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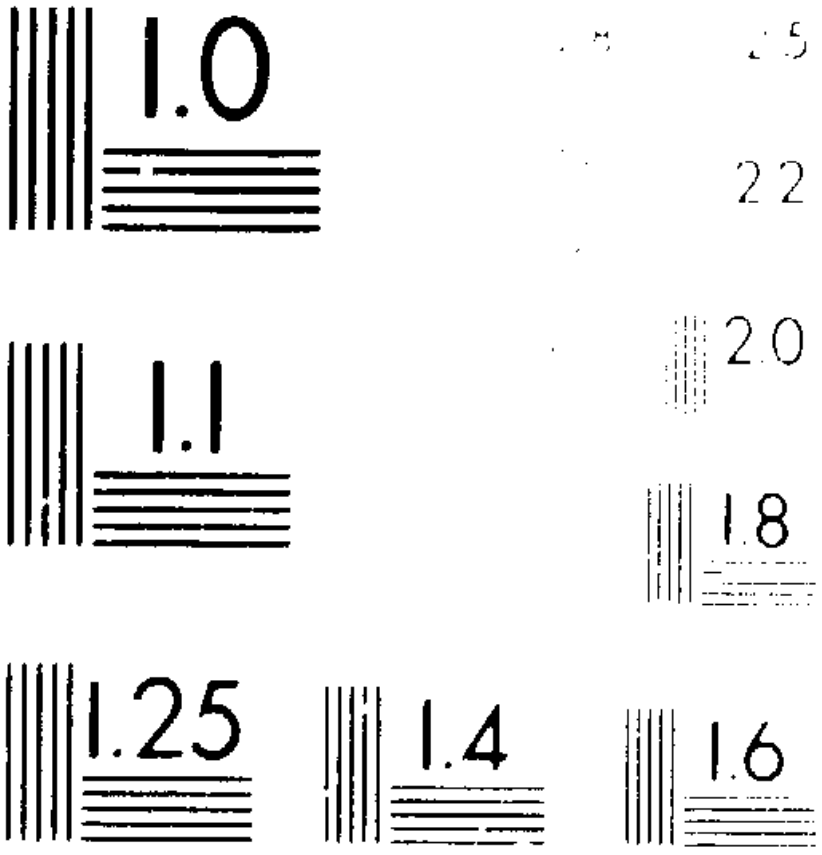
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org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FIN K. L. UTNE
Fjellveien 7
1800 ASKIM
Norway
Tlf. 02- 88 29 18

14376

FINAL REPORT

Job ref.: DP/EGY/81/029/11-58.

Duty Station: Plastic Development Centre (PDC), Alexandria.

Time: 3. December 1984 - 17. January 1985.

Summary

On my first day at the Centre I was cordially greeted by Eng. Mrs. Nadia Nosseir, Head of Technical Affairs, and introduced to the staff.
A review was made on the tasks lying ahead, and a work-program was set up. (Attachment A)
As is usual, such a program could not be followed rigidly, as new points were constantly showing up.

The Director of PDC, Mr. Abu Zeid, was abroad at the time, but we met and discussed details a few days later.

After two weeks it was decided that my stay was to be prolonged by 14 days, and that I was to participate with a lecture in a symposium held by PDC for representatives from the plastic industry on the 15th January. (Attachment B)
This prolongation enabled us also to complete the items of the original work-program.

I would estimate that my time was roughly divided thus:

25% Repairing and setting in order the equipment. (Attachment C)

25% Instructing the counterparts in the calibration and use of the equipment.

15% Lectures and talks on statistics and other actual technical topics.

10% Accomplishing tests on samples delivered by customers and suggesting reports on the same.

10% Going through lectures that the counterparts were to hold in coming courses for technicians from the plastic industry.

5% Advising on the themes to be included in future advanced courses.

5% Giving advice on Standards to be adopted.

5% Giving advice on new equipment. (Attachment D)

Askim, 21. January 1985

Attachment A

مركز تنمية صناعات البلاستيك
PLASTIC DEVELOPMENT CENTRE
CTORIA – ALEXANDRIA
فيكتوريا – إسكندرية

Copy for Eng. / Utne

Nadia Nosseir

WORK PROGRAMME FOR MR. FIN UTNE MISSION
From 3 December 84 till 2 January 85

3 Dec.	Arrival Alexandria
4 Dec.	Meeting with Head Technical Affairs and PDC staff, discuss job description and Haze Meter to find fault.
5 Dec.	OFF
6 Dec.	Study of specifications list 1984
7 Dec.	OFF
8 Dec.	OFF
9 Dec.	Study of theoratical background for the new equipment (chemical lab.)
10 Dec.	One Day Symposium Given By Esso Chem Co. to PDC
11 Dec.	Study of theoratical background for the new equipment (chemical lab).
12 Dec.	Electrostatic, investigate practical cases List of Egyptian Standards
13 Dec.	Sample preparation, shape , orientation
14 Dec.	OFF
15 Dec.	OFF
16 Dec.	Sample taking, where, how many
17 Dec.	Visit
18 Dec.	Quality control of film thickness uniformity
19 Dec.	General solving of problems, PVC used in sewage.
20 Dec.	Programme for the calibration of equipment.
21 Dec.	OFF
22 Dec.	OFF
23 Dec.	Statistical method
24 Dec.	Study of engineering programmes (training)
25 Dec.	Suggestions for equipment for packaging
26 Dec.	Visit
27 Dec.	Make a study of the relation between mechanical, optical and rheological tests.
28 Dec.	OFF
29 Dec.	OFF
30 Dec.	General solving of problems plastics used in packaging
31 Dec.	Programme for the calibration of the equipment
1 Jan.	Visit
2 Jan.	General discussions
3 Jan.	Fly Cairo/Oslo

Head Technical Affairs
Fa Nosseir
Ms. Eng. N. Nosseir

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تليفون :
تلغرافيا : إيجيبلاستيك
تلكس : ٥٤٢٢٣
ص.ب : ١٥١٧ المعمورة العلمية الإسكندرية

مركز تنمية صناعات البلاستيك
PLASTIC DEVELOPMENT CENTRE
VICTORIA - ALEXANDRIA
ڤيكتوريا - اسكندرية

ENG. FIN UTNE MISSION
4th DECEMBER - 2nd JANUARY

ACTIVITIES WHICH WILL BE UNDERTAKEN DURING THE MISSION

1. Haze Meter try to find fault.
2. Electrostatic, investigate practical cases.
3. List of Egyptian Standards.
4. a) Study of specifications List 84
   b) Study of theoratical background for the new equipment (chemical lab.)
5. a) Sample preparation, Shape, orientation
   b) Sample taking, where, how many
6. Make a study of the relation between mechanical, optical and rheological tests.
7. Quality control of film: thickness uniformity
8. General solving of problems: a) PVC used in sewage
   b) Plastics used in packaging
9. Programme for the calibration of the equipment
10. Statistical methods
11. Study of engineering programmes (training).
12. Suggestions for equipment for packaging.
13. Some visits to plastics industry in Egypt upon request.

Head Technical Affairs
Ms. Eng. N. Nosseir

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تليفون :
تلغرافيا : ايجيبلاستيك
تلكس ٥٤٢٢٣
ص . ب : ١٥١٧ المنظمة العالمية الاسكندرية

Attachment B - DP/EGY/81/029/11-58.

Lecture held by Fin Utne 15.01.85 in PDC, Alexandria.

SOME EXPERIENCE ON QUALITY CONTROL.

My name is Fin Utne. My homeland is Norway, where I have for more than 25 years been working in the Centrallaboratory of a large concern with seven different factories. For the last 15 years I have been responsible for the electronic instruments which the laboratory makes use of in analytical work.

The concern is mostly occupied with rubber production, being the only producer of automobil tires in Norway. But part of our production is with plastics.

Questions arising concerning plastics were usually forwarded to me, but about half of my work was in connection with rubber also.

I have been asked to give a lecture here on Statistical Quality Control, but I have read a lecture held here for about a year ago by our Head of Technical Affairs, Eng. Mrs. Nadia Nosseir and I must admit, I could not do it as well.

So I have chosen to tell you of some experience we have had on quality control.

I am going to pick out some typical cases of quite different types, where quality control has played an important role.

As you may hear, I am deliberately trying to talk very slowly and distinctly so that you may understand every word that I am saying. Neither you nor I am communicating in our mother tongue.

First I will fresh up some of the main points in Eng. Nosseir's lecture.

In the production of a lot of presumably identical articles, there will always be some variation of a dimention if you measure it accurately enough. This is a variation of chance, a quite natural phenomenon.

If we check these measurements in a frequency distribution chart, we get something like this. (Se Fig.1a)

If we draw a line connecting the endpoints of our evenly spaced checkmarks, we get an envelope looking like this.(Fig.1b)

In this special example we used only 50 measurements. If we had taken 1000 measurements, or 50 000, and had used smaller intervals, then the curve would have tended to get near to the curve that we call a normal frequency distribution, something like this. (Fig.2)

The vertical axis shows the frequency, or the probability of occurrence of a value of magnitude x measured along the horisontal axis. We get a maximum when x is equal to the population mean, $\bar{\bar{x}}$, and the curve is symmetrical about this value.

Now this curve is purely a theoretical curve based on many theories on probability. Some of the parameters governing the curve are given here. (Fig. 3a)

A man working on a statistical problem usually does not know anything about the curve that he is going to fit to his measurements. He only has a list of measurements that have been done.

What can he do?

If he is sure that his measurements really only differ by random variations, he can work out a sample mean value, $\bar{x}$, and his sample standard variation, s.

If he uses the correct formulae, then he can at least be sure that he is doing his best. (Fig. 3b)

Let us take an example. A man has done tensile tests on presumably identical test pieces, and has measured these 10 values. (Fig. 4a)

Nine of the values are clustered around 420 newtons, and the one that I have placed on the bottom is the only value less than 300 N.

By the standard formulae he gets a mean value $\bar{x} = 423.7$, and a sample standard deviation $s = 9.9$. He should see at once that there is something wrong with the measurement on the bottom.

It differs from the mean by a value of 25.7, which is 2.6 times the standard deviation. The probability of having a value so far from the mean is only $f = 1.4 \cdot 10^{-3}$.

If the man is conscientious, he should work out his mean and standard deviation again, dropping the measurement on the bottom.

Now the picture will change drastically. His mean will rise to 426.6 and his standard deviation will drop to less than half the value of before, giving $s = 4.3$. (Fig. 4b)

Taking a new lokk at the bottom measurement, he will find that the difference from the mean is now 28.7, and this is 6.7 times the standard deviation.

If he takes the trouble to work out the probability of such a value occurring, he will find $f = 1.8 \cdot 10^{-11}$, and he can be quite sure that the bottom measurement does not belong to the main population. The sample tested must have had a flaw.

Let us now go back to our curve of normal frequency distribution. (Fig. 2) We know that the total area under the curve contains the total amount of our measurements, or 100%.

Between the vertical lines of the population standard deviation - sigma and + sigma we have about 65% of our measurements. Between -2σ and $+2\sigma$ we have about 95% of the total area, and between -3σ and $+3\sigma$ we have more than 99% of the area.

The curve is symmetrical, telling us that on both sides of the population mean we have 50% of our measurements.

Can this curve of probability be drawn in another way that may help us in other problems? Let us try.

Let us draw a new curve beginning from the left from a value of -4σ and continually show the percentage of the area that our normal curve contains as we move to the right. We will get a curve something like this. (Fig. 5)

As we can see, the 50% value corresponds to the value $\sigma = 0$ where we have the population mean.

The curve takes the form of a giant S, going asymtotically towards pluss and minus infinity at the values of 100% and 0%,

Now curves are rather hard to draw. It is much easier to draw a straight line. So let us change our coordinates, so that we get the same values registered with a straight line. (Fig. 6)

As you see, the marks showing the percentages are no longer evenly spaced, and we will never find the zero-value, or the 100%-value, as they will theoretically be as far off as the South Pole and Norway.

Let us again make a change. Let us turn our vertical scale 90° to a horizontal position, and place it on the bottom of our chart. (Fig. 7a)

Do any of you recognize this chart?

If we place a scale showing some value vertically, and register some data in connection with percentages as points on this chart then a straight line through the points will cross the mid-line at the most probable 50% value according to statistical theories. All the points will be weighted in proportion to a normal distribution curve.

We will take an example of this in a GNG-test. GNG means "Good - NoGood".

In a test for environmental stress cracking of plastic material, 10 specimens of a sample are placed under bending tension in a metal holder like this. The whole thing is placed in a large sized test-tube containing some liquid which gives a good surface contact with the plastic, without swelling or attacking the surface. Usually we use water containing a wetting agent.

The giant test-tube is immersed in a liquid giving a very constant temperature regulation.

At certain time intervals we inspect the sampleholder, and note the failure percentage. The time intervals are somewhat logarithmically chosen, as we shall see. (Fig. 7b)

Starting with a rather low value of 6 minutes, we proceed with 15 min., 30 min., 1 hr., and 2 hours or more.

I have already plotted certain values. They show that after 15 min. one sample or 10% had failed. After 30 min. 4 samples or 40% had failed. After 1 hour the failure was 60% and after 2 hours 90% had failed.

Placing a line of best fit through these points we note where it crosses the 50% line and report:

$$F_{50} = 42 \text{ minutes}$$

This is enough of pure statistics, and now I am going to tell you about "The Case of the Mysterious Buckets".

The title sounds like a detective story, and actually nearly all the work done in a laboratory is somewhat related to detective work. But this case was rather a sad story.

A large plastic factory in Aleppo, (you call it Haleb), had produced some thousands of buckets that were sold at a cheap price to the farmers in the district. They were easy to clean and were mostly used for collecting milk from cows and camels and goats. But one day, to the surprise of the farmers, the buckets, that were filled with milk in the evening, were empty in the morning.

Some of the farmers thought demons were playing a jest with them. But of course, the real demons were the producers of the buckets.

In thei eagerness to increas production, they had worked with too low temperatures on the mold, and too high temperatures under injection. This had given some partial degradation of the polymer together with very high internal stresses on the finished product. It did not take long for cracks to develop around the sprue, and the buckets began to leak.

And this was where I came into the picture. By the advice of UNIDO it was decided to erect a laboratory capable of doing all kinds of tests on plastic articles. Both mechanical and chemical. I was chosen to be with them in setting up the laboratory, and to train the counterparts.

The laboratory was to be placed on the premises of the big factory, but was to serve all factories in the district. It took nearly 8 months.

About two months before I was to leave, I began wo.king out routines for taking articles from the production and testing them qualitatively. But then the difficulties began.

The leaders of the factory did not want to give me regularly samples from the production that appeared to be of good quality. They said I could do my tests on rejects from the production, as I had done when training the counterparts.

I could not make them understand, that if the tests done in the laboratory were to be of any value, the test samples had to be taken at random, and especially not from the rejects. What is the use of testing rejects? They have failed anyhow.

I was very disappointed. When I came back to Vienna to give my report to my substansial officer in UNIDO, I said to him: "My mission has been a failure. They have a fine laboratory, and able counterparts to serve the appliaces. But on the day that I left, I am sure the dust began collecting on the laboratory benches."

This was absolutely the worst type of quality control that I have ever experienced.

The next case I am going to tell about is "The Case of the Conscientious Worker".

You know what conscientious means? It means, wanting to do something very correctly.

In a production of rubber boots we had to do a 100% test for leakage. Rubber boots are to be used in rainy weather, in marshes and wet fields, and are of no use if they leak.

We had a centrifugal fan delivering air at an overpressure of about 0.1 atmosphere. This air we blew through a stopper like an oversized cork which we thrust onto the bootlegs, and immersed in clear water. Any leaks would readily be detected as a stream of rising bubles.

This test usually detected failures at a rate of 0.1% to 0.5%. And this we found normal.

Then suddenly one day the failure rate rose to 6%. We were alarmed. In some part of the production something was going wrong.

In a production of this kind, with more than 200 people working on each article, it was not easy to find the place where the fault came from. But there are always bottle-necks in a production line where you put in more people doing the same job.

In one of these bottle-necks we had 16 persons doing a time-consuming stage in parallel. If one of these persons was constantly doing something wrong, we would be getting reject percentages of the order that we were observing.

A rubber boot is a very ingenious affair, with many layers of rubber sheet vulcanized together. The work they were doing at this particular stage was to smear an adhesive over an underlying rubber layer, in order to fasten another layer on top of it. But before this the boot was given a drying period, where the solvent from the adhesive was given a chance to evaporate.

The oldtimers working at this stage did their work very casually dipping the brush only once for every boot. But there was a newcomer doing a very conscientious job. Although he worked very fast, he dipped his brush three times for every boot passing by.

Now actually, the adhesive was not neccessary for making two unvulcanized rubber sheets laminate together during the vulcanizing process. The purpose of the adhesive was only to keep the second layer of rubber in place until the boot entered the vulcanizing autoclav. But putting too much adhesive on the surface hindered a sufficient evaporation of the solvent, and this made voids and leakages in the vulkanized laminate.

The man was soon made to understand that he must slut in his work, just as much as his collegues did, and soon everything was going fine again, and we were happy with leakage rejects down under 0.5% as before.

And now I'm going to tell "The case of the missing test".

In one of our factories we made material for rainware. It was a PVC-coating on cotton textiles. And as far as I can remember, the textiles came from Egypt.

We made raincoat material in one department of the factory, and cut and sewed the raincoat pieces together in another department of the same factory. The seams were later welded by HF to make them watertight.

Now in the material-producing department they made a 100% control of the coated surface by visual inspection. This was done by a man with the nickname "Eagle-eye". If there was a flaw, he would be sure to detect it.

One day someone detected an oily patch on the inside of a finished raincoat. The raincoat department said it must come from the coating process, and the coating department said it must be oil from some sewing machine.

At the Centrallaboratory we had to make an investigation. We pressed a filterpaper against the oil patch, rinsed the tip of the filterpaper in ethanol, and inspected the solution against pure ethanol in a UV-spectrophotometer. We got a very convincing curve of DOP.

Thus the department responsible was found and it turned out that a circulation fan in the fusing zone had failed, and had been replaced by a preliminary fan. This did not give the desired circulation, and drops of condenced DOP were now and then being blown over the embossing roll and onto the cooled surface of the finished coating behind the embossing roll. As the material rolled up, the DOP was taken up by the reversed side of the material and was not seen on the inspection of the coated surface. Nobody had ever thought of inspecting the reverse side. But from that day this test was included in "Eagle-eye"s responsibility.

My last story that I will tell is "The case of the too-good testresults".

Yes, quality control-people should be very careful and observant if a test gives results far better than expected. In this particular case we were producing material for tarpaulins for a large German firm.

A certain burning test was specified. And burning tests are always very tricky. The test on its own was subject to fluctuations so that applying a wide normal curve to the results was actually doing statistics on the test itself and not on the product.

We knew, that even if a material was of a good rating, there was such a large variation in the intensity of the test, that we had to reckon with a failure percentage of at least 10%. The specification demanded a failure rate of not more than 1 in 6, so in a way we were on the safe side.

We did our tests, and the German firm had a laboratory in Oslo doing confirming tests on the same picked out samples.

We regularly had failures in the order of 10%, but to our surprise the laboratory in Oslo had none.

The coating people heard of this, and found it quietning, but we at the Centrallaboratory were not quiet.

And when things got worse, wi[th] our failure percentages around 50%, and the laboratory in Osl[o] still getting zero percent failure, then we knew that something was wrong, and was sure to give us a real horse-kick one day.

I was asked to look into the matter.

After the first demonstration of the test at this laboratory in Oslo, I saw where they had misread the specification for the test equipment. It was easy to see.

The test specified a small, accurately machined brass cup to be filled with 0,3 ml ethyl-alcohol and to be placed on a thermally isolating surface at a specified distance under the sample to be tested. The fluid in the cup was to be ignited, and the flame would usually increase in height as the brass cup warmed up, until the flame reached the sample, either igniting it or not.

At this laboratory they had for convenience machined a nice brass stand, with snugly fitting edges to hold the brass cup securely in place, but alas, also keeping the cup cold enough to hinder the flame ever getting higher than about 3 cm. The flame never came higher than about halfway to the sample.

I showed them the sentence in the specification mentioning "a thermally isolating surface", and they gasped.

From that day our tests were in good correspondance, and our coating people were suddenly alerted.

And now, a last word of warning: Never fall asleep with testresults better than statistical probability should predict.

Diam. in mm

< 49.7	1
49.7 - 49.79	1 1
49.8 - 49.89	1
49.9 - 49.99	1 1 1
50.0 - 50.09	5
50.1 - 50.19	5 5
50.2 - 50.29	5 5 1
50.3 - 50.39	5 1 1 1
50.4 - 50.49	1 1 1
50.5 - 50.59	1 1
50.6 - 50.69	1
> 50.7	1

Fig. 1a

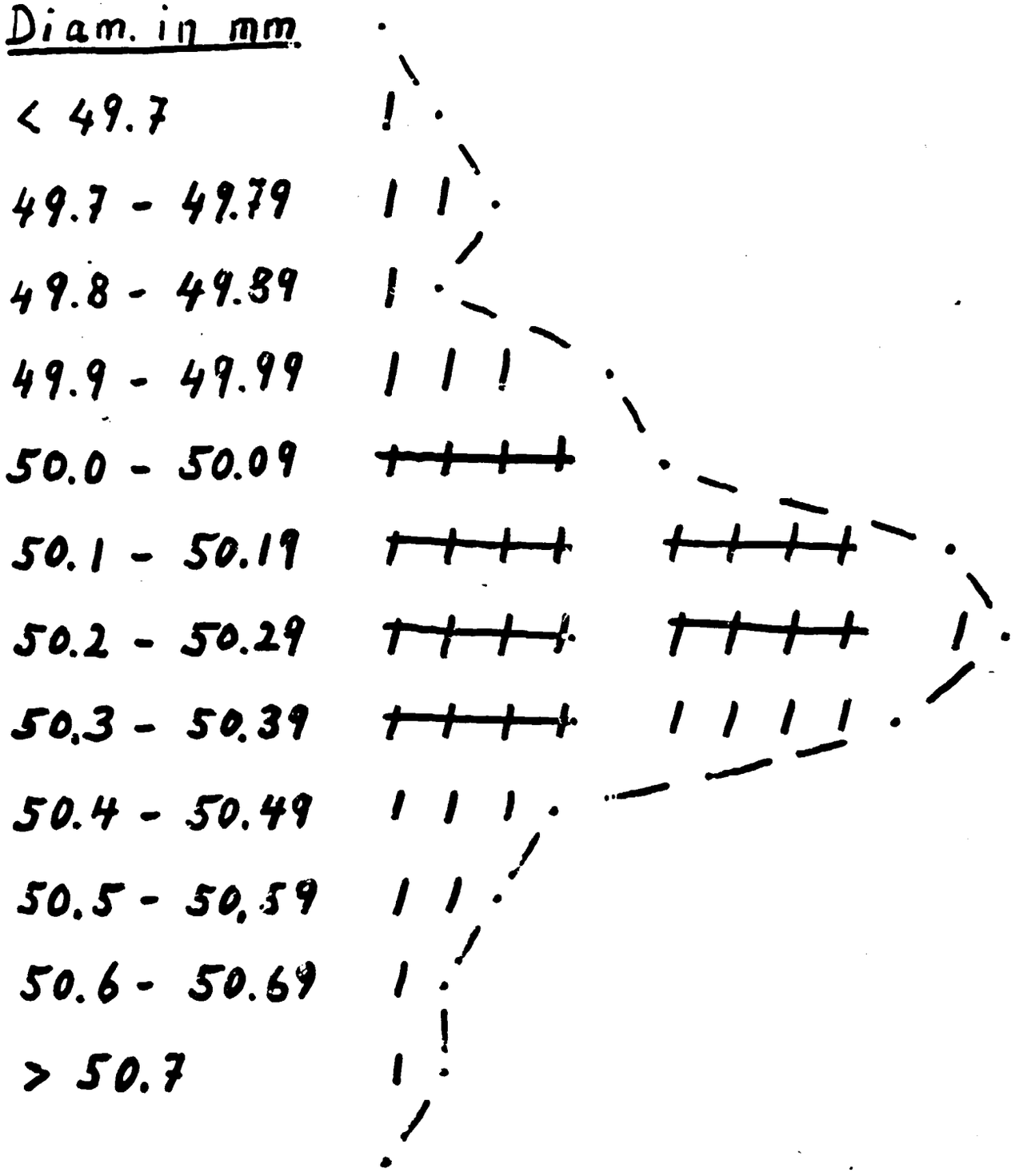
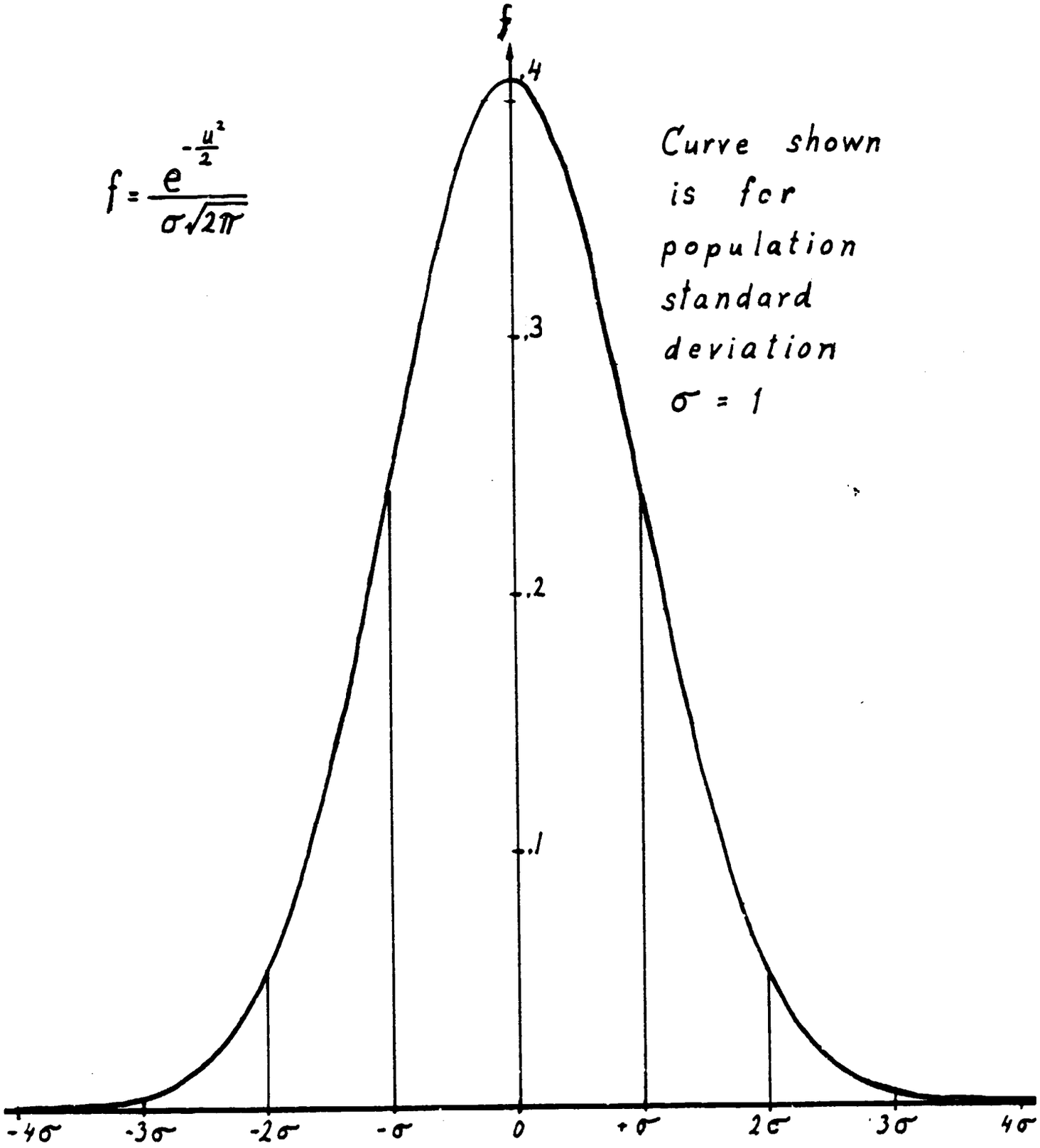

Diam. in mm
< 49.7
49.7 - 49.79
49.8 - 49.89
49.9 - 49.99
50.0 - 50.09
50.1 - 50.19
50.2 - 50.29
50.3 - 50.39
50.4 - 50.49
50.5 - 50.59
50.6 - 50.69
> 50.7

Fig. 1b



$$f = \frac{e^{-\frac{u^2}{2}}}{\sigma\sqrt{2\pi}}$$

Curve shown is for population standard deviation $\sigma = 1$

$$u = \frac{x - \bar{x}}{\sigma}$$

Fig. 2

Population mean value:

$$\bar{\bar{x}} = \lim_{n \to \infty} \frac{\sum_{n} x}{n}$$

Population standard deviation:

$$\sigma = \lim_{n \to \infty} \sqrt{\frac{\sum_{n} x^2 - (\sum_{n} x)^2/n}{n}} = \sqrt{\frac{\sum_{n} x^2 - n(\bar{\bar{x}})^2}{n}}$$

Fig. 3a

Sample mean:

$$\bar{x} = \frac{\sum_{n} x}{n}$$

Sample standard deviation:

$$s = \sqrt{\frac{\sum_{n} x^2 - (\sum_{n} x)^2/n}{n-1}} = \sqrt{\frac{\sum_{n} x^2 - n(\bar{x})^2}{n-1}}$$

Fig. 3b

N		
434		
431		
420		
427		
424	$\bar{x} = 423.7$	$\bar{x} = 426.6$
429	$s = 9.9$	$s = 4.3$
426		
423		
425		
398	$\Delta = 25.7$	$\Delta = 28.6$
	$= 2.6\,s$	$= 6.7\,s$
	$f = 1.4 \cdot 10^{-3}$	$f = 1.8 \cdot 10^{-11}$

Fig. 4a

Fig. 4b

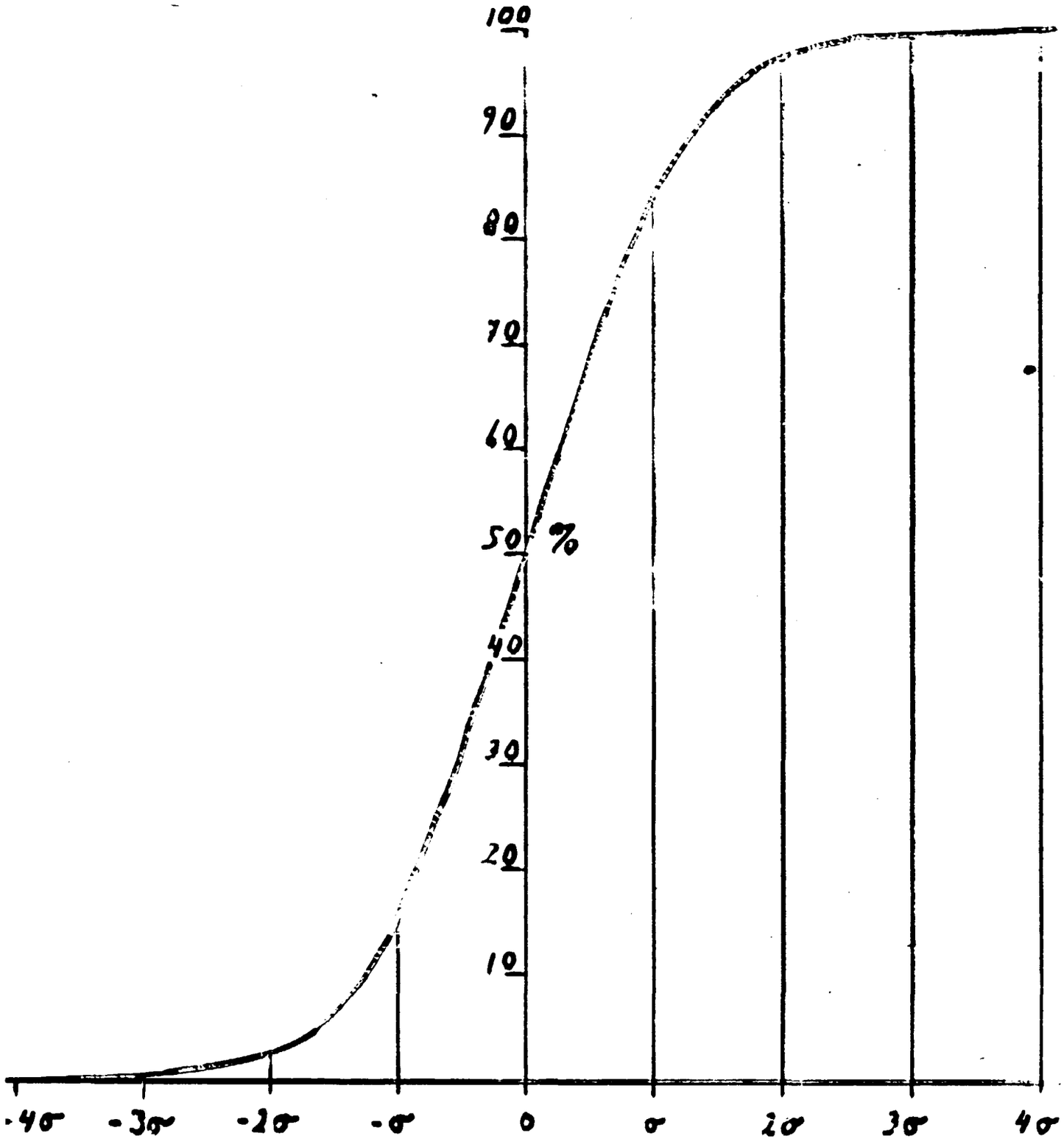


Fig. 5

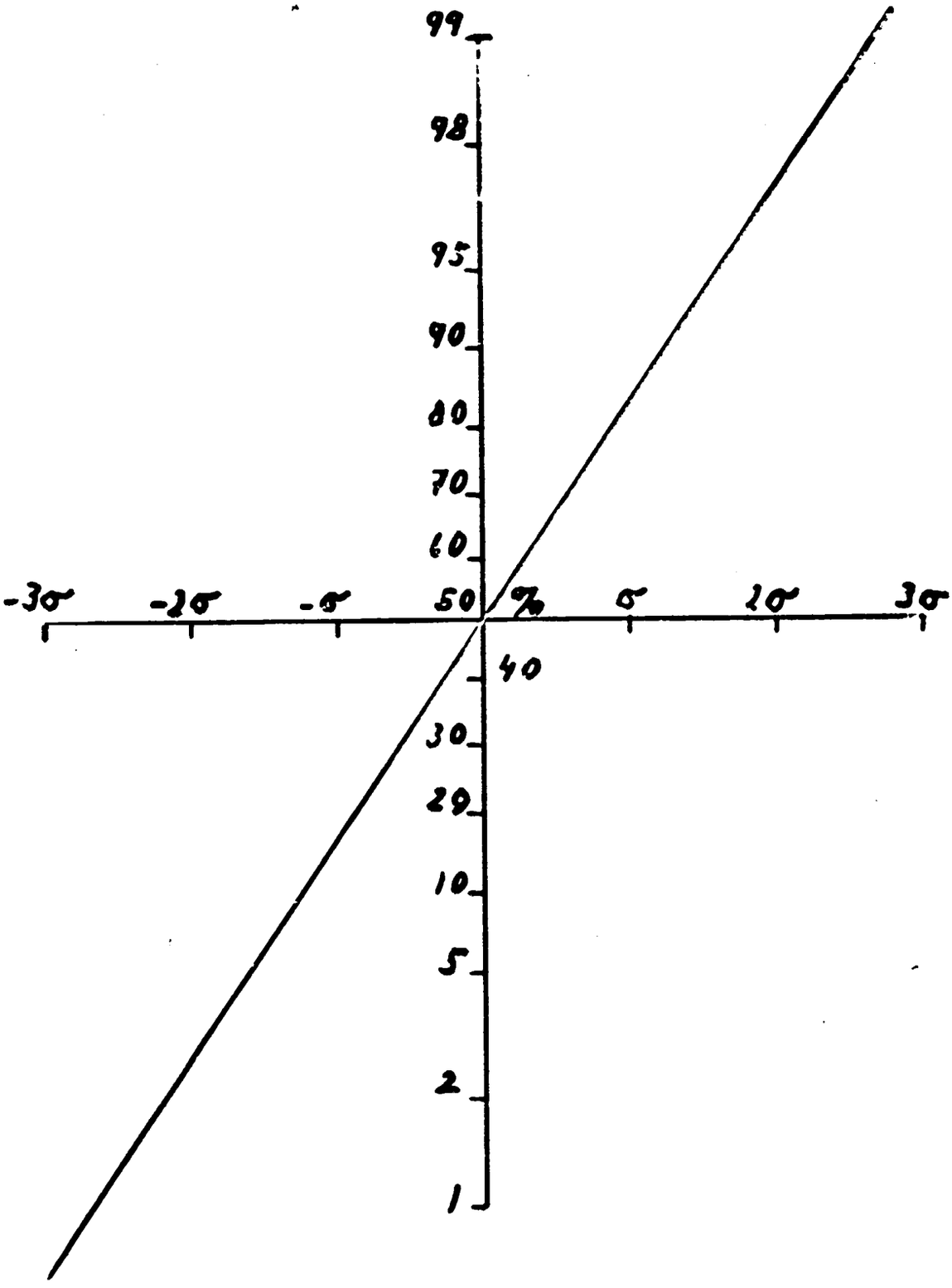


Fig. 6

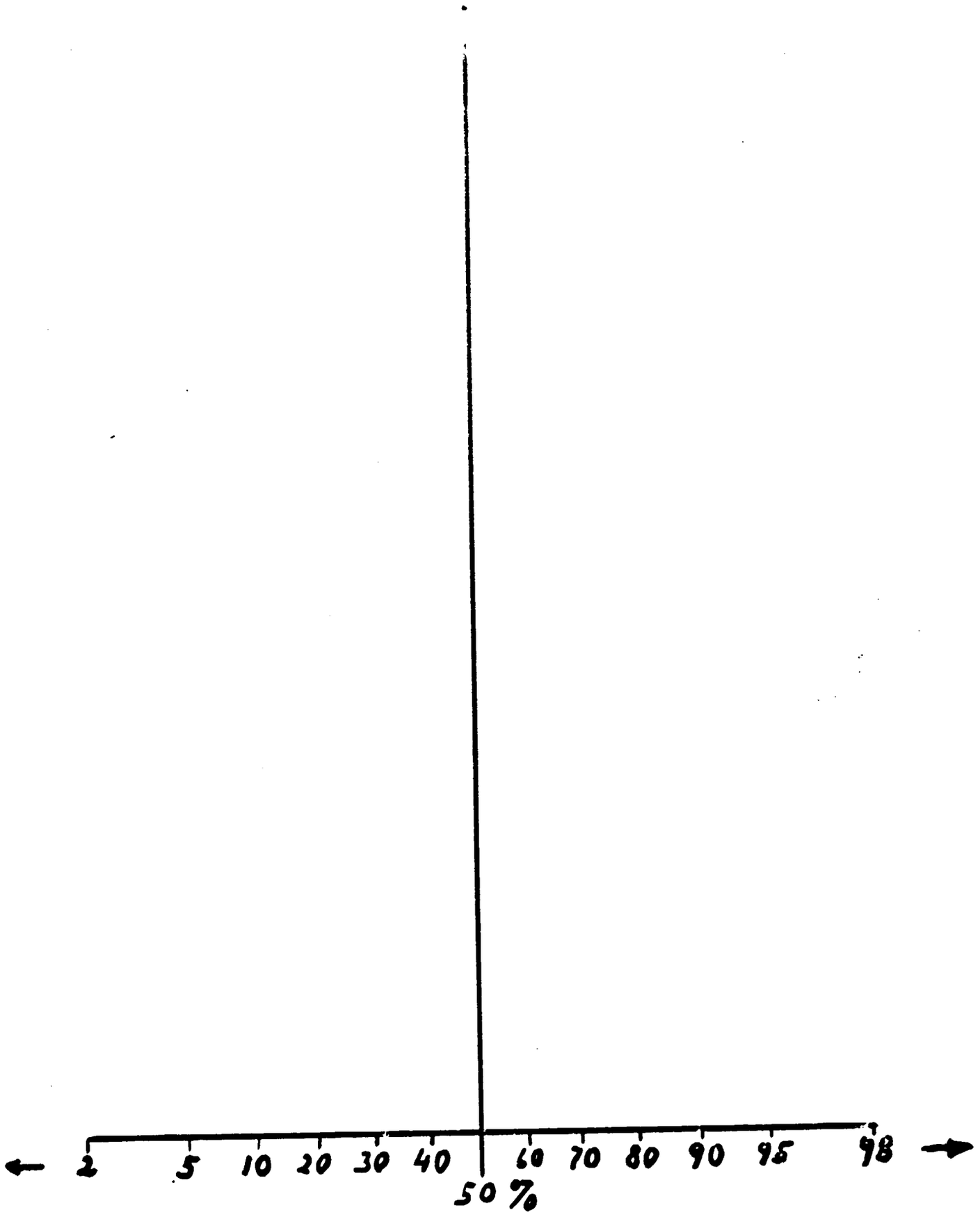
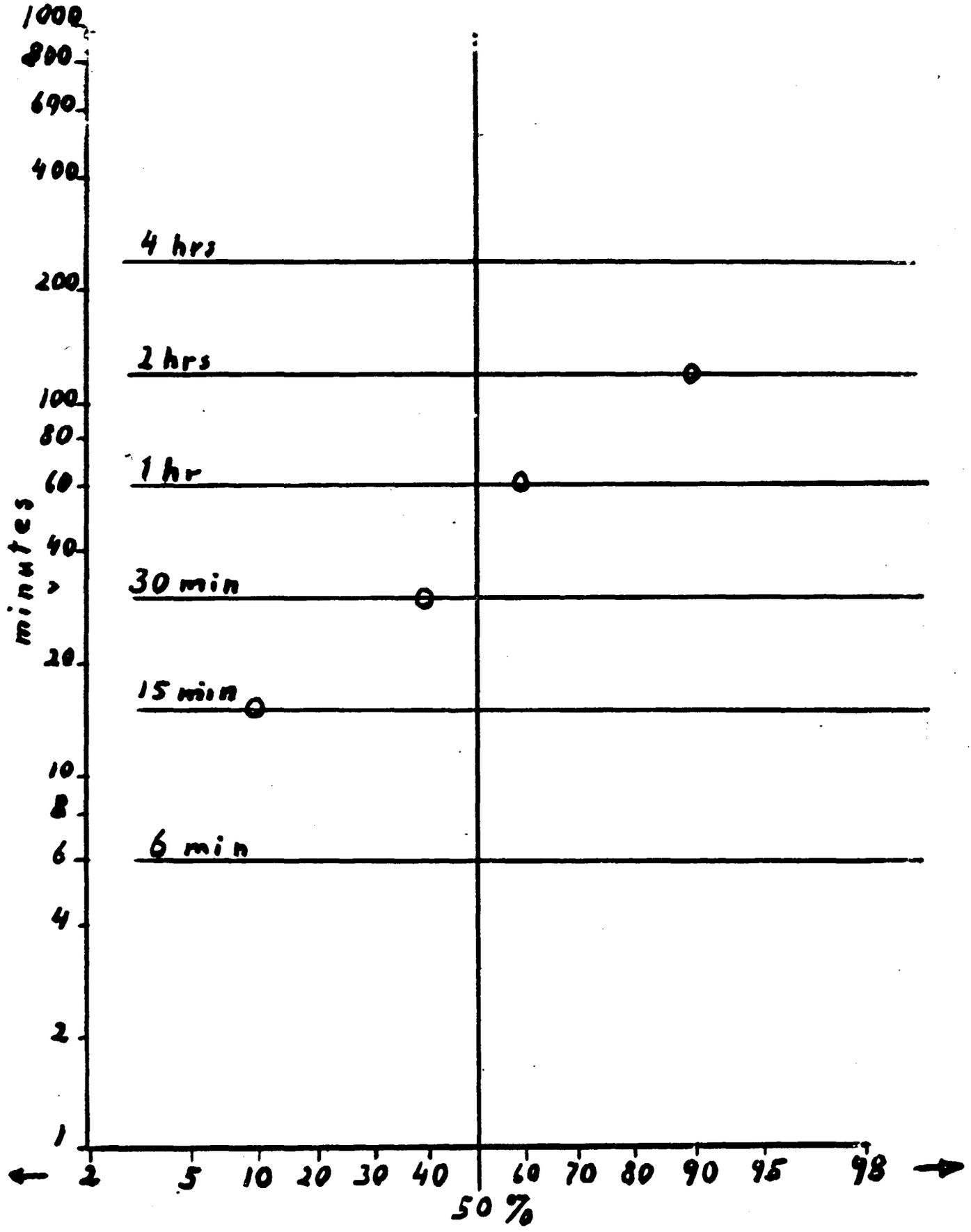


Fig. 7a


1000
800
600
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200
100
80
60
40
20
10
8
6
4
2
1
minutes
4 hrs
2 hrs
1 hr
30 min
15 min
6 min
2
5
10
20
30
40
50 %
60
70
80
90
95
98

Fig. 7b

DETAILS ON THE EQUIPMENT INSTALLED AT THE
PLASTIC DEVELOPMENT CENTRE IN ALEXANDRIA.

TENSION AND COMPRESSION TESTER, INSTRON 1195.
A beautiful testing machine with many load cells and accessories. We have gone through the procedures of calibration, and the use of the extensiometer with its sensors. The grips of the sensors are a bit too tight for thin material, as they have a tendency to slip. But on material thicker than 2 mm they work well. I have suggested the use of a soft rubber tubing covering the grips when testing thin material.

A cycling accessory had been mounted on the control-panel, and this we were able to connect to the specified board to complete its circuitry and get it working.

PUNCH CUTTER PRESS from Daventest.
The press is in fine condition, but they do not have any dies for it. I have recommended some. I have also recommended the use of hard cardboard substrates to preserve the cutting edge of the dies.

PENDULUM IMPACT TESTER from Zwick.
In order and in use.

ELMENDORF TEAR TESTER.
In order and in use.

BURST STRENGTH TESTER from Daventest.
In order and in use, but I had to make the counterpart take care to adjust the right feeding pressure before testing, as specified by the testprocedure.

BUFFING MACHINE from Wallace.
I have explained, that when using this machine the operator must always push the sample in a direction against the rotation of the abrading wheel. If not, the sample will be wedged between the wheel and the sledge, and force the sledge so hard against the guiding bolts that these may be bent. This is what has happened here. I suggested a fine-mechanic take a look at it and to place micro-thin foils under the fastening screws of the sliders in order to adjust for the slight arc that has been introduced.

LOWTEMPERATURE TORSIONAL TESTER, Clash & Berg.
The load cord and pulleys were mounted wrong. I suggested means of getting temperatures down to -72°C, but I don't suppose any test for Egypt will go that low.

STEREO MICROSCOPE Olympus X-TR.
A very fine instrument that gives an extraordinary good view. It is mounted with a camera, Olympus PM-6 and an exposuremeter Olympus EMM-7. I made it clear, that the exposuremeter gives a direct reading of the exposuretime in seconds, whereas all cameras have the shutters graduated in the reciprocal of the time. If the exposuremeter should show a time larger than one second, the shutter must be adjusted to B, and manipulated by hand with the help of a stop-watch. Pictures made were of a good quality.

HIGH MAGNIFICATION MICROSCOPE. Reichert NEOVAR-POL.
This is not in order. The magnification is at least 20-50 times too small, and the picture never gets in focus. What we do see in a blur, seems to be badly distorted as the centre of the picture has the double magnification in comparison to the edges. There must be a lense, or a lense-system missing. I could not find out of it, but have written a draft for a letter to the producers.

MICROTOME from Reichert.
The cylinder had been run so far out that the driving mechanism had lost its grips and could not bring it back. Luckily, I was able to push the cylinder with a steady force and work the screw slowly backwards until the threads got the right grip, and the feading mechanism was able to take over again. Nothing in it seems to have been damaged. I emphatically advised them to never let the cylinder advance further than to when the red limit-line appeared.
The knife had been badly damaged, and was mounted the wrong way. Turning it around and finding a portion of the edge which seemed undamaged, we were able to cut beautiful slices of 5 micron thickness from a sample of hard PVC. They have a spare knife, but I advised them to save it as long as possible.

SPHERICAL HAZEMETER from Daventest.
This was not in order, as there were cold solderings on the indicator unit and the photocell was defect. This last fault was detected some three years ago by the head electrician of PDC, and a new photocell had then been ordered from Daventest. Meanwhile the electrician had died, and when a new indicatorunit came from Daventest instead of a photocell, this new indicator was mounted with no bettering of the results. I summarized my findings in a telex, hoping for a new photocell in time before leaving, but in vain.

GLOSSMETER from Daventest.
The counterpart missed a Black-box for this, enabling easy zero adjustment. I found closing the aperture of the photocell with the thumb just as effective.

POLARIZING VIEWER from Kayeness.
In fine order. I have explained the principles on which it is based and demonstrated some of its applications.

XENOTEST 250 from Original Hanau, Heraeus.
Since it arrived about two years ago, this has never been functioning correctly. It always cuts out after about 15 minutes due to overheating. The local representatives and the producers had been contacted, but did nothing more than delivering new thermofuses.
After a scrutinous investigation it was found that the motors of two fans and a waterpump were all running the wrong way. A change of two of the three connections to the 3-phase mains remedied all problems. The Xenotest has been functioning perfectly afterwards. The heat measured on the surface is now never over 50°C.

ULTRASONIC WELDER from Telsonic.
The pneumatics of the welder were leaking all over. The couplings are of a disposable type and can not be mended. We had to move and position the sonotrode by hand. In any case, as PDC will never be doing production with this welder, only test-trials and demonstrations, they would have been much better served

with a manual setup for the sonotrode.
The oscillator could not be adjusted to the resonance of the transducer. Opening up, we found that the HF-ironcore for trimming the frequency, was stuck in an end position. A square bolt was slipping in its corresponding square hole, which was now nearly round. We cut a slit in the HF-core and made a screwdriver of HDPE and were thus able to get the setup in resonance. It works fine now.

IMPULS WELDER 100GE from Polystar.
This is in order. I have explained the working priciple, and its virtues and limits.

SURFACE AND VOLUME RESISTIVITY APPARATUS from Daventest.
The instrument is in order, but there is no means of finding out if the readings are correct. I will send PDC a calibrated resistance from Norway with a value around 50 Megohms.
I discouraged the use of mercury electrodes, as the resistances are so great anyhow, that metal electrodes with the help of a little conducting paste will do quite sufficiently. The main point is that the humidity round the sample is as specified and that the underlaying surface is smooth.

ELECTRICAL FIELD METER from Daventest.
I tried and explained the instrument and it seems to be quite in order. But the manual lacks a description of a specified test. It only refers to B.S.2782, Part II, Meth. 250 A(1976). I will see if I can get a copy in Norway.

OPTICAL PYROMETER
A very fine instrument with a steady digital indication.

ANALYTICAL WEIGHT Sartorius 2004.
This came during my stay. A very fine instrument which can not be utilized fully without a solid fundament, separated from the surrounding bench and going right down to rocks below. As it now stands on a heavy stone slab, a hand resting on the same slab will change the reading of the last two digits.
They know how to follow the procedure of alignment and calibration.

GAS PERMEABILITY MEASURING APPARATUS from Daventest.
The Edwards Vacuum Pump is fine and easily gives a vacuum down to 2 mBars. There were microcracks in the glass bulbs of both the Edwards Vacustat and the measuring assembly with the capilary tube. A local glassblower made a fine job of fixing them.
The vacuumpump and the Vacustat as a separate pair were tight, and could hold vacuum for a long time. But we were never able to get the joints of the testing unit tight, and had to abandon the use of vacuum.
We rearranged the permeability cell so that it worked on overpressure, with a pressuredifference of 10 N/cm^2.
We used the accurate pressure gauge from the Davenport Burst Strength Tester to measure the pressure. Tests done on films of known character gave confirming results.

CARBON BLACK BY PYROLYSIS from Daventest.
The temperature regulation is good, but the silicon corks are a bit worn. I showed the counterpart how to regulate the gas flow correctly, and suggested increasing the temperature by steps in order to evade a rapid boiling of the sample with loss of the fillers. Many tests were done with good reproducibility and logic results.
They lack a fume cupboard.

ENVIRONMENTAL STRESS CRACKER from Davontest.
The apparatus is quite in order, and I explained to the counterpart the details of using it and noting the results on the appropriate chart.
I used this example in my lecture on quality control, showing how the chart was adjusted to the normal distribution, thus giving a reliable reading of the estimated 50% failure time.

pH-METER from Griffin & George.
This had been stored unused for more than two years. I ordered new batteries and tried to save the electrodes by soaking for three days in distilled water. At least one of them seems to be working satisfactorily. The pH-meter is of a very simple type with no compensation for temperature or sensitivity. The meter must be adjusted to the nearest pH to be used by a series of buffer solutions.

ROTATING DISK VISCOMETER from Brookfield.
This came during my stay. I demonstrated the use, and emphasized that all measurements of viscosity must be accompanied by the spindle number and at what speed the measurement was made.
We were able to calculate a reasonable K-value for an emulsion-PVC by measuring the viscosity increas after disolving a small portion of the PVC in cyclohexanon. Formula by Fikentsch.

LABORATORY MIXER from Brabender.
A fine machine for doing all kinds of mixing under full control of speed and measurement of torque, but in a small scale.
The encapsulation of the heating oil was leaking a bit along the upper rim. This was probably caused by too high a pressure on the circulation. We reduced the pressure to the lowest possible, and the leakage was barely perceptible and not anoying.

VICAT SOFTENING POINT TESTER from Daventest.
In fine order. But I noticed a small hvite plate swimming in the oil. This the counterpart was asked to remove, as it could interfere with the circulating pump.

MELT VISCOSITY MEASURING by Daventest.
The temperature adjustment knob was slightly in misalignment, but was easily adjusted. I explained the appearant reduction of viscosity measured with some melts containing fillers, as the melt then lost its ability to wet the surface of the capilary walls and moved forward as a "plug". A measurement of the reduced "die-swelling" verified this explanation.

When measuring polymer densities by pycnometer I recommended always to use samples from the extrudate coming out of the Meltviscosity apparatus, as they were most likely to be free of embedded bubbles.

MELTING POINT measuring apparatus.
The temperature regulation was fine, and the optical inspection of the capilaries was very clear. Very accurate measurements were made.

RECOMMENDATIONS

IR-SPECTROPHOTOMETER AND GASCROMATOGRAPH
In a large plastic factory near the premesis of PDC they have in their laboratory a very fine and modern IR-S. I have given them a written description of how to prepare a sample of opaque material by partial decomposition, and make a film of this for mounting on the IR-S.
It was agreed that PDC could cooperate with them in using this IR-S, and it will then be quite unnecessary for PDC to have their own IR-spectrophotometer.

The same can be said of a very modern Gas Chromatograph at the same laboratory.

ABBE-REFRACTOMETER
I recommend that PDC acquire a good Abbe-refractometer, with the possibility of temperature regulation of the sample compartment. This will enable a rapid and accurate identification of a number of plasticizers and oils.

SEVERS HIGH SHEAR VISCOMETER
In order to be able to measure the viscosity of polymer melts at high shear, they would have to acquire a viscometer of the Severs type. I would not give this apparatus a very high priority.

DENSITY GRADIENT COLUMN
My experience with such an apparatus for measuring polymer densities, has not awakened my enthusiasm. The column is so time-consuming and expensive to prepare, and has such a relatively short time of usage, that I can not recommend the acquisition of this apparatus.
It is much better to use an ordinary pycnometer. The main problem in all such densitymeasurements is getting samples free of air-voids.