

ETHYL GASOLINE CORPORATION

MANUFACTURING AND TRAFFIC DEPARTMENT

PLEASE ADDRESS REPLY
TO: P.O. BOX 1271
WILMINGTON, DELAWARE

February 9, 1942

Dr. W. F. Machle
Kettering Laboratory
University of Cincinnati
Cincinnati, Ohio

Dear Dr. Machle:

Thank you for your letter
of February 2, attaching copy of your blender
survey in comparison with fifth floor
conditions. I want to have the opportunity
of studying your report carefully, after which
I shall be pleased to pass on to you any
necessary comments.

Very truly yours

Charlie
C. Wasserman

C:LS

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N9529

December 2, 1941

Survey of Hygienic Conditions in the
Blender

Object

44
To examine into the state of ~~the~~ health of blender
in this —————
workers for the year 1941) and to determine whether ~~the con-~~
(Especially) changed
~~dition of this group~~ has ~~altered~~ materially in the past few
To this end,
years. ~~To accomplish this~~ the clinical and analytical

records of the group were studied on a time base and ^{also} by ~~means~~
time of during
~~of comparison with~~ 5th floor workers employed ~~over~~ the same
period ~~of time.~~

Conclusions

(1) The state of health of blenders is apparently worse
than at any time since 1934.

(2) As measured by the rate of occurrence of abnormal
clinical findings, there has been a progressive trend toward
lead
increase in exposure since 1938.

(3) ~~It has not been established that~~ and definite the charted rates
are stable; ~~however,~~ it is obvious that no ~~certain~~ improve-
ment has occurred since 1934.

(4) The rate of occurrence of abnormal ~~positive~~ clinical findings

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year period has been less than that for the 5th Floor group.

(5) In no instance, in either group, do the rates for 1941 reach the 1934 levels. *if abnormality*

(6) The practical significance of the recent increase *in the lead* in the blender must be estimated on the basis of the clinical status of the workers. *exposed*

(7) The lowest rates of abnormality are associated with the longest service.

(8) The present situation is not the result of cumulative effects of years of exposure but is an immediate response to recent irregularly recurring and for the most part brief exposures of increased intensity.

(9) There is no positive correlation between the amount of drumming (which has remained relatively constant) and the occurrence of abnormalities in the blender group.

(10) The most likely explanation for the increase in exposure in 1941 is the inauguration of the 6-hour cycle and the increased throughput.

(11) Twenty per cent. of blenders were not worse in 1941 than in 1940; 80% ^{exhibited} ~~manifested~~ more abnormalities in the last year.

Procedure

The data for this memorandum were taken from the clinical records of the Dye Works Hospital, and the analytical records of the Kettering Laboratory.

To effect comparisons on an annual basis, the frequency of occurrence of abnormalities was converted into rates in each examination ~~for~~ the group under study, the modes of expression being two-fold: ^{the} as number of examinations required to elicit one abnormality, and the number (or fraction) of abnormalities encountered in a single examination. The criteria by which abnormalities were judged ^{all} ~~were~~ as follows:

(1) Subjective

(a) Headache - occurrence in history

(b) G.E. tract disturbance - occurrence in history

or report of occurrence on dispensary card.

(c) Insomnia or dreams - report in history or dispensary card

(d) Weakness, incoordination, etc. - report in history or dispensary card.

(2) Objective

(a) Hemoglobin - any value less than 76%

(b) Erythrocytes - any ^{count}~~value~~ less than 4,300,000

(c) Hypotension - any value less than 100 systolic
or 65 diastolic

(d) Hypertension - any value above 145 systolic or
90 diastolic

(e) Albuminuria - any occurrence

(f) Urinary lead - any value above 0.15 mg./liter

(g) Fecal lead - any value above 1.00 mg./sample.

(h) Blood lead - any value above 0.05 mg./100 gm.

(i) Stippling - any value above 20/50 h.p.f.

(j) Pallor - any occurrence

For purposes of rough comparison the rates of occurrence

of abnormalities in both groups were computed for the total

number of men in each. Following this the rate for each group was determined by years and study was made of subdivisions of each group divided on the basis of 5-year periods of employment. The mean age of each group was calculated, ~~and compared.~~

The incidence of hypotension, low erythrocyte counts and low hemoglobin values ^{was} ~~were~~ determined by years for each group on a rate basis ~~by years~~ since these observations were in our opinion the most significant objective clinical findings recorded.

Results

^{and not by years}
In Table 1, the rates of occurrence of abnormalities ^{in the} in the blender and 5th Floor ~~workers~~ may be compared ~~with~~ ^{each other} ^{by years} ^{also by grouping according to} ~~each other and on the basis of groups with different~~ duration of employment. The two large groups are comparable from the point of view of age as may be seen from inspection of the mean values for age given in Table ~~2~~. Moreover, the distribution of men on the basis of duration of employment was in general the same in both sets ~~of men~~, the

5th Floor groups, however, tending to center somewhat more closely about the mean with too few men employed for less than 2 years to make up a satisfactory group for comparison.

The overall rates for each group were not greatly different, being higher in the case of the 5th Floor employees. ~~There~~ ^{are} It is a matter of considerable interest to note that an inverse relationship exists between the number of years of work and the frequency of abnormalities. That is to say, men who have worked the longest have been freer of symptoms than those working less than two years. This finding ^{the fact} ^{increase} establishes that the recent ~~increase~~ in abnormalities is not ^{the} the result of accumulated injury and exposure, for if this were the case, the higher rates would be associated with the longer ^{periods} ~~times~~ of service. It is also apparent that this relationship is ~~not~~ ^{neither} spurious ~~and~~ ^{nor} a result of recent steady increase in exposure (except possibly in the 1 - 1.9 yr. group) since the 10+yr. group ^{extends over} ~~includes~~ the year 1934 (Fig. 1) in which the rates were the highest encountered.

The rate of labor turn-over has been such that it could

not influence the results over the long time-base studied, since by far the greater proportion of the men had more than 5 years of service in their respective operations, ^{the} ~~any~~ data from the few short-time employees previous to 1940, having ~~not been included in~~ ^{excluded from} this study. It follows, therefore, that we are dealing with a bona-fide phenomenon in which employees with the longest period of exposure manifest the greatest freedom from its potential effects. ~~we may~~ ^{perhaps} attribute this to the fact that these men also have ^{had} the most experience ^{and} longest period of training in the operation.

^{Re abnormalities}
The conclusion that the increased rates in 1941 were the result of chance, desultory exposures is further borne out by the finding that the increases in rates in 1941 were distributed at random ^{among the samples in the} ~~throughout the~~ blenders without relation to the number of years of employment. Further supportive evidence emerges from ~~inspection of~~ the analytical results given in Table 2. Prior to 1935 or 1936, ^{the} ~~too few~~ ^{were to fear} samples ~~were~~ obtained from the men to accurately portray the conditions. ~~However, since this time the mean results for the~~ ^{are}

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abnormalities surprisingly well. Several other interesting considerations are apparent from the figures in Table 2.

First, fecal lead excretion, as measured by the amount of lead found in a single sample of feces, does not correlate with the year-to-year differences in rates of occurrence

of abnormalities seen in the blender group. This is ^{not} to be ~~surprisingly~~ anticipated in view of the fact that ~~the principal source~~ ^{are principally} of sporadic high exposure ~~is~~ to the vapors of T.E.L. and

not to dusts. On the other hand the relatively constant ^{lead} rate of fecal excretion in the Fifth Floor men is ^{associated} ~~in that~~

~~group associated~~ with a similar relatively uniform rate ^{of} abnormalities, as would be anticipated, ^{since} ~~from the fact that the lead~~ exposure ^{lead dusts} of this group is mainly to ~~particulate lead com~~

~~pounds~~. In neither group do the fecal excretions reach values that ^{indicate hazardous lead exposure} ~~are usually considered to be of clinical~~ ~~significance~~.

^{In contrast,}
~~On the other hand~~ the mean urinary lead excretion

(expressed in terms of concentration) has been significantly ^{in all workers}

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This high level is consistent with

~~supports~~ the clinical observations, particularly in the

blender group where ~~there have occurred~~ step-wise increases *have occurred* in

1940 and 1941, hand-in-hand with the increases in rates of

abnormality. Over the entire period of time, however,

correlation is not as close, *however,* ~~as in these years.~~ When the

~~analytical results are separated into those obtained from the~~

~~regular quarterly samples and those from special samples,~~ It

may be seen that the closest correlation *is obtained when* ~~with these is~~

The analytical results on the special samples are set against the clinical findings
~~obtained from the special samples.~~ This is to be expected

in view of the selection involved, since special samples are

in the main obtained from cases of suspected intoxication or

following known episodes of exposure. It would appear, however,

as were *obtain between these two sets of data*
that ~~a closer correlation would be obtained~~ if uniform practices

had been followed regularly throughout the period of study.

That is to say, if over the entire seven-year period, samples *had been*

men who
~~were obtained routinely from cases that~~ presented an undue

had been
number of abnormalities and ~~these findings were~~ due to lead

absorption, one would expect to encounter a very close

association between the rates of abnormality and the magnitude

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of the lead exposure as measured by the excretion. Failure to obtain a closer correlation suggests that the abnormalities were not uniformly due to lead absorption. to obtain a closer correlation may be explained by the non-~~an additional factor that may have operated against a more direct correlation~~ specific nature of the abnormalities, and perhaps to a degree,

~~may be~~ by the high overall levels of exposure. Since we are ^{not} dealing in any

with men ~~(in all groups)~~ in whom cases of acute, unmistakable plumbism ~~do not occur~~, the only ^{of varying lead exposure} evidence upon which complete

~~diagnostic~~ reliance may be placed is that obtained from the

analytical data. In view of this ^{and the additional fact} ~~fact and the observation~~

that special samples ^{indicate} ~~best relate themselves to the clinical~~ ^{primarily the status} of individuals at ^{a particular time} ~~status at any one time~~, it would seem desirable to combine

greater frequency of spot (special) sampling with the routine recording of several items in the clinical data. This study can be carried out on a few men in each operation, ^{men being} selected who have had the higher rates of abnormality or the greatest potential exposure, or both.

On the assumption that conditions within the blender had become worse since 1939, the clinical data ^{were} analyzed to determine which of the observations best portrayed the trend.

^{the effects of} Because of low frequencies and non-related occurrences, it

^{evidence is}

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the trend sufficiently well ~~conceivably~~ to be used as indices. These are tabulated in Table 3. It is evident that hypotension is the best criterion of ~~the three studied~~, since the overall rates for hemoglobin and erythrocytes were too low to permit differentiation. It ought not ~~to~~ be assumed ~~from this~~ that these data would not achieve significance as indices were the determinations ~~to be~~ made more frequently. It is suggested that these observations be made routinely on the men selected for special study, with the idea of throwing light upon this point.

Discussion

From a practical point of view the foregoing results may be reviewed in the light of future demands upon the lead plants and blender. Close year-to-year correlation between amount of drumming and rates of abnormality is not found although observation and experience have ~~adequately established~~ ^{reasonably} ~~this~~ this procedure ~~to be~~ ^{might occur} one of the most hazardous in the blender. Any relationship that ~~occurred~~ would tend to be obscured by

the slight annual differences in numbers of drums and the

Moreover, because of present design and the lack of segregation of
necessity of treating the data on a yearly basis. ~~Accordingly,~~

Again,

fluctuation in exposure from month ~~to~~ month would not appear

from these figures and since any ^{induced} effects would be noted within

an even briefer time interval, it ^{need} ~~would~~ not be anticipated that

correlation on a yearly basis would ~~necessarily~~ follow. For

the same reason neither do the quantities of T.E.L. produced

per year relate themselves to the abnormalities in any close

fashion. It is significant nonetheless that sudden increases

in production of Fluid (such as that which occurred in 1934 and

in 1939) are associated with increases in clinical ^{symptoms} ~~findings~~.

Part of the increase in rates of abnormalities is undoubtedly

due to the addition of ^{new} ~~men~~ and less well-trained men. *In*

large part, however, it is the result of increase in exposure

since all men manifested the effect. *In* ^{u.} ~~light~~ of this fact

TEL
we ~~may~~ view with concern any increase in ~~lead~~ production,

especially that which involves an increase in the amount of

drumming. The lead hazard has been well controlled over a

*difficult to measure of exposure, it would not be expected that a
other year-to-year correlation would appear.*

period of years, but the increase in ~~clinical findings of~~ *abnormalities in workers*

the blenders in 1941, the anticipated load for 1942, and the age

of the existing ~~equipment~~ *blenders* ~~urge upon us the necessity of~~ *necessitate*

~~immediate~~ substantial improvement in the equipment ~~of the~~

~~blender~~ as soon as possible.

E. E. Evans, M. D.

Willard Machle, M.D.

Table 1

Prevalence of Abnormalities During 12-Year Period 1930-1941

Blonder Group (25 Men)

Teeth	No. Exams	No. Exams Per Abnormality	Rate/Exam
Upper	1200	3.1	0.323 $\pm$ 0.013
Lower	1754	3.1	0.476 $\pm$ 0.012
Both	163	1.6	0.625 $\pm$ 0.038
Upper	74	1.4	0.714 $\pm$ 0.053
Lower	102	1.9	0.526 $\pm$ 0.053
All	246	2.4	0.417 $\pm$ 0.028

Fifth Floor Group (36 Men)

Upper	560	4.7	0.213 $\pm$ 0.016
Lower	520	1.7	0.526 $\pm$ 0.025
Both	125	1.6	0.625 $\pm$ 0.043
All Men	1765	1.9	0.526 $\pm$ 0.023

Table 2

Lead Excretions of Blender and Fifth Floor Men

(Urine - mg./L.; Feces - mg./sample; Blood - mg./100 ml.)

Blender

Year	Special Samples		Quarterly Samples		All Samples		Blood
	Urine	Feces	Urine	Feces	Urine	Feces	
1941	0.16	----	0.09 *	0.35 *	0.14	0.35	0.050
1940	0.15	----	0.12	0.51	0.13	0.51	0.048
1939	0.12	----	0.10	0.43	0.11	0.43	0.042
1938	0.13	0.68	0.10	0.30	0.11	0.32	-----
1937	0.14	0.25	0.10	0.40	0.13	0.38	-----
1936	0.16	0.33	0.14	0.64	0.15	0.60	-----
1935	0.008	0.27	0.10	0.39	0.09	0.36	-----

Fifth Floor

1941	0.13	----	0.07 *	0.41 *	0.10	0.41	0.045
1940	0.13	----	0.07	0.41	0.09	0.41	0.038
1939	0.10	0.22	0.09	0.34	0.10	0.32	0.035
1938	0.10	0.59	0.10	0.46	0.10	0.47	-----
1937	0.14	0.60	0.06	0.40	0.09	0.43	-----
1936	0.18	0.46	0.08	0.36	0.12	0.38	-----
1935	0.07	0.91	0.08	0.36	0.08	0.43	-----

** Note: 20 of 100 samples are included. These results may not portray conditions adequately.*

Table 3

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Rates of Occurrence of Specific Abnormalities for
the Past Four Years

Year	Blender				Fifth Floor			
	Hypo- tension	Hb - 76%	Eryth. - 4.5 M.	All Abnorm.	Hypo- tension	Hb - 76%	Eryth. - 4.5 M.	All Abnorm.
1941	0.244	0.06	0.05	0.555	0.139	0.03	0.04	0.357
1940	0.175	0.03	0.05	0.348	0.134	0.05	0.02	0.305
1939	0.152	0.07	0.001	0.163	0.175	0.001	0.01	0.378
1938	0.244	0.003	-----	0.400	0.264	-----	0.02	0.354

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Table 4

Mean Age of Groups under Study

	Mean Age	Sigma	P.E.
Blender	36.17	± 6.71	± 0.94
Fifth Floor	35.33	± 5.00	± 0.56

ABNORMALITIES RATE/EXAMINATION

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07

06

05

04

03

02

01

1933

1934

1935

1936

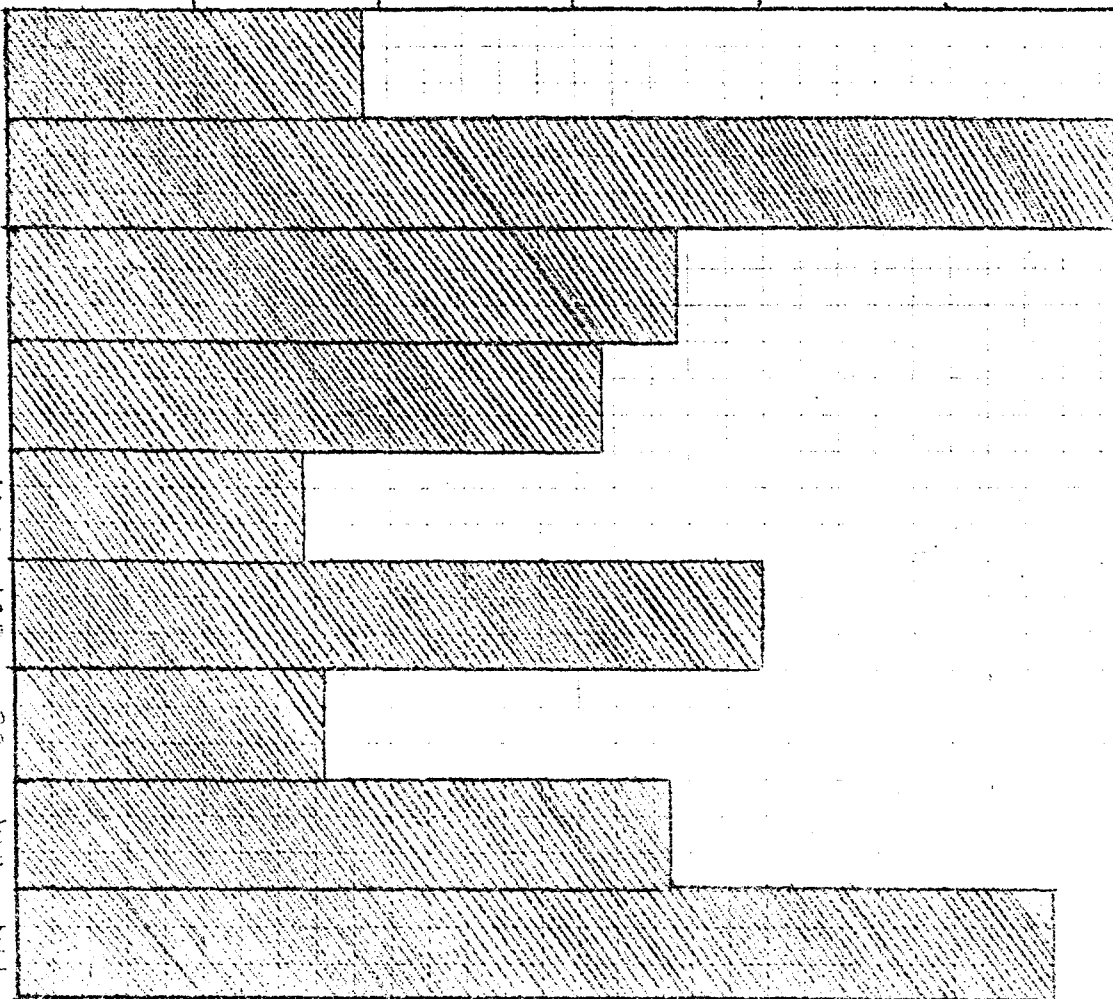
1937

1938

1939

1940

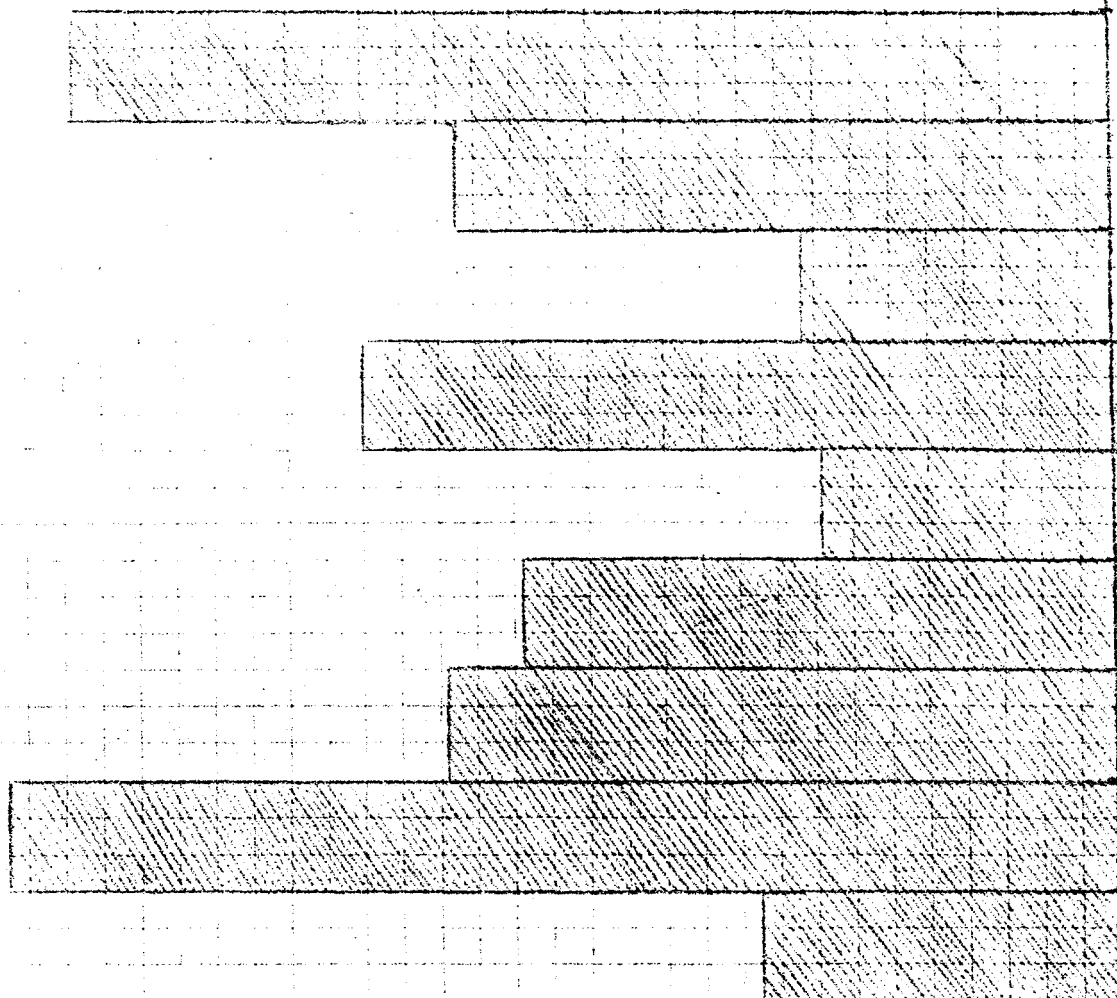
1941



BLENDER

YEARS

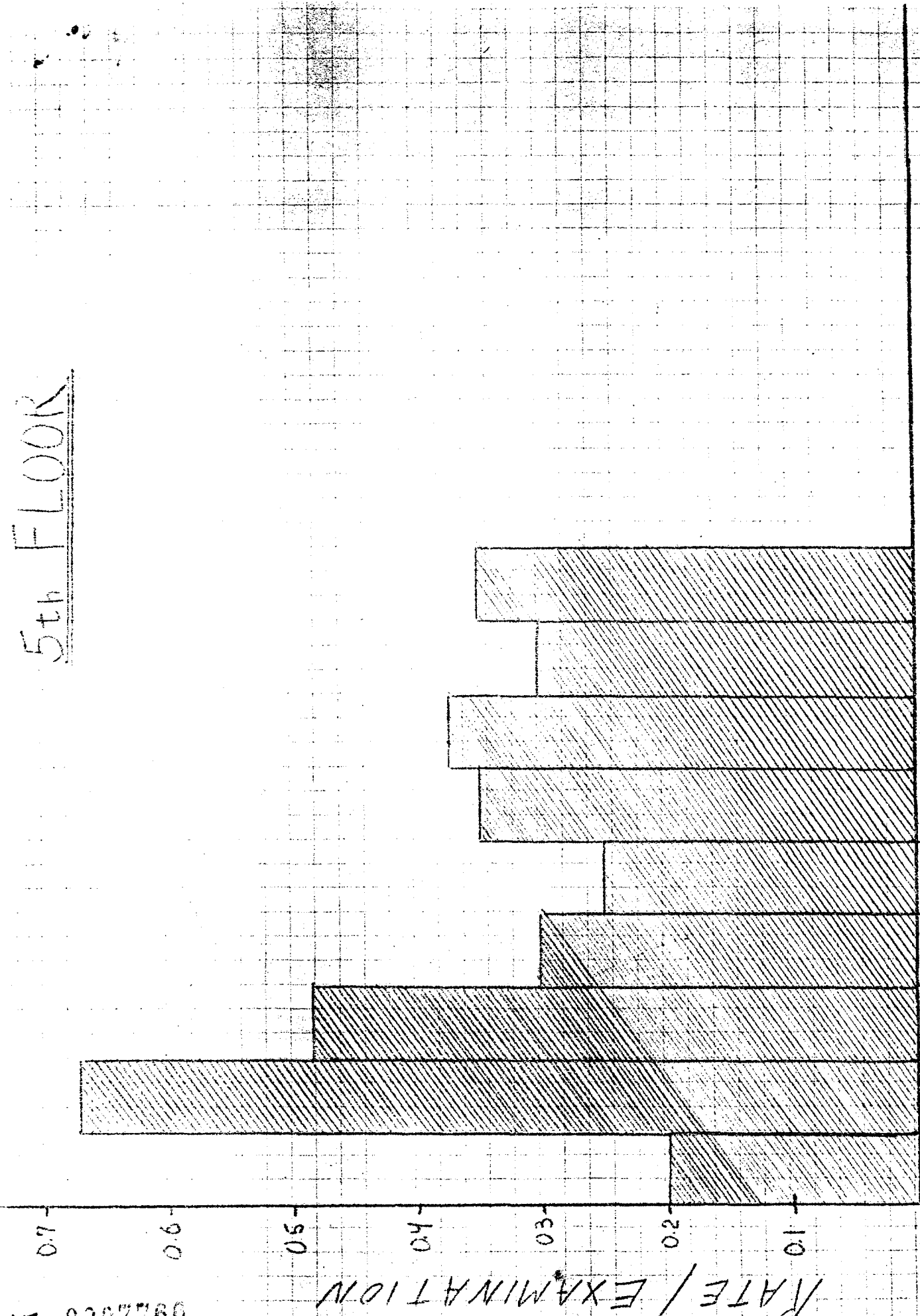
BLENDER



YEARS

11 AILE / EXAMINATION

5th FLOOR

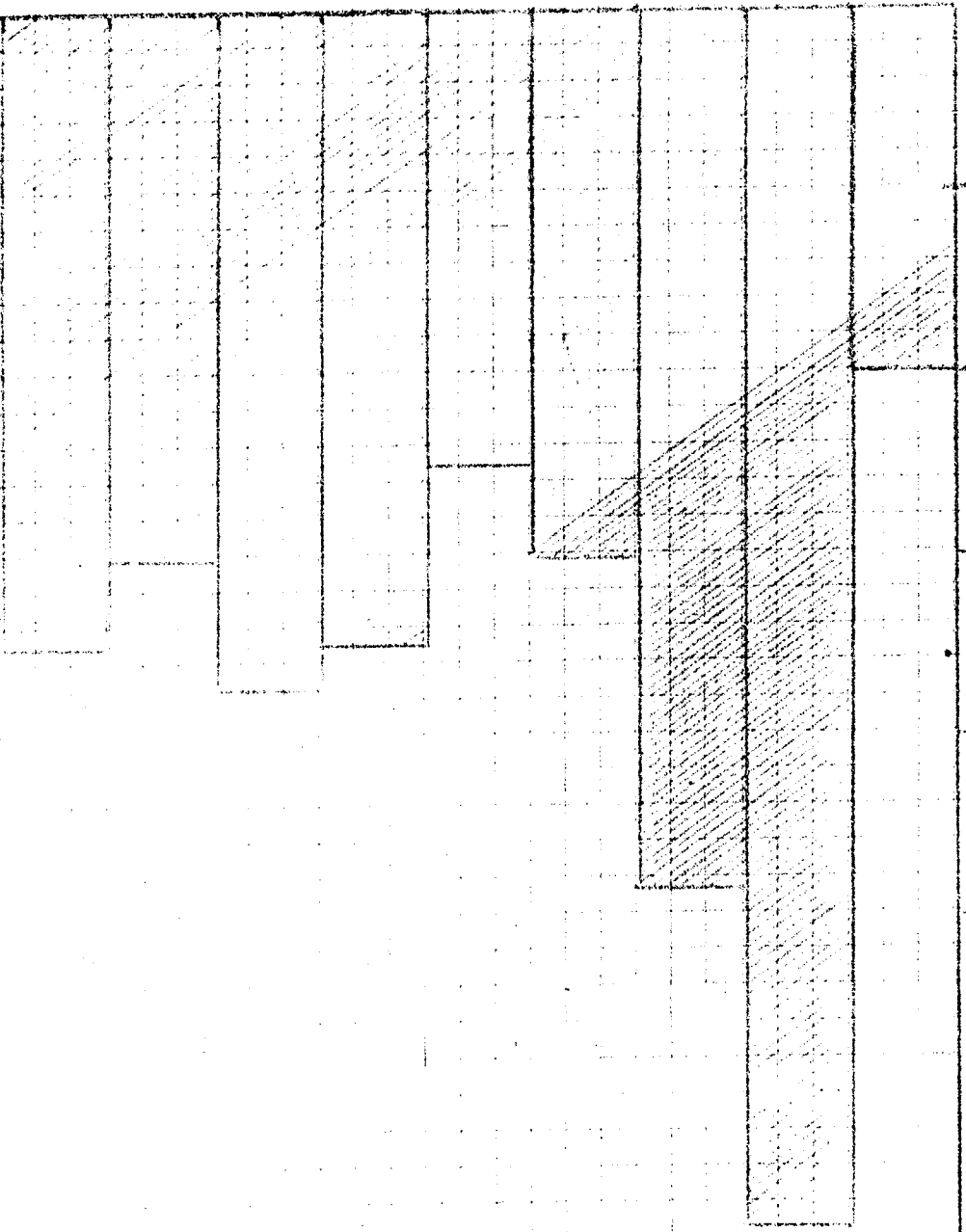


1933 '34 '35 '36 '37 '38 '39 '40 '41

YEARS

5/1/5

10 20 30 40 50 60 70 80 90 100



EXAMINATION

5th FLOOR