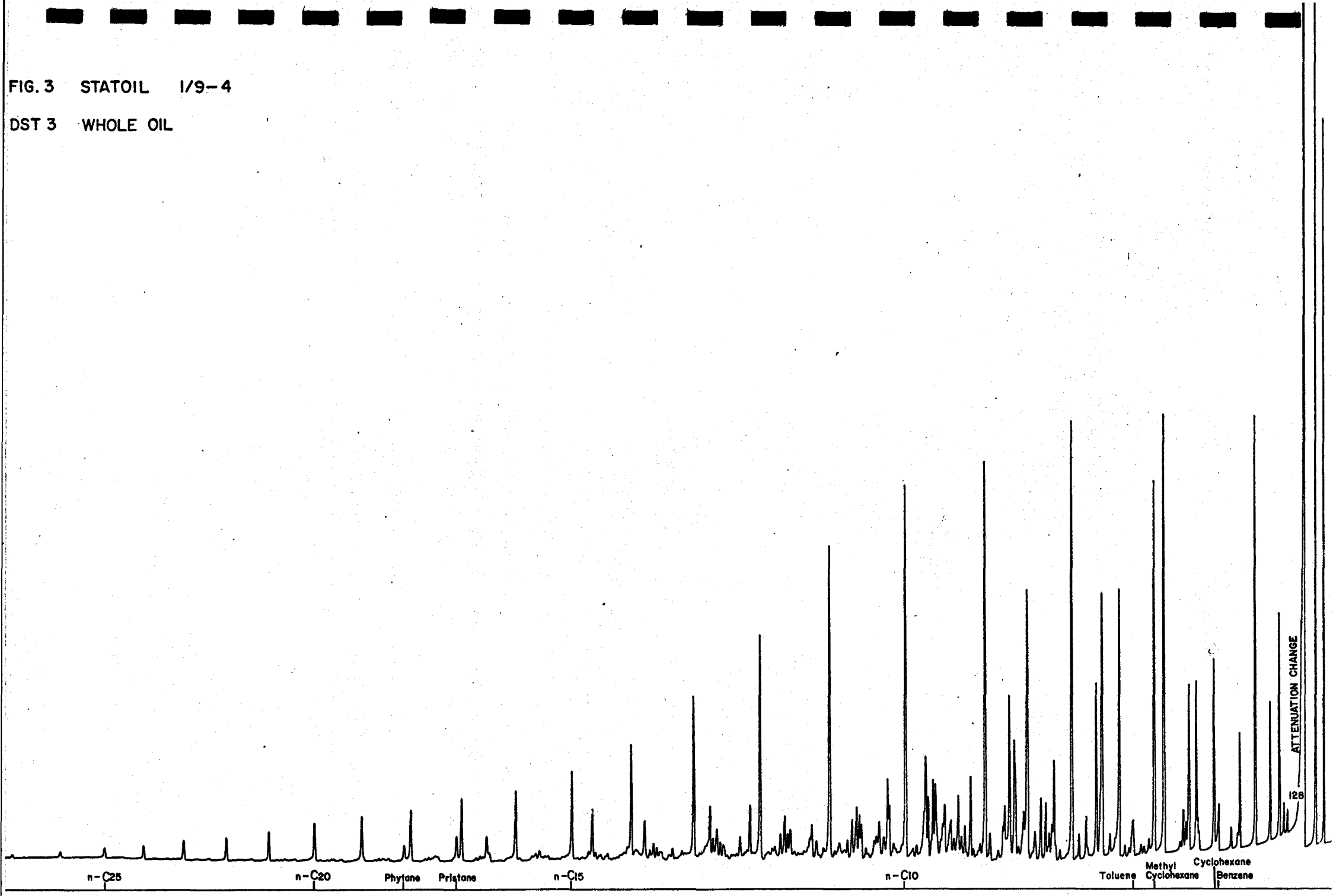
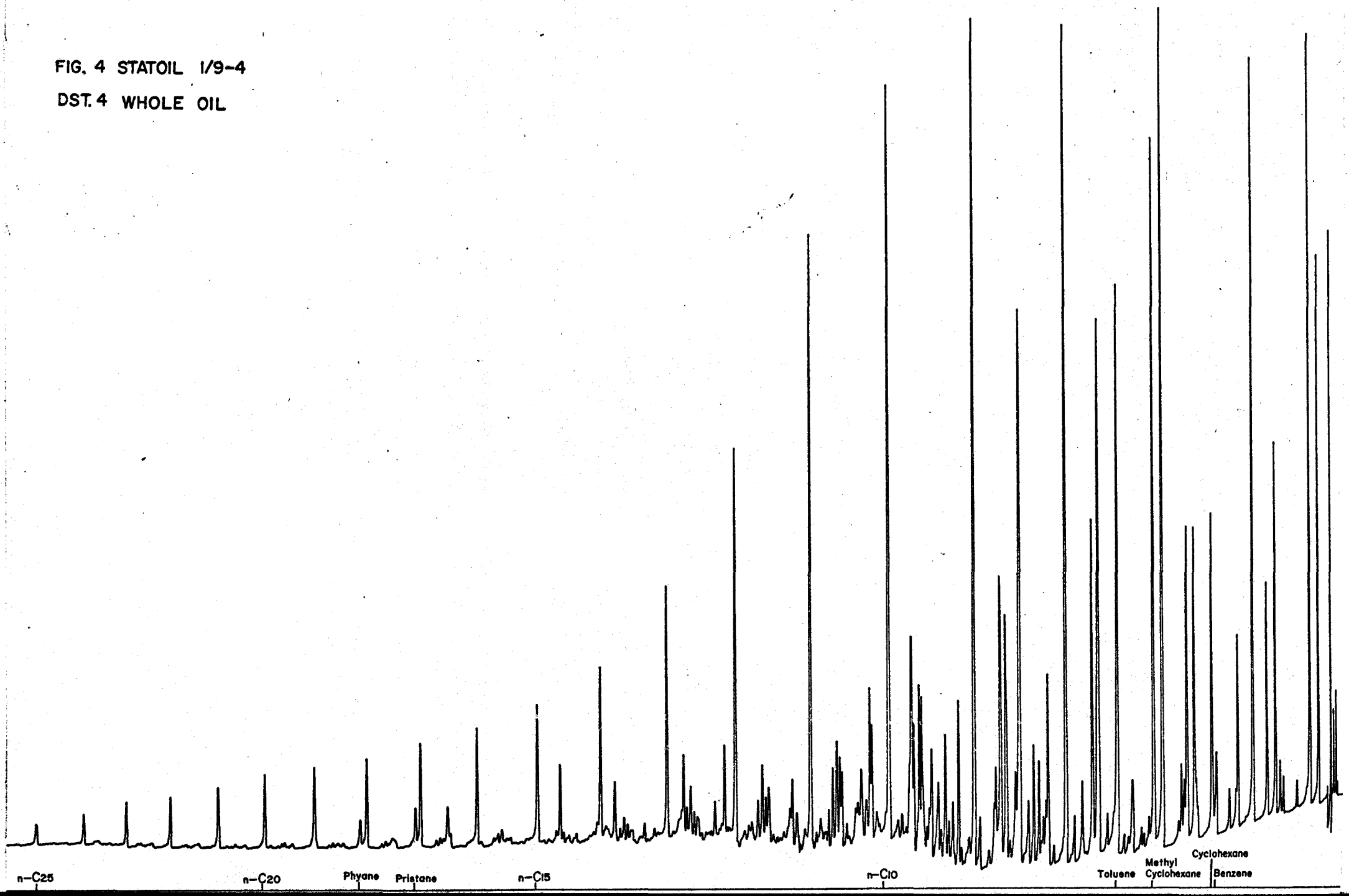


FIG. 4 STATOIL 1/9-4

DST. 4 WHOLE OIL



FIGURES 5-8

GAS CHROMATOGRAMS OF THE SATURATED HYDROCARBONS

COMPANY: STATOIL WELL: 1/9-4 LOCATION: NORWEGIAN N. SEA

Fig. 5	DST 1
Fig. 6	DST 2
Fig. 7	DST 3
Fig. 8	DST 4

FIG. 5 STATOIL 1/9-4

DST 1 SATURATED HYDROCARBONS

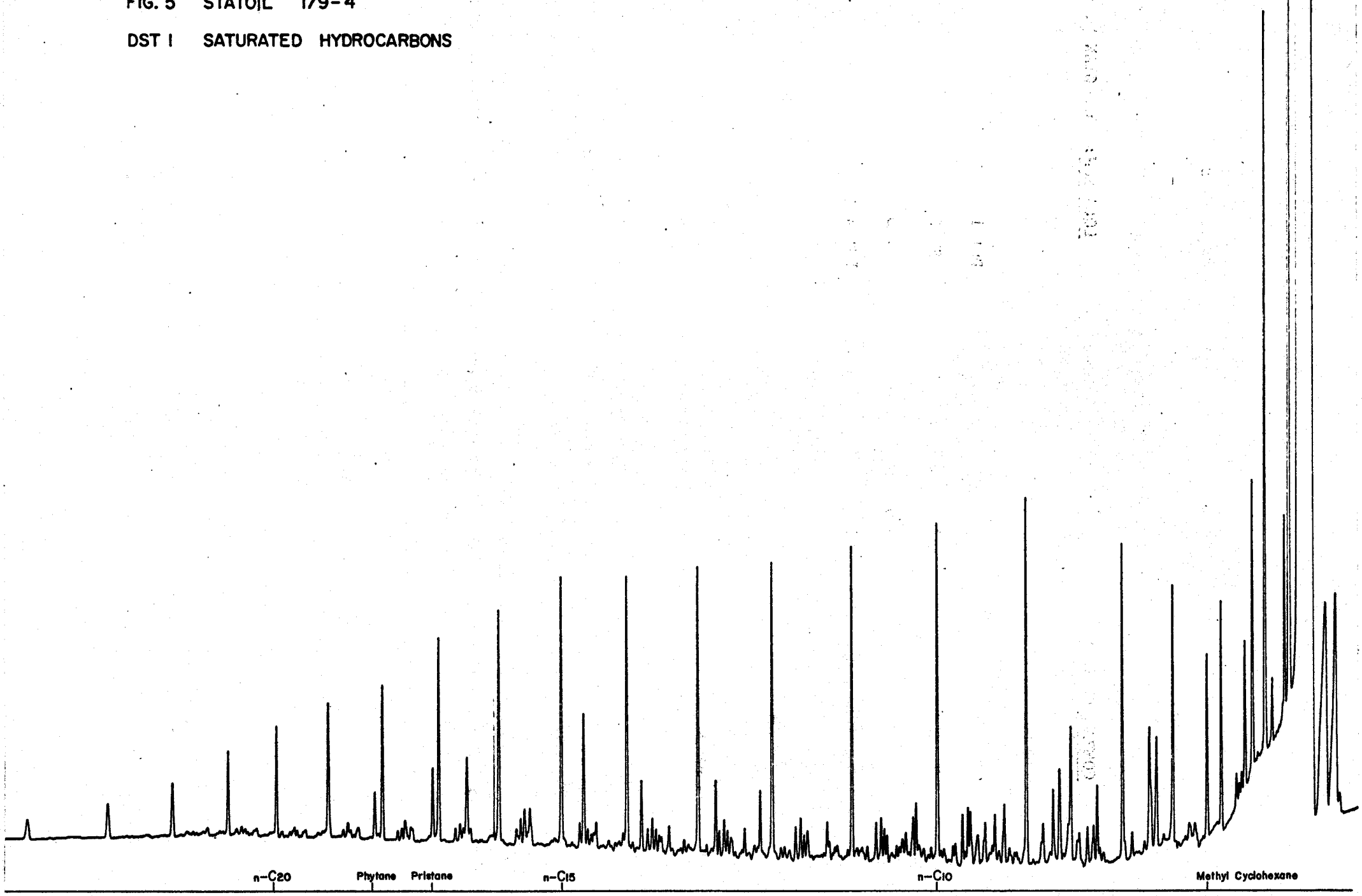


FIG. 6 STATOIL 1/9-4

DST 2 SATURATED HYDROCARCARBONS

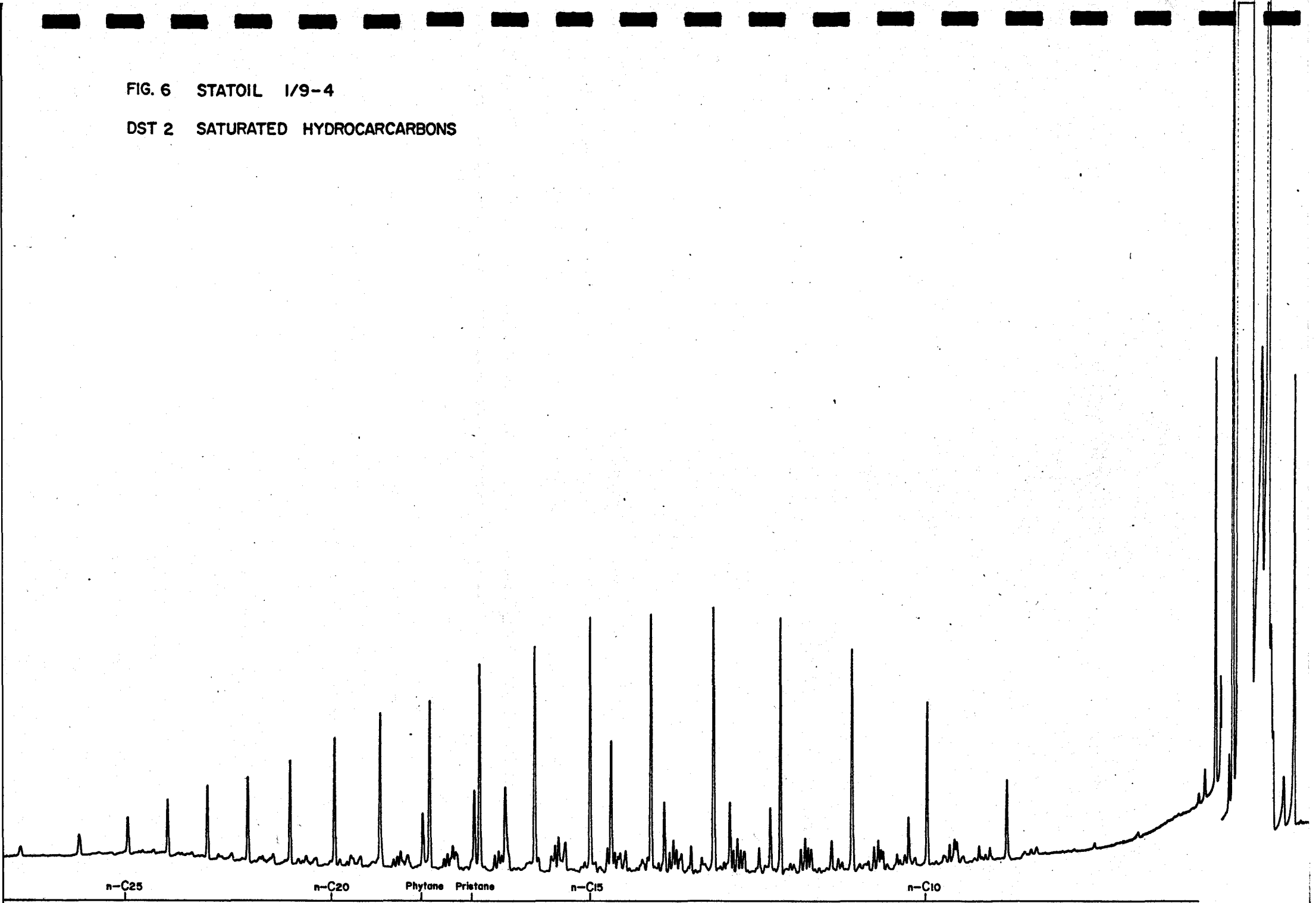


FIG. 7 STATOIL 1/9-4

DST 3 SATURATED HYDROCARBONS

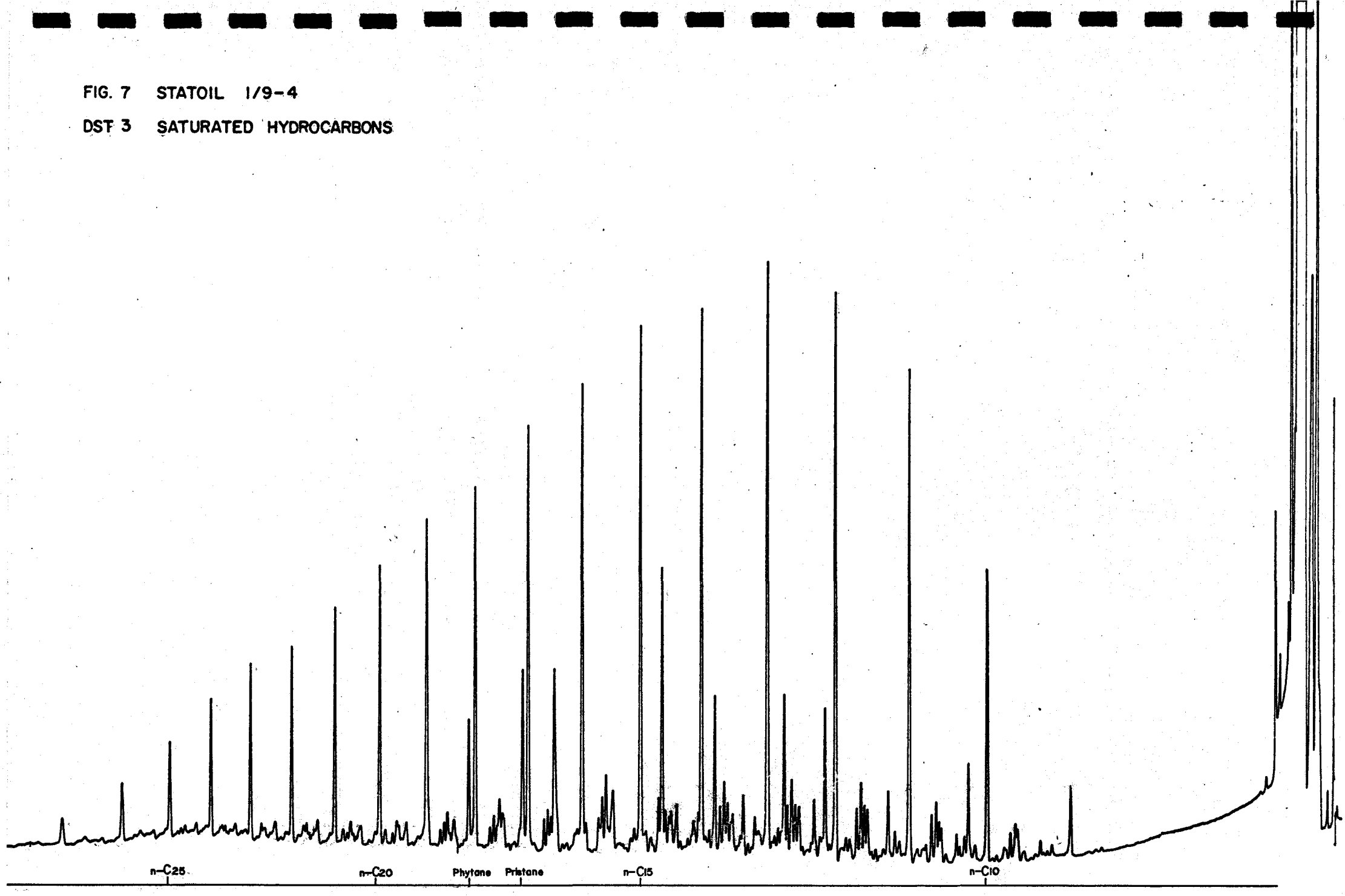


FIG. 8 STATOIL 1/9-4

DST 4 SATURATED HYDROCARBONS