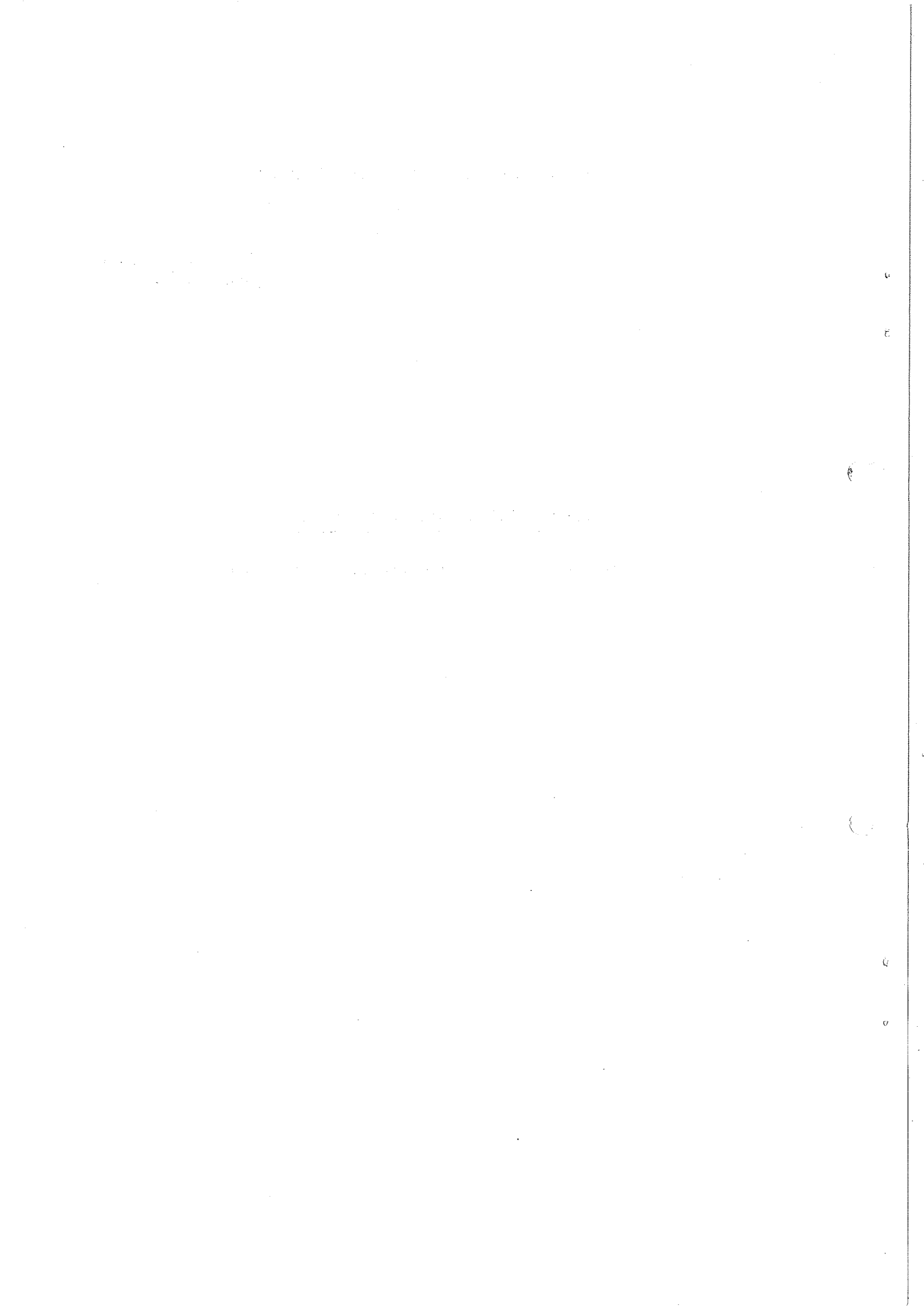


EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

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ISR BACKGROUND STUDIES AT THE PS

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For experimentation at the ISR it is vital to know the intensity of the background radiation not due to beam-beam interactions. To investigate this problem, an optical 12-gap spark chamber with a sensitive surface of  $80 \times 63 \text{ cm}^2$  was installed in the PS ring. It was placed between magnet 15 of the PS and the outer wall of the ring. This position was chosen since both, magnet 15 and magnet 14, are open at the outer side (Fig. 1,2). Secondaries from beam-gas interactions reach the spark chamber without being absorbed in the yokes of the magnets.

A counter telescope directed tangent to the vacuum pipe upstream was placed in front of the chamber. It consisted of two scintillation counters each with a sensitive surface of  $3 \times 3 \text{ cm}^2$  (Fig. 1). A television camera transmitted the view of the spark chamber onto a TV screen, which was situated together with the electronics in the South Hall, next to the ring entrance door 3. Polaroid photographs of the chamber could be taken when it was triggered.

A monitor made of two counters was placed 80.5 cm away from the vacuum chamber on the inner side of the PS ring between magnet 9 and magnet 10. Figure 3 shows the monitor signal displayed on an oscilloscope. One sees an increase during the acceleration of the protons to a constant signal during "flat top". The two spikes at the beginning of the acceleration cycle are due to beam losses at the times of injection and transition. A pulse of 100 ms length gated on the electronics 635 ms after injection; it is displayed with the monitor signal. The delay to trigger the spark chamber was 900 ns. During the gate the energy of the circulating protons was about 22 GeV. The pressure in the vacuum pipe was measured by six vacuum gauges.

Photographs were taken under different conditions.

1. The chamber was positioned as close as possible to the ring (position A on Fig. 1). Ten telescope-triggered photographs (Fig. 4) and ten random (Fig. 5) were taken at this position; the average number of circulating protons per burst was  $1.9 \times 10^{11}$ ; the average gas pressure in the section 14-15 was  $2 \times 10^{-6}$  Torr.
2. The chamber was placed at position B (Fig. 1) and ten triggered photographs (Fig. 6) and five random (Fig. 7) were taken. The

number of circulating protons was  $1.8 \times 10^{11}$  in average per burst; the average gas pressure was  $2 \times 10^{-6}$  Torr in section 14 - 15.

3. The same geometrical conditions as under 2, but with a change in machine intensity, which was brought to its maximum, corresponding to an average of  $9.9 \times 10^{11}$  protons per burst (Fig.8).
4. To investigate roughly the sensitive time of the spark chamber, additional delays of  $1.0 \mu\text{s}$ ,  $1.5 \mu\text{s}$ ,  $2.0 \mu\text{s}$  were introduced on the chamber trigger. The performance of the chamber under the same condition as at 2 but with an additional delay of  $1.5 \mu\text{s}$  is shown in Fig. 9. Taking into account the  $0.9 \mu\text{s}$  delay of the electronics we conclude the sensitive time of the chamber to be about  $2 \mu\text{s}$ .

Describing the background by

Background  $\propto$  beam current  $\times$  gas pressure  $\times$  sensitive time of the chamber

a comparison of the conditions under which this investigation was done with that expected at the ISR can be made

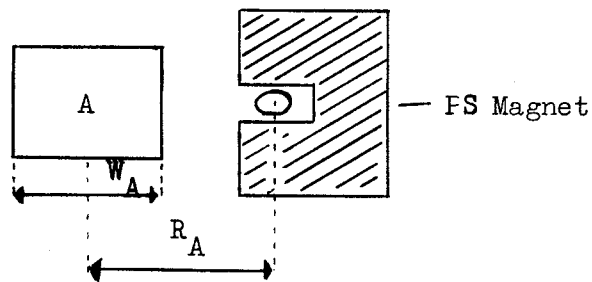
$$\frac{\text{Background PS}}{\text{Background ISR}} = \frac{1.9 \times 10^{11} \times 2 \times 10^{-6} \times 2 \times 10^{-6}}{8 \times 10^{14} \times 10^{-11} \times 2 \times 10^{-6}} \approx 48$$

The difference in the gas composition  $\text{H}_2\text{O}$  and heavy gases at the PS and  $\text{H}_2$  at the ISR will bring about an additional factor of 7 in favour of the conditions at the ISR.

The track multiplicity of triggered photographs is displayed in Fig. 10

From the random triggered photographs (Fig. 5) we can evaluate the particle flux per second passing a ring of width  $w = 1 \text{ m}$  centred in the vacuum pipe. (N.B. This flux is independent of the ring radii<sup>1)</sup>).

On the average  $2.4$  particles /  $2 \mu\text{s}$  were traversing the sensitive surface A of the spark chamber.



Since the particle flux falls off as  $1/R^1$ ) we calculate the particle flux  $N$  through a ring of width 1 m centred in the vacuum pipe to be

$$N = 2.4 \times \frac{2\pi W_A R_A}{A} \times \frac{1}{W_A} = 2.4 \times \frac{2 \times 3.14 \times 0.8 \times 1.125}{0.63 \times 0.8} \times \frac{1}{0.8} = 33.7 [2 \mu s]^{-1}$$

Taking into account the factor of 48 from the ratio of PS background/ISR background we expect at the ISR in a 1 m ring a flux of  $3.5 \times 10^5$  particles per second, even assuming the ISR residual pressure gas to be heavy molecules.

We want to thank Professor R.L. Cool for helpful discussions.

1. The first part of the document discusses the importance of maintaining accurate records of all transactions and activities. It emphasizes the need for transparency and accountability in financial reporting.

2. The second part of the document outlines the various methods and techniques used to collect and analyze data. It includes a detailed description of the experimental procedures and the statistical tools employed.

3. The third part of the document presents the results of the study, including a comparison of the different methods and a discussion of the implications of the findings. It also includes a conclusion and a list of references.

4. The fourth part of the document provides a summary of the key findings and a final conclusion. It also includes a list of references and a list of figures and tables.

## REFERENCES

1. B.D. Hyams, ISR Users' Meeting, CERN, 2-3 December, 1968.

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## FIGURE CAPTIONS

- Fig. 1 Experimental layout.
- Fig. 2 View of the chamber in the ring of the PS.
- Fig. 3 Oscilloscope display of the monitor signal and timing of the gate.
- Fig. 4 Triggered photographs of the chamber taken at position A.
- Fig. 5 Random photographs of the chamber taken at position A.
- Fig. 6 Triggered photographs of the chamber taken at position B.
- Fig. 7 Random photographs taken at position B.
- Fig. 8 Triggered photographs taken at position B with maximum machine energy.
- Fig. 9 Performance of the chamber with an additional delay of  $1.5 \mu\text{s}$ .
- Fig. 10 Display of the track multiplicity for triggered photographs at position A, position B with low and high machine intensity respectively.



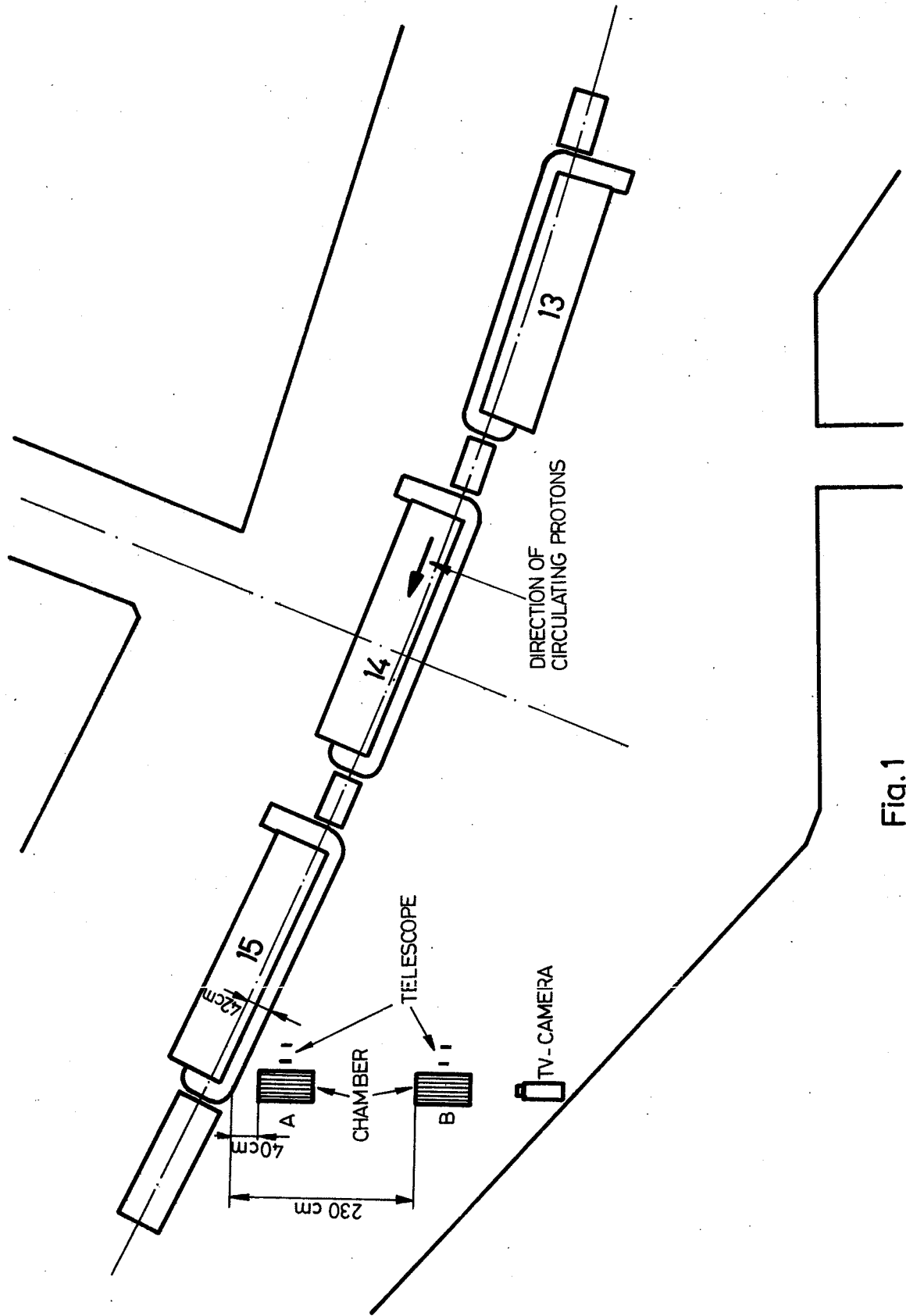
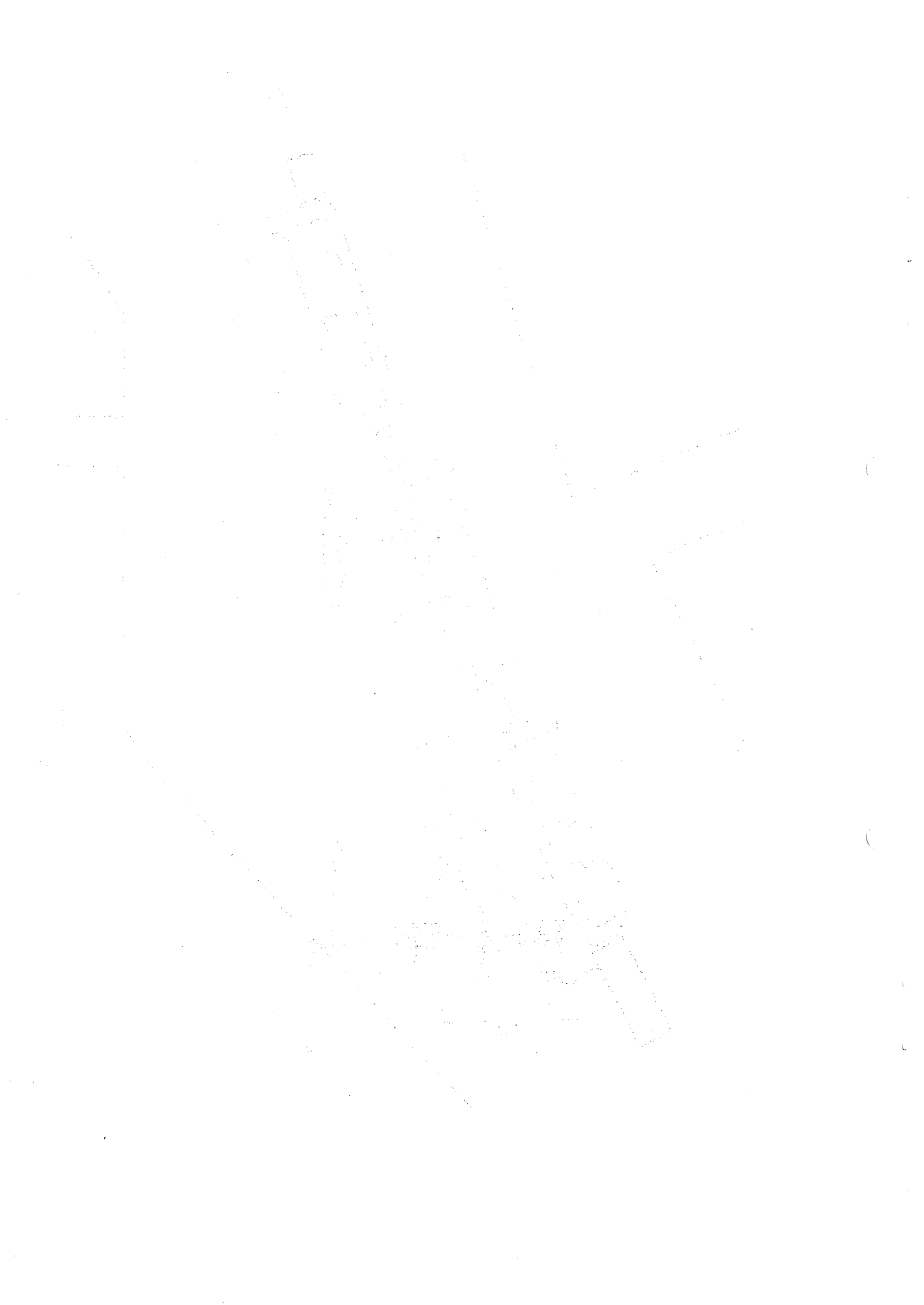


Fig.1



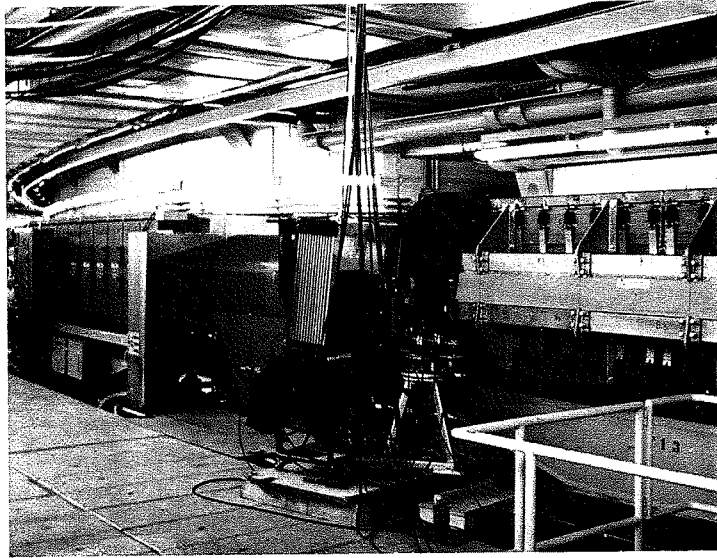


FIG. 2

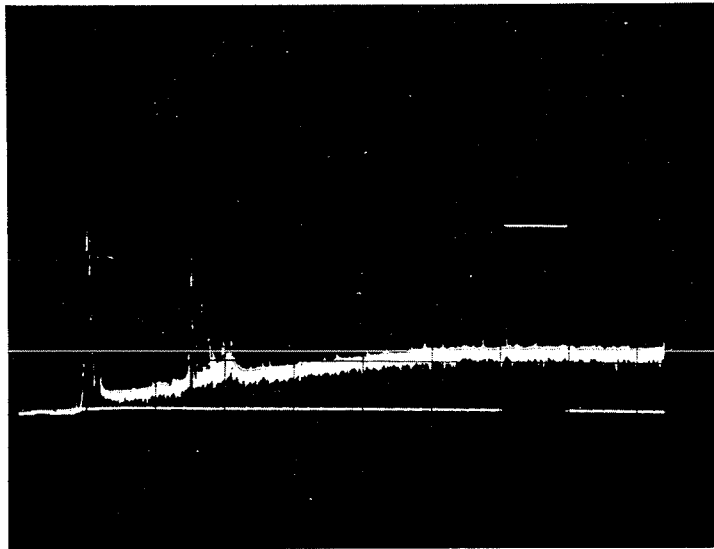


FIG. 3

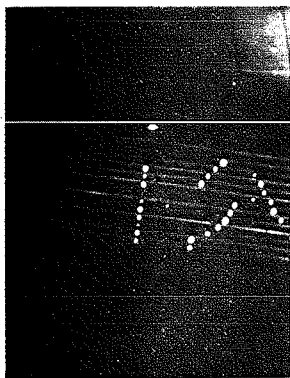
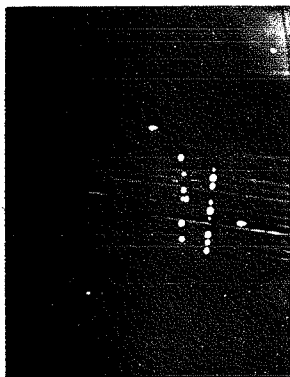
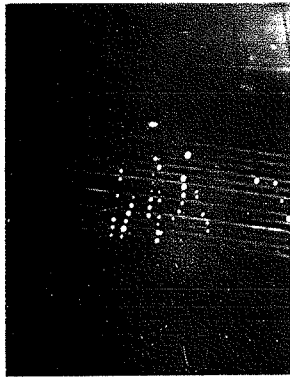
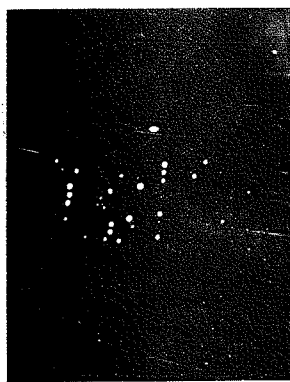
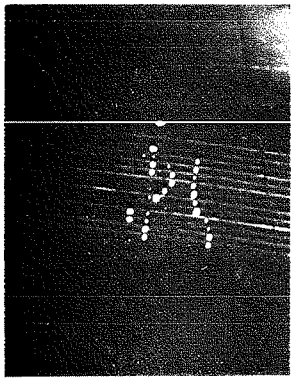
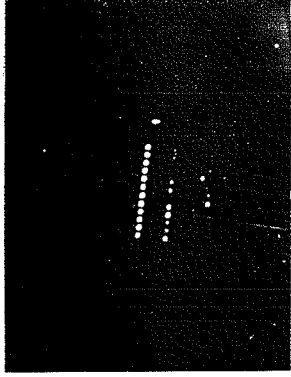
1. The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that proper record-keeping is essential for the integrity of the financial system and for the ability to detect and prevent fraud. The text notes that without reliable records, it would be difficult to track the flow of funds and identify any irregularities.

2. The second part of the document focuses on the role of internal controls in ensuring the accuracy of financial reporting. It describes how internal controls are designed to prevent errors and misstatements, and to ensure that all transactions are properly authorized and recorded. The text highlights that strong internal controls are a key component of a robust financial management system.

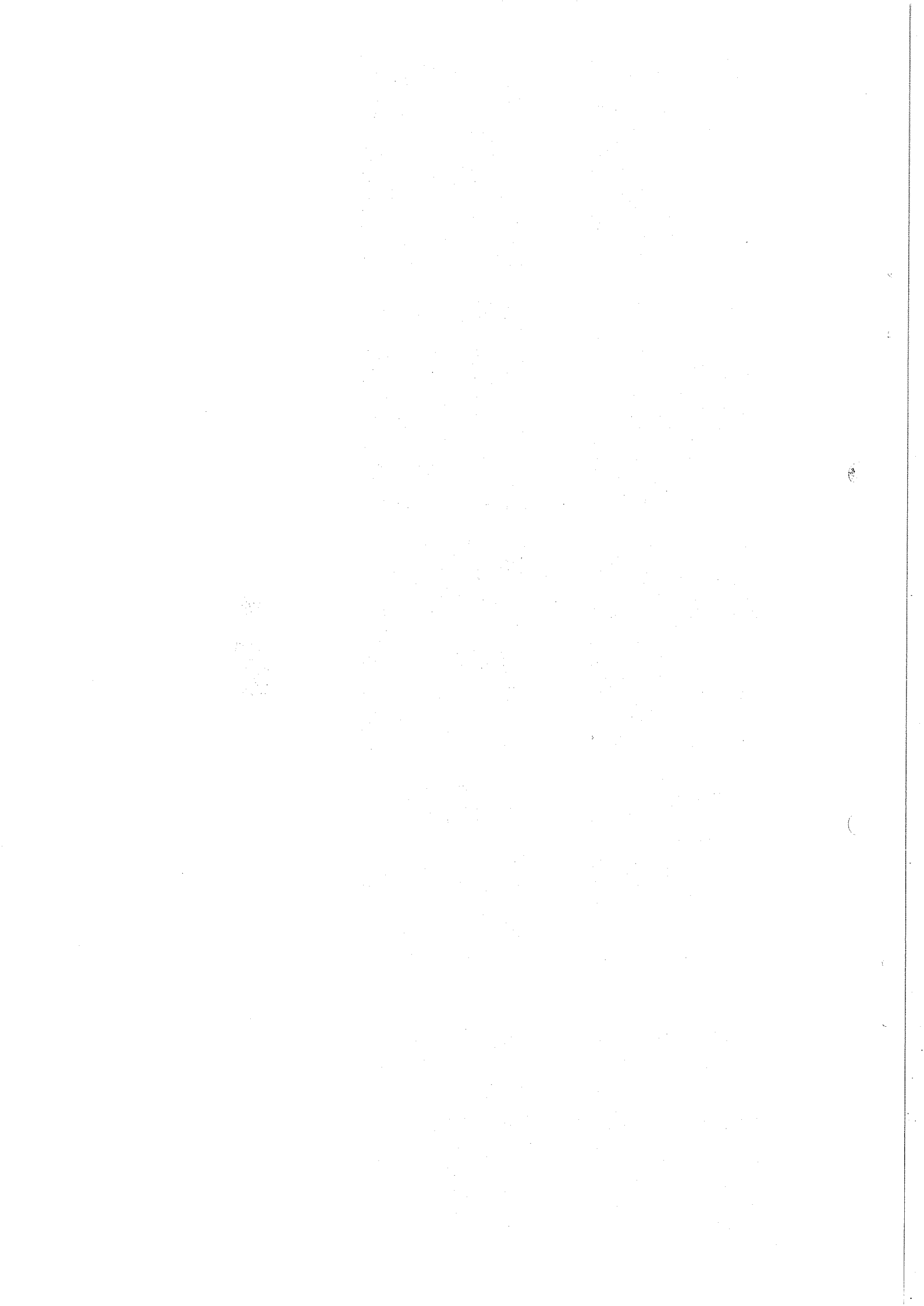
3. The third part of the document addresses the need for transparency and accountability in financial reporting. It argues that providing clear and concise information to stakeholders is crucial for building trust and confidence in the organization. The text suggests that regular communication and reporting can help to identify potential issues early on and allow for timely corrective action.

4. The fourth part of the document discusses the importance of staying up-to-date on changes in financial regulations and standards. It notes that the financial industry is constantly evolving, and organizations must be prepared to adapt to new requirements. The text suggests that ongoing education and training for staff can help to ensure that the organization remains compliant with all applicable laws and regulations.

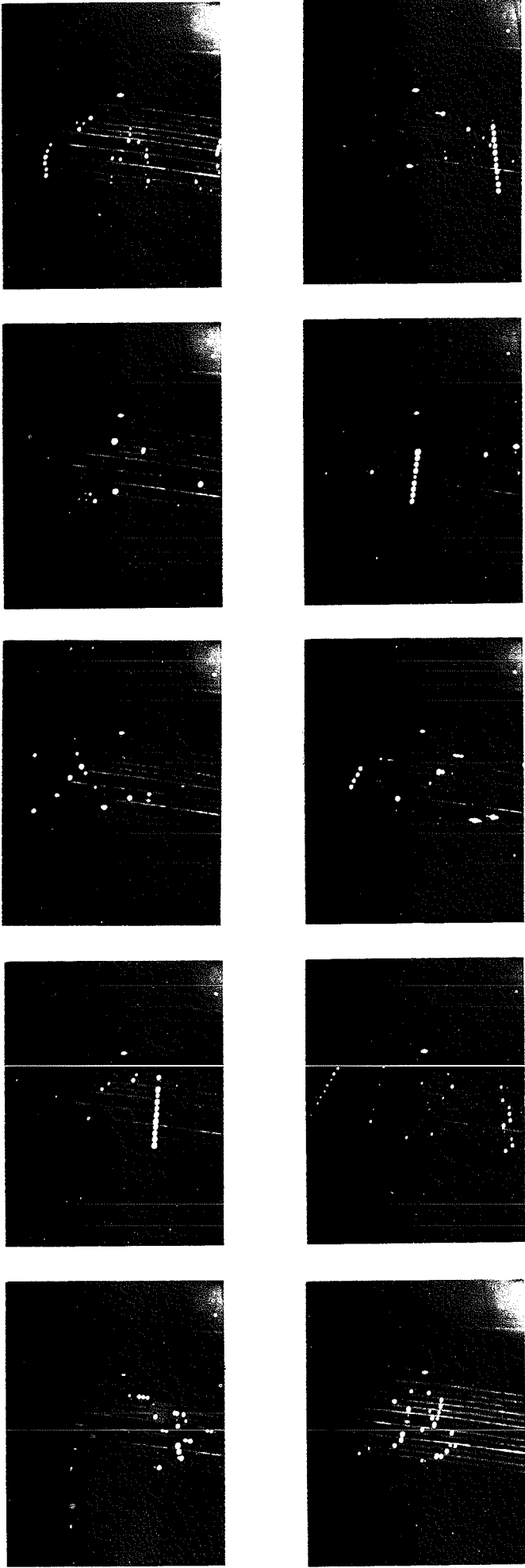
5. The fifth part of the document concludes by emphasizing the overall importance of financial management in the success of an organization. It states that sound financial practices are essential for long-term growth and sustainability, and that organizations should strive to maintain the highest standards of financial integrity and accountability at all times.



**Fig 4**







**Fig. 5**



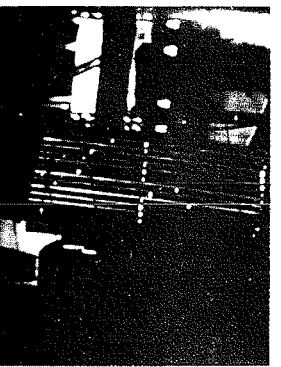
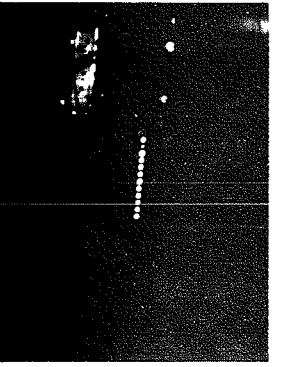
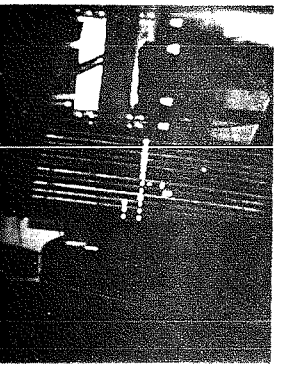
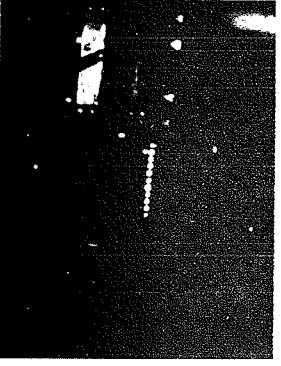
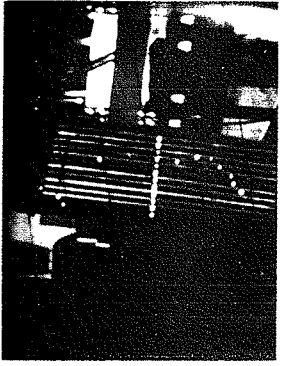
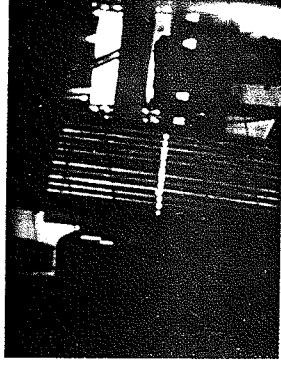
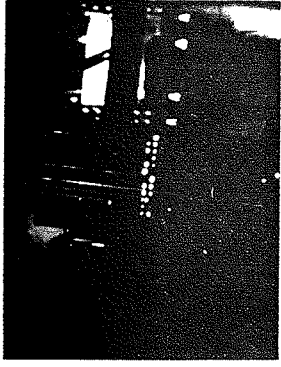
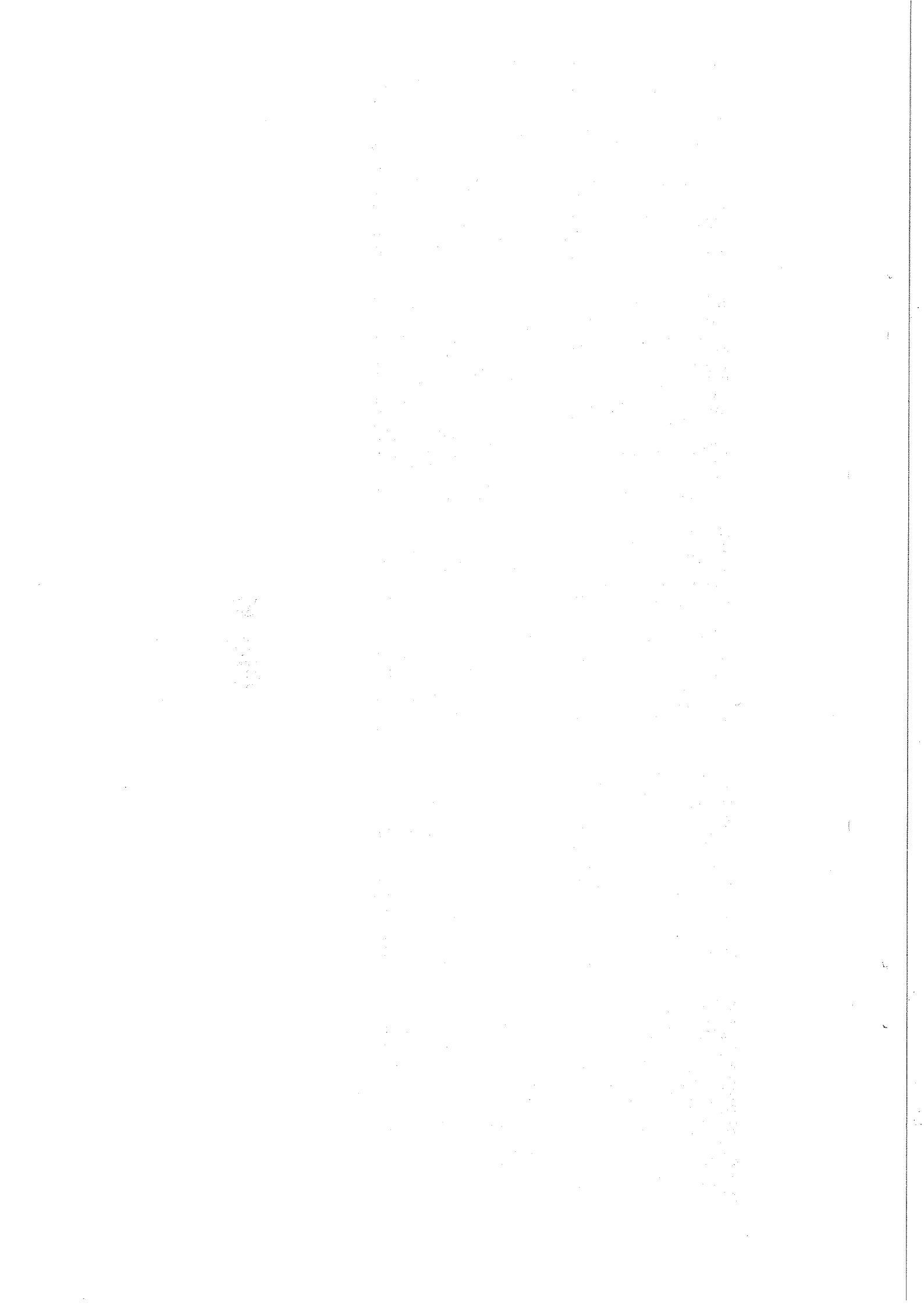
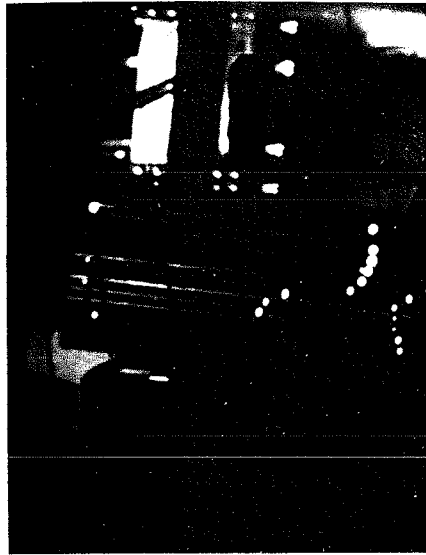


Fig. 6





**Fig- 7**



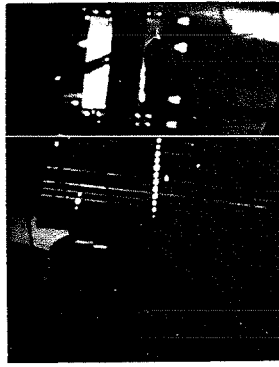


Fig. 8

1. The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that proper record-keeping is essential for the integrity of the financial system and for the ability to detect and prevent fraud.

2. The second part of the document outlines the various methods used to collect and analyze data. It describes the process of gathering information from different sources and how this data is then processed to identify trends and anomalies.

3. The third part of the document focuses on the role of technology in modern data analysis. It discusses how advanced software and tools have enabled more sophisticated and efficient data processing, leading to better insights and decision-making.

4. The final part of the document concludes by highlighting the ongoing nature of data analysis. It notes that as new data is constantly being generated, it is crucial to have robust systems in place to handle this information and to continuously refine analytical methods.

5. The document also addresses the challenges associated with data analysis, such as data quality and privacy concerns. It provides strategies to mitigate these risks and ensure that the data being analyzed is reliable and secure.

6. Furthermore, it discusses the importance of collaboration between different departments and organizations. Effective data analysis often requires sharing information and expertise across various teams to achieve a comprehensive understanding of the data.

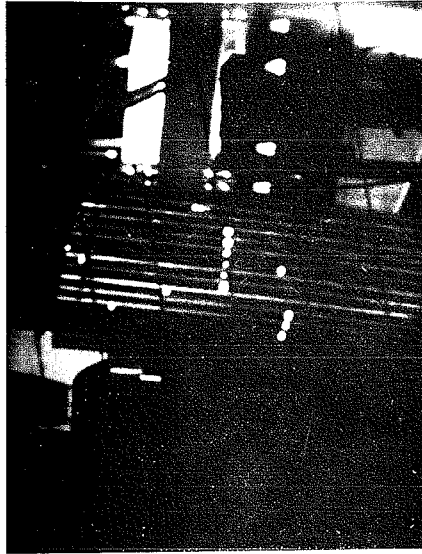
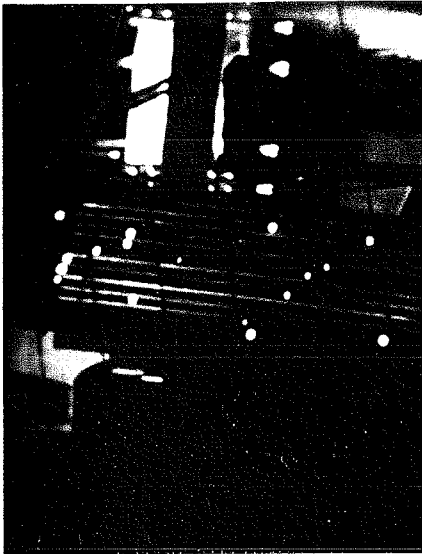
7. The document also touches upon the ethical implications of data analysis. It stresses the need for transparency and accountability in how data is collected, processed, and used, ensuring that individual privacy is protected.

8. In addition, it explores the future of data analysis, including the potential of artificial intelligence and machine learning. These technologies are expected to revolutionize the field by enabling more complex and automated data processing.

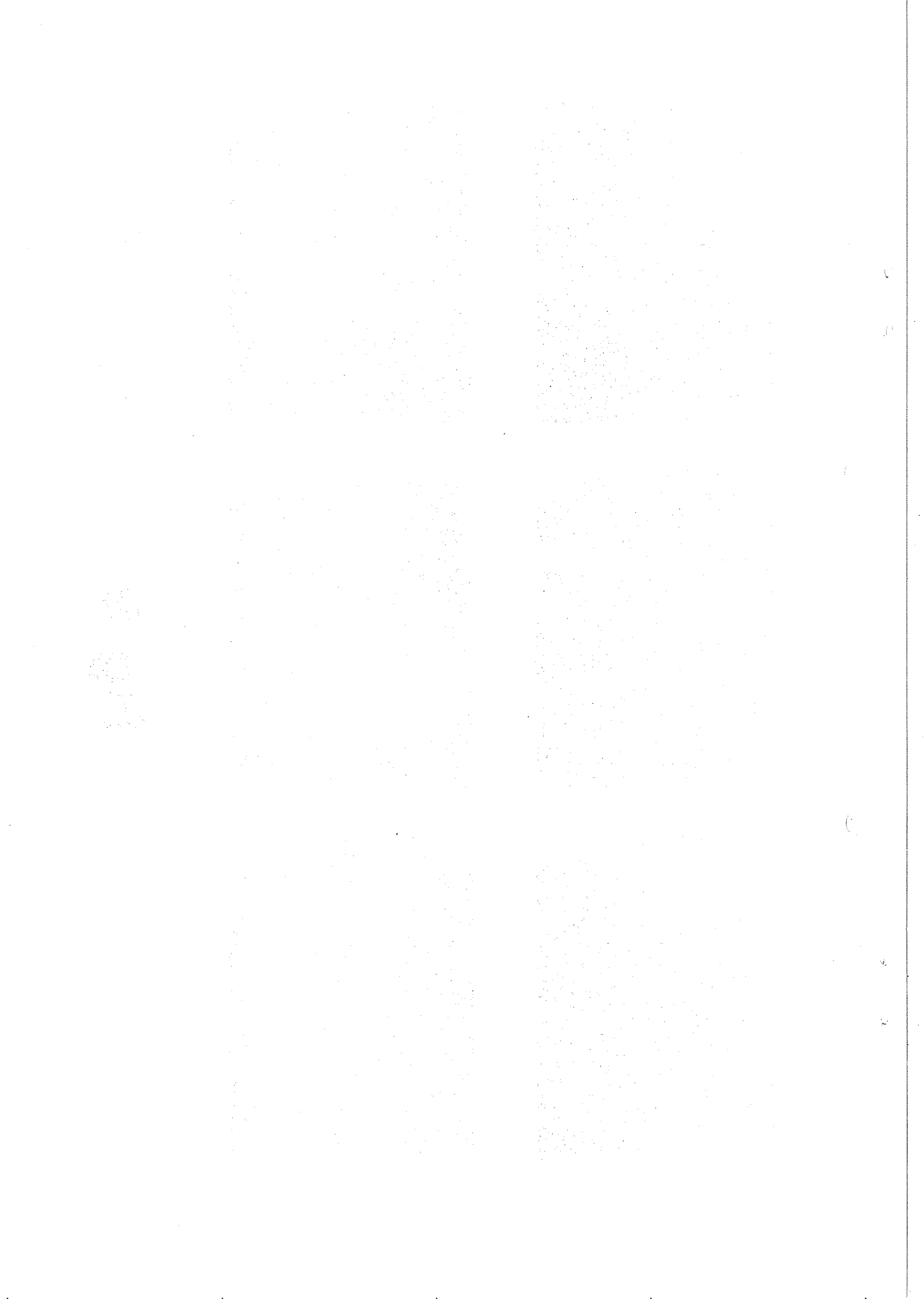
9. Finally, the document emphasizes the importance of continuous learning and staying up-to-date with the latest developments in the field. As the landscape of data analysis evolves, professionals must be committed to ongoing education and skill development.

10. The document concludes with a call to action, encouraging readers to apply the principles and practices discussed throughout the text to their own work and to contribute to the advancement of the field.

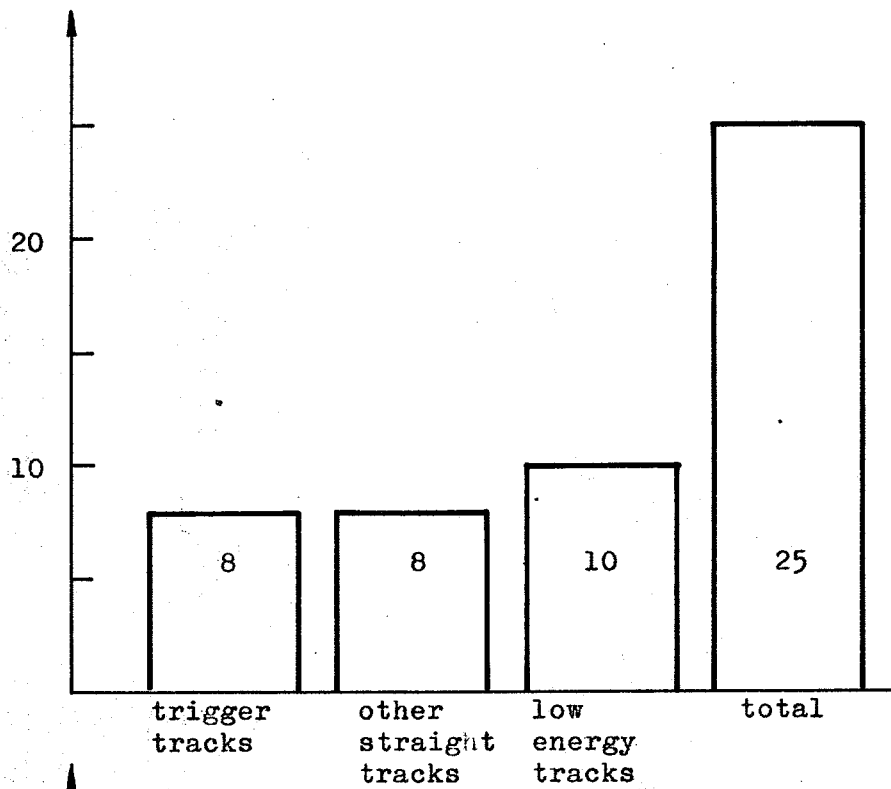




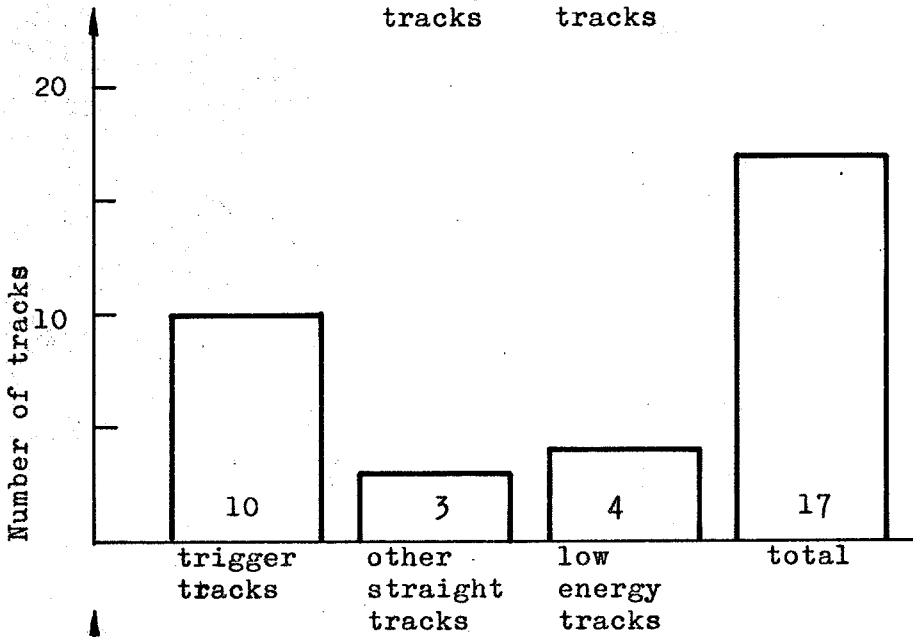
**Fig. 9**



POSITION A  
triggered on coincidence  
statistics from 10 pho-  
tographs  
 $1.9 \times 10^{11}$  protons in ring  
per burst



POSITION B  
triggered on coincidence  
statistics from 10 pho-  
tographs  
 $1.8 \times 10^{11}$  protons in ring  
per burst



POSITION B  
triggered on coincidence  
statistics from 9 pho-  
tographs  
 $9.4 \times 10^{11}$  protons in ring  
per burst

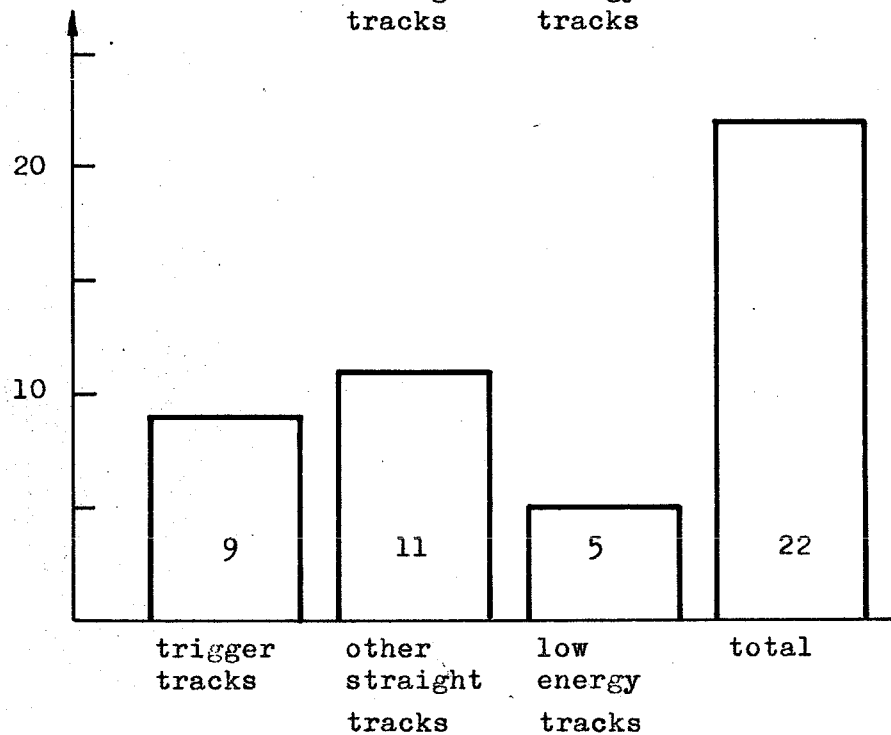


FIG. 10

