R413
WAS

Application of Methods of Statistical Analysis

to Company Standardization Work

by

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Purpose of Discussion

As a background for the Forum discussion today, Dr. Gaillard asked me to give a brief outline of what he termed the theoretical basis for the application of statistical method in company standardization work. Years of experience have taught me that perhaps the best kind of sleeping potion for an engineering audience is the phrase "theoretical basis". Perhaps Dr. Gaillard felt that in these troubled times most of us are so on edge that the best way to have a successful meeting is to start it with a short period of repose. Accordingly, he assigned me the job of administering the sedative. He assured me, however, that there would be some in the audience to furnish the fireworks later.

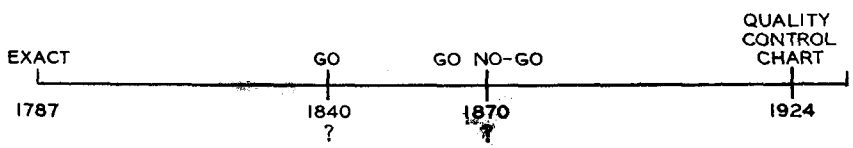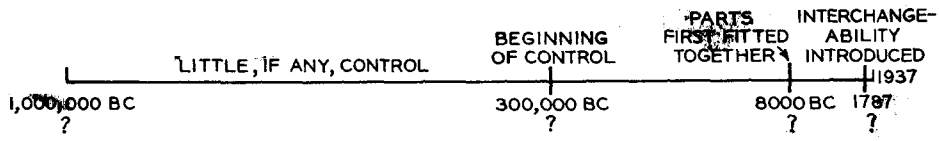| Mass Production	Scientific Method	Governmental Acts
Specification	Hypothesis	Legislative
Production	Experiment	Executive
Inspection	Test of Hypothesis	Judicial

Text from the Prophets

"The possibility of improving the economy of steel to the consumer is therefore largely a matter of improving its <u>uniformity</u> of quality, of fitting steels better for each of the multifarious uses, rather than of any direct lessening of its cost of production."

John Johnston
Director of Research
U. S. Steel Corporation

"Thus in many directions the engineer of the future, in my judgment, must of necessity deal with a much more intimate <u>knowledge</u> of the materials with which he works than we have been wont to deal with in the past. As a result of this more intimate knowledge his structures will be more <u>refined</u> and his factors of safety in many directions are bound to be less because the old elements of uncertainty will have in large measure disappeared."

Frank B. Jewett
President
Bell Telephone Laboratories

1,000,000 YEARS AGO	150,000 YEARS AGO	10,000 YEARS AGO	150 YEARS AGO
			INTRODUCTION OF INTERCHANGEABLE PARTS

Why after 1900

LITTLE, IF ANY, CONTROL | BEGINNING OF CONTROL | PARTS FIRST FITTED TOGETHER | INTERCHANGE-ABILITY INTRODUCED

1937

1,000,000 BC
?

300,000 BC
?

8000 BC
?

1787
?

EXACT | GO | GO NO-GO | QUALITY CONTROL CHART

1787

1840
?

1870
?

1924

STATISTICIANS DREAM

Abstract concepts and theory precede understanding of facts.

Concept of State of Statistical Control

Bowl $\begin{cases} 1) & \text{Maximum Control} \\ 2) & \text{Valid Prediction within limits.} \end{cases}$
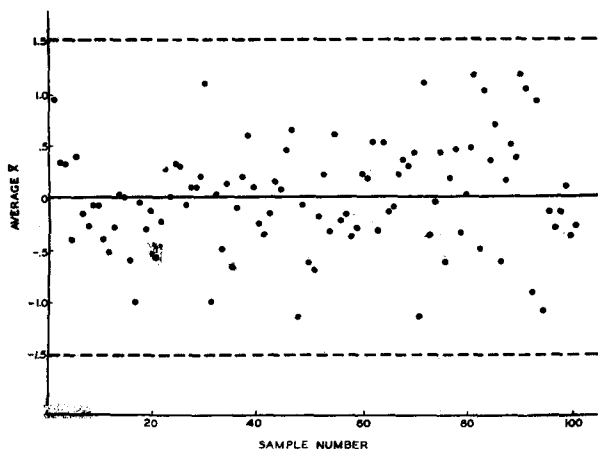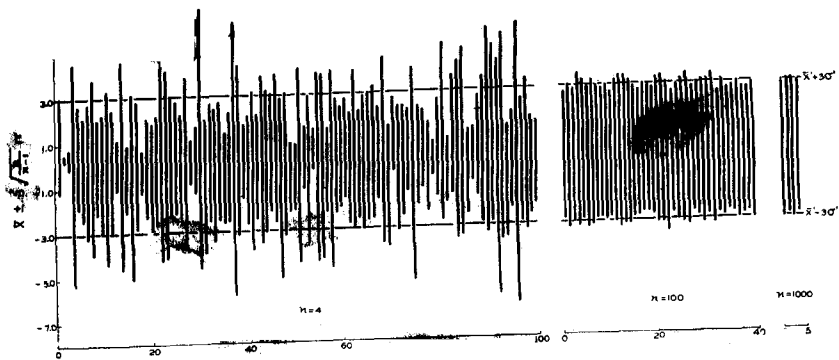

Fig. Valid prediction of statistic θ if we know $f(X)$ in bowl.

PREDICTION — TYPE II

Fig Even if we know $f(X)_a$ and have control we cannot set efficient tolerance ranges.
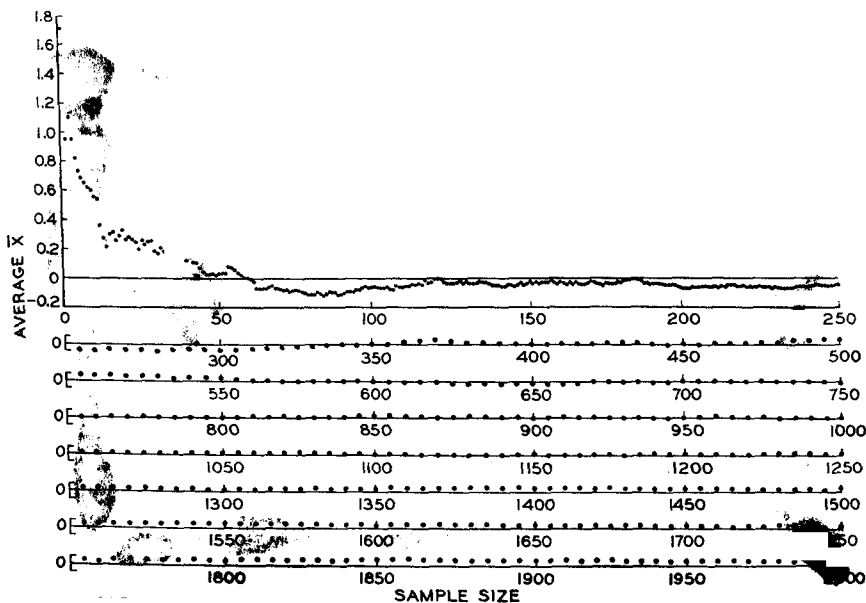

Fig Even if we have state of control we must have large samples to set efficient tolerances.

HOW ATTAIN STATE OF
STATISTICAL CONTROL.

Ans. By means of the operation
Statistical Control.

Steps
1. Specify how observed data are to be analyzed to give clues for assignable cause.

2. Specify how data are to be taken and broken up into subgroups.

3. Specify criterion.

4. Specify action to be taken when criterion is not met.
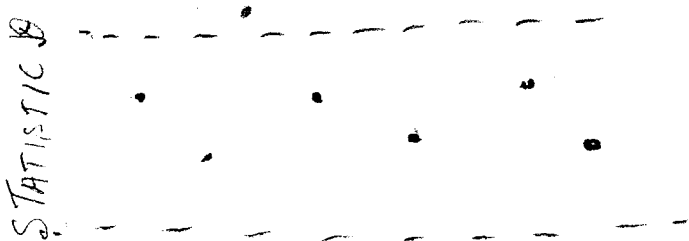
5. Specify quantity of data.

STATISTIC D

Fig — Criterion.

SPECIFICATION

Old

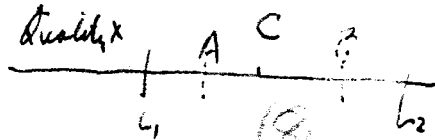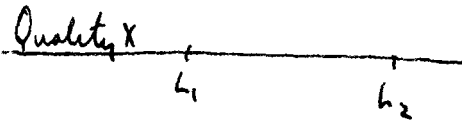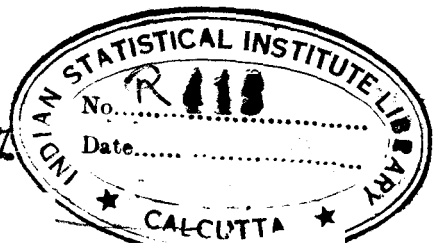|	
1. Tolerance range as screen.	1. Specification is of nature of hypothesis
2. Mass production based upon scientific knowledge	2. Mass production a means of acquiring knowledge.

Quality X

L_1 L_2

Quality X   A   C   ?

L_1 L_2

fig —

Show importance from viewpoint of design — Overall Tolerance limits

100%

$\frac{1}{\sqrt{n}}$

— ? about 30%

OLD	NEW
Live with the demons of chance	1) Get rid of the demons of chance.

<u>Example.</u>

a) Slide, showing 20 d obs. of resistance.

b) slide showing control charts and how demons were eliminated.

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2) Take a lot of data and shake well before analyzing.	2 Take a lot of data but do not shake before analyzing.

<u>Example</u>

Evidence lost in shaking.

Old	New
1) Routine job	1) Important step in scientific method.
2) Screening process separate good from bad	2) Detect assignable causes to be removed
3) Eye on the product	3) Eye on the process.
4) Inspects in accord with a standard	4) Helps shape ~~standard~~ in much same way as a judge helps shape the law.

CONCLUSION

Methodology

→ STEP I → STEP II → STEP III →

OLD
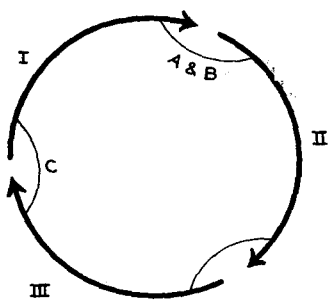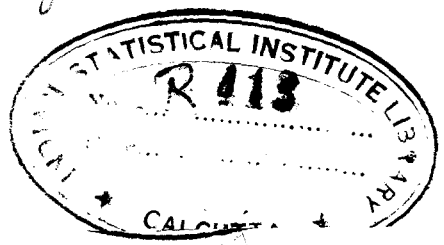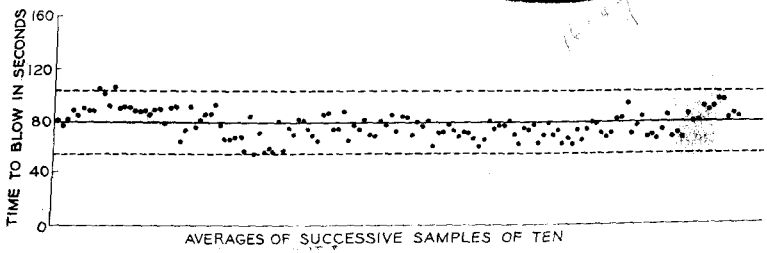

NEW

Statistical method + Mass production

New tool of research.

Results

Control better than more refined measurements.