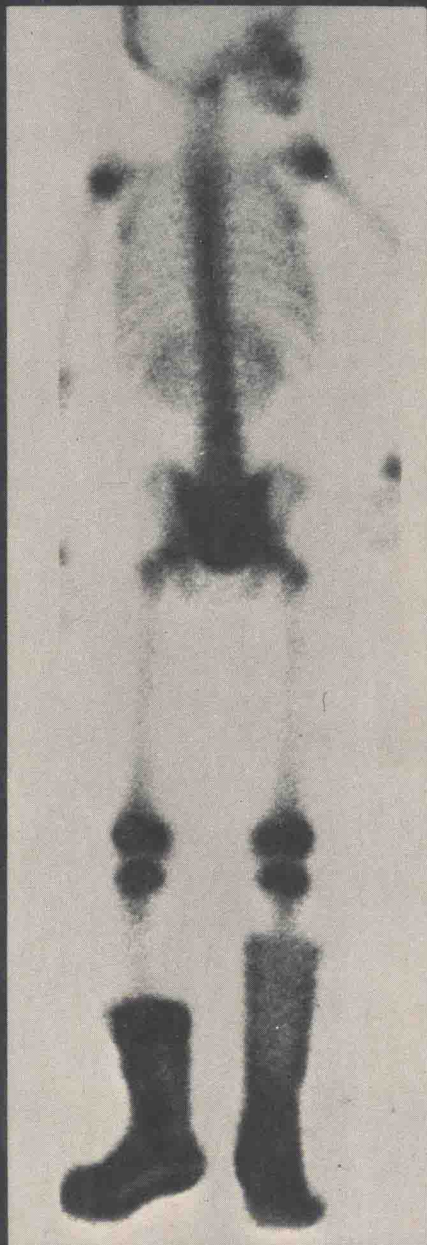


Radionuclide Imaging Artifacts

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Radionuclide Imaging Artifacts

Foreword

WE PROFIT and learn most from our mistakes. This book is a collection of mistakes: some in instrumentation, some introduced by the patient, some from peripheral devices added to the imaging chain and some in the preparation and administration of the radiopharmaceutical. Any chain, however, is only as strong as its weakest link. The resulting image is at times a spectacularly different one than what was anticipated. On the other hand, the result can be a change so subtle that the interpreter who is unaware of the abnormality may miss it or, worse yet, make an error in diagnosis because of it. We have only ourselves to blame, however, for in nuclear medicine all of the components that go into the imaging system are under the direct control and supervision of the nuclear medicine physician and technical staff. Nuclear medicine personnel generally prepare and inject the radiopharmaceuticals, position the patients, operate the imaging devices, develop the films and interpret the results. Unfortunately, each of these activities comprises numerous steps where errors can be made or artifacts introduced.

David Wells and Donald Bernier have collected numerous artifacts from a wide range encountered in the practice of nuclear medicine. Drawing on their long experience as supervisors in active divisions of nuclear medicine, they have recalled for your review numerous important technical pitfalls. Some of the artifacts shown in this book occurred under their own supervision. The results are positive, however, because they are willing to share these mis-images so that you and others may profit from their observations. They have also collected numerous examples from others. As the physicians who have supervised their work these past several years, we would hasten to add that not all of the artifacts included in this volume occurred in our own division of nuclear medicine.

The important message the authors bring is that artifacts do indeed occur. The least these errors in imaging can do is disrupt the clinical routine and result in loss of time simply because of the need to repeat the study. Worse yet, they may go undetected because the technologists involved are not familiar with the particular problem at hand. This introduces the potential for an erroneous diagnosis. The images of the technical artifacts are not only of inherent interest themselves, but also they may be clinically important and should be seen by all who practice nuclear medicine. We hope that sharing these strange images with you may result in an overall improvement in quality control and in the quality of nuclear medicine practice.

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Preface

THE EVOLUTION of nuclear medicine can be traced through many people: men and women with a variety of backgrounds, whose main concerns were high-quality patient care and better methods of disease detection and treatment.

This evolution has included the development of sophisticated and complex radiopharmaceuticals and instruments. In the beginning, the mechanics of performing the patient's examination were quite simple. Radiopharmaceutical preparation consisted of dispensing the material as it was received from the supplier, and organ imaging was accomplished with a rectilinear scanner by performing a few simple calculations. As time has progressed, we have entered into the era of "cookbook" preparation of sulphur colloid, macro-aggregated albumin, labeled phosphates and other radiopharmaceuticals. The nuclear instrumentation has become more sophisticated as well, providing images with a high degree of resolution in shorter periods of time. Today, nuclear medicine departments have not only a scintillation camera, but also some type of computer device interfaced with it. Today's instrumentation is designed with more "bells and whistles." The development of the complex radiopharmaceutical preparations and the addition of the "bells and whistles" have definitely been major factors in the advancement of the field. However, as we all know, their use has also caused many problems. The bone radiopharmaceutical does not always end up in the bones. Macro-aggregated albumin has shown up as clumps in a localized area of the lung. The bells on the instrument will clang when they are supposed to ding, and the whistles will pop when they are supposed to blow.

The illustrations in this book represent a collection of unusual problems—some controllable, others uncontrollable—associated with radionuclide imaging. These findings can be caused by poor radiopharmaceutical preparation, instrumentation malfunction or operator error. It is the intent of the authors that this book be utilized as both an educational document and a practical reference tool when technical problems occur.

We wish to express our sincere appreciation to all the contributors for their time and effort in preparing the illustrations and texts and for their significant contribution to nuclear medicine technology. As time progresses, we would also welcome artifactual illustrations from other members of the nuclear medicine community. This book will probably need to be frequently reprinted owing to the multitude of artifacts which do occur from day to day as even more advanced techniques and instrumentation are introduced.

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1

Detector and Display Components

1

ARTIFACT: *Ouch*

CAUSE: Rapid change in room temperature leading to fracture of scintillation crystal

METHODS OF TROUBLESHOOTING: This artifact is visually obvious.

METHODS OF CORRECTION: Barring acts of God, attempt to maintain constant temperature in imaging rooms. Never leave crystal unprotected, without collimator, since collimator insulates against rapid temperature change.

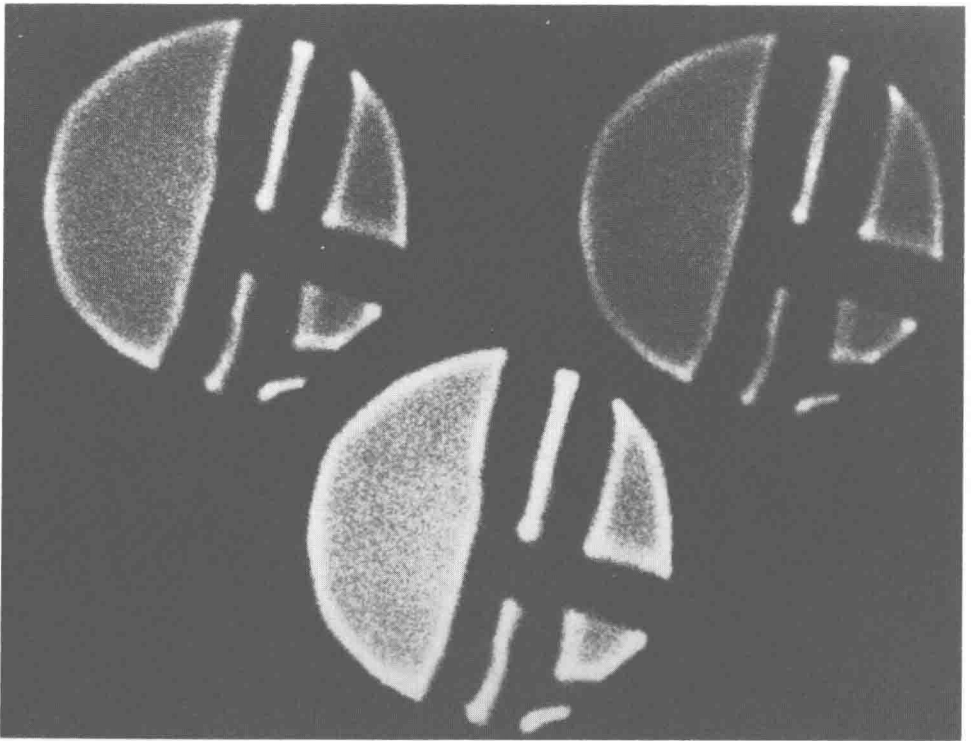


Fig 1A

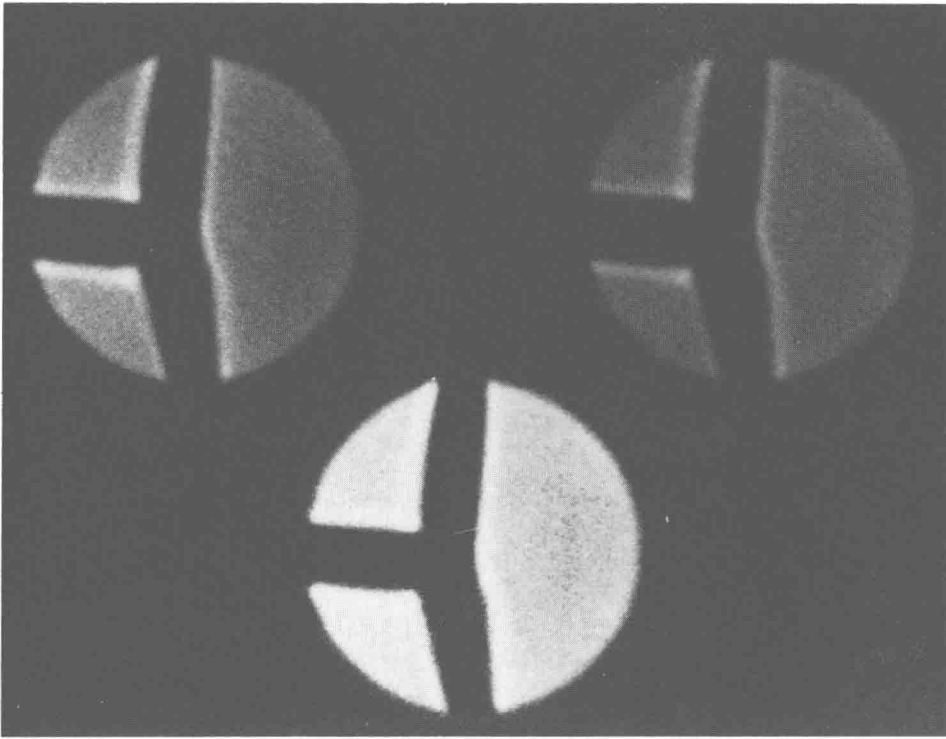


Fig 1B

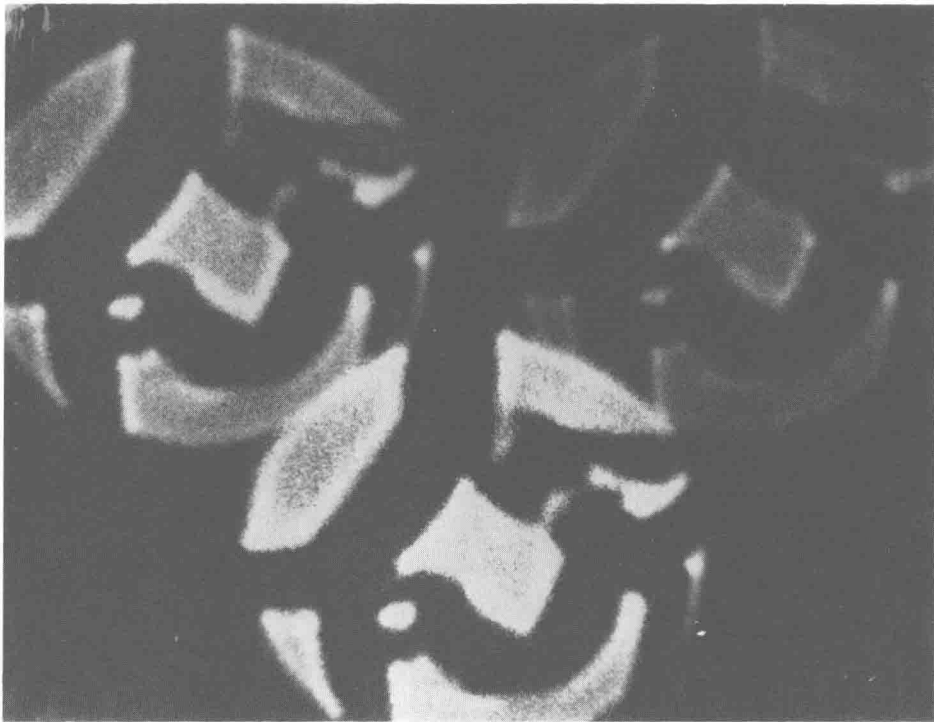


Fig 1C

2

ARTIFACT: *The Surge*

CAUSE: Electrical power surge to camera cathode ray tube during image acquisition

METHODS OF TROUBLESHOOTING:

1. Check position of "on-off" power switch and cord connection to receptacle.
2. Check other instruments in the department to determine whether they have been affected by power surges.
3. Call power plant to inquire about recent momentary power losses.

METHODS OF CORRECTION:

1. If problem is associated with momentary loss of power with subsequent surge, a "low-voltage cutoff relay" device may be constructed and placed in the circuit between the AC outlet and the camera. When a power drop occurs, the relay will open, thus preventing a surge when power is resumed. The camera can be turned off, the relay reset and the camera power switch turned on again.
2. If location of power switch is cause of frequent accidental disengagement, consider mounting a protective "flip up" cover over switch.

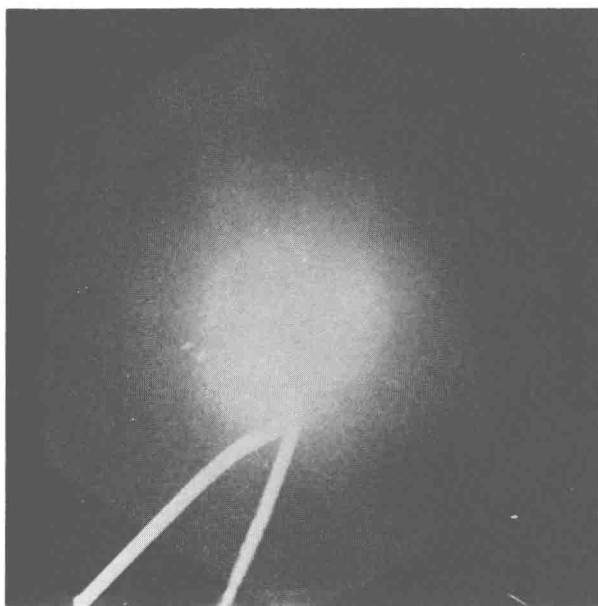


Fig 2A

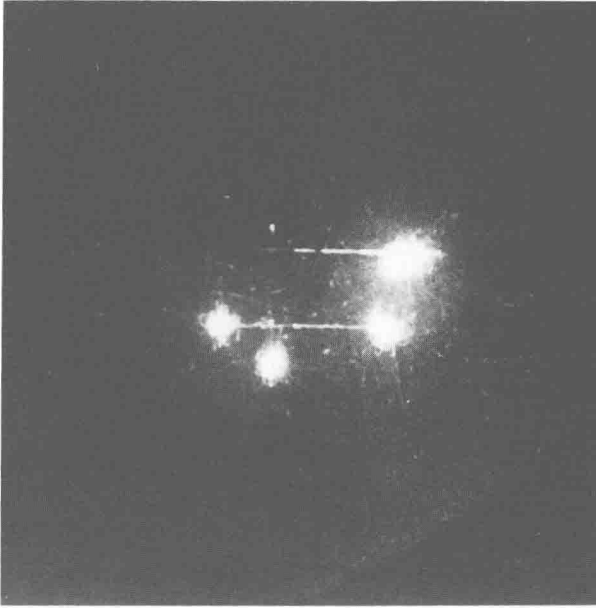


Fig 2B



Fig 2C

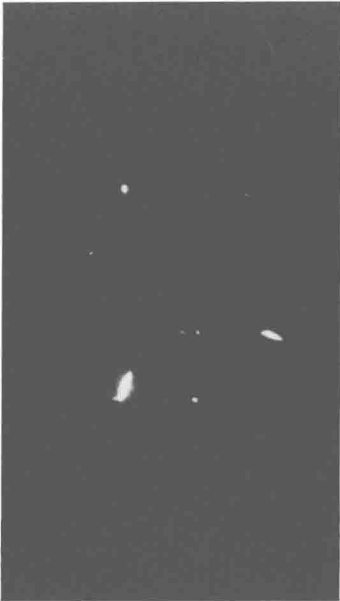


Fig 2D

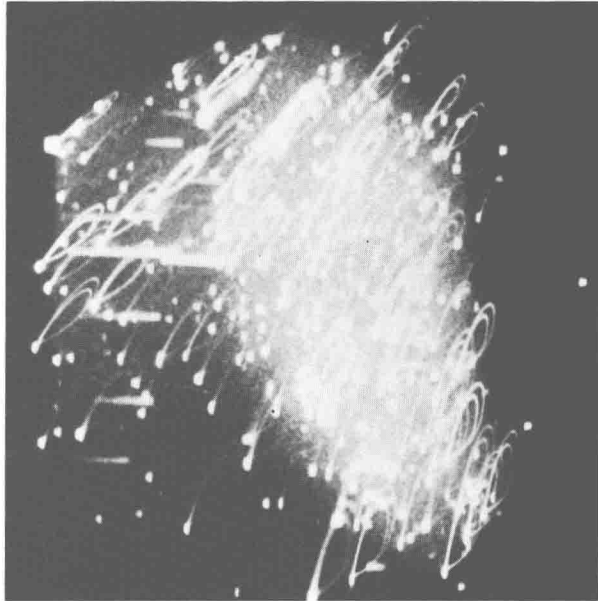


Fig 2E

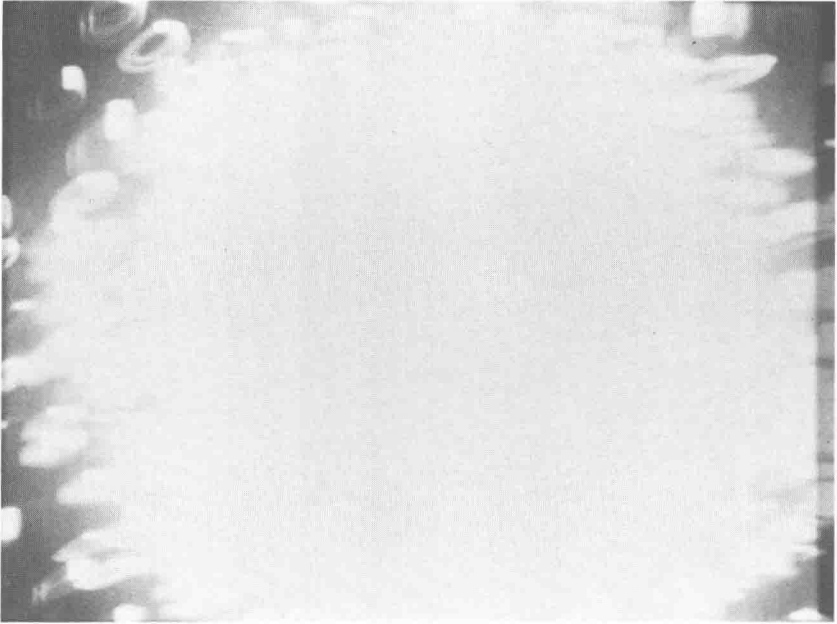


Fig 2F

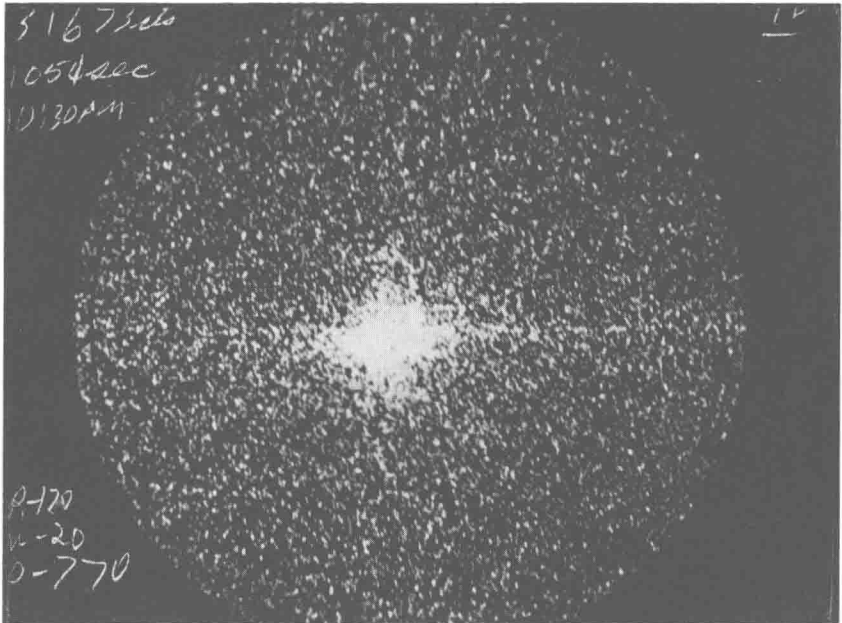


Fig 2G

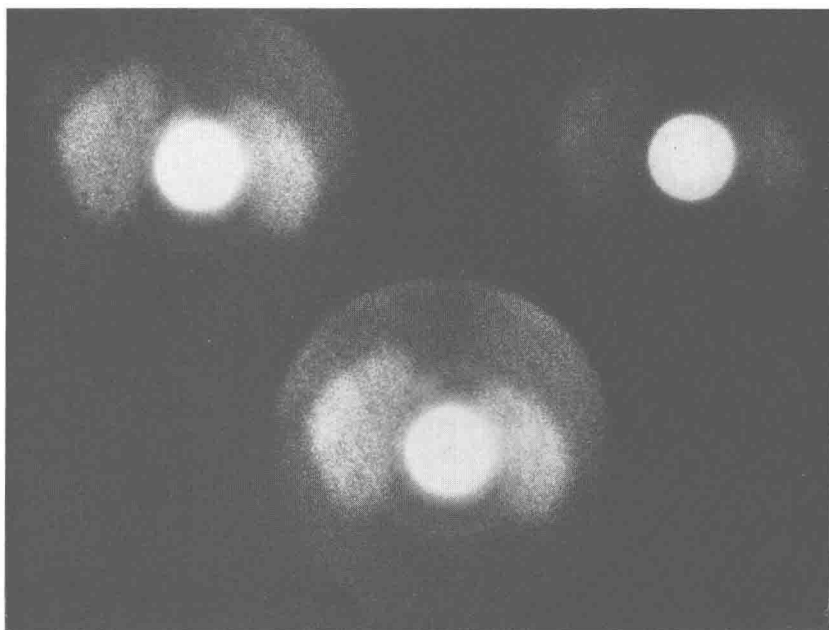


Fig 2H

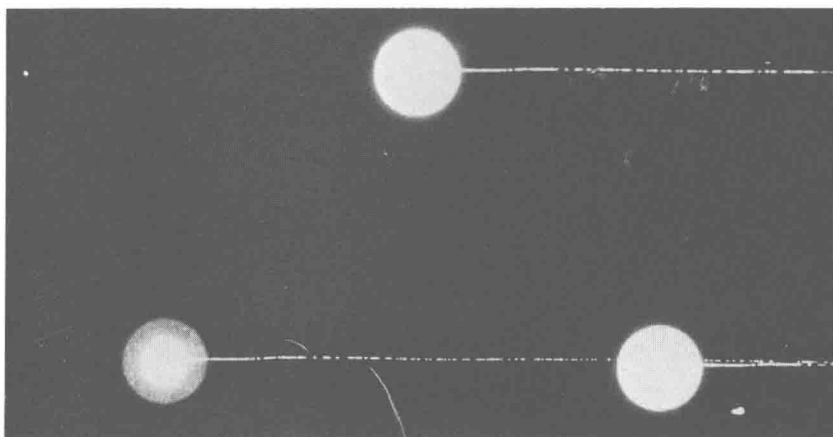


Fig 2I



Fig 2J

3

ARTIFACT: *The Spotlight*

CAUSE: Noise in AC line from an ultrasonic water bath

METHODS OF TROUBLESHOOTING: Disconnect all electrical devices in vicinity of camera. Repeat flood field and observe.

METHODS OF CORRECTION:

1. Install AC line filters.
2. Be sure that no electrical devices are connected to the same circuit as the camera.
3. Whenever possible, place each camera system on a separate circuit.

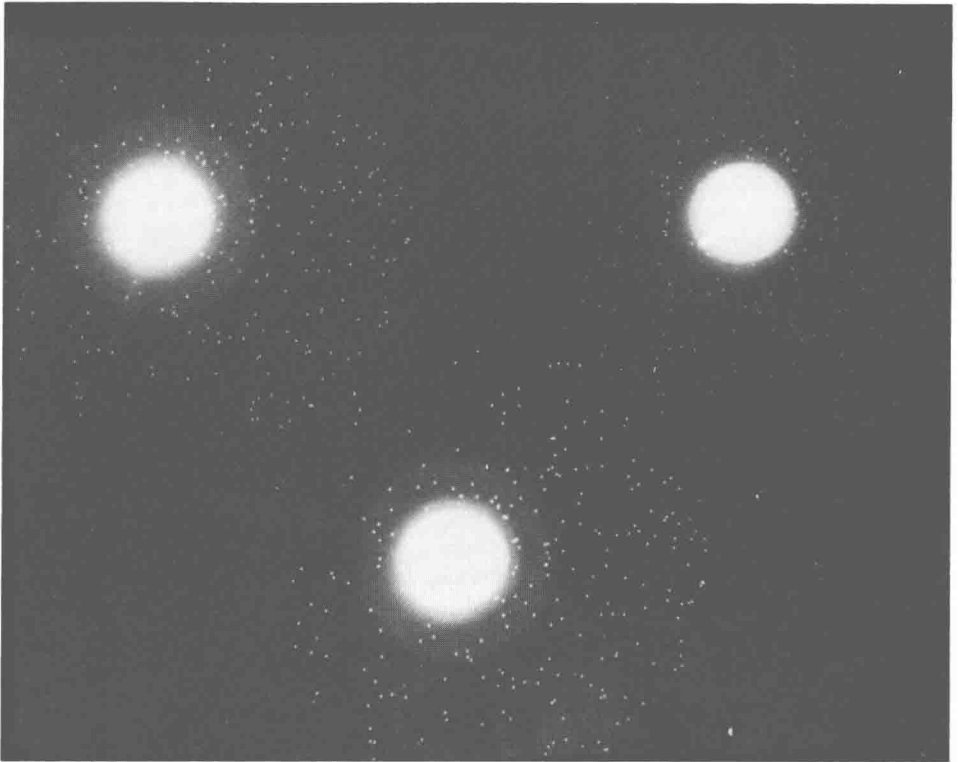


Fig 3

4

ARTIFACT: *Mottled Flood*

CAUSE: Failure of internal gross focusing mechanism for cathode ray tube

METHODS OF TROUBLESHOOTING: Visually check external focusing, astigmatism and intensity settings of cathode ray tube.

METHODS OF CORRECTION: If artifact persists, call service representative.

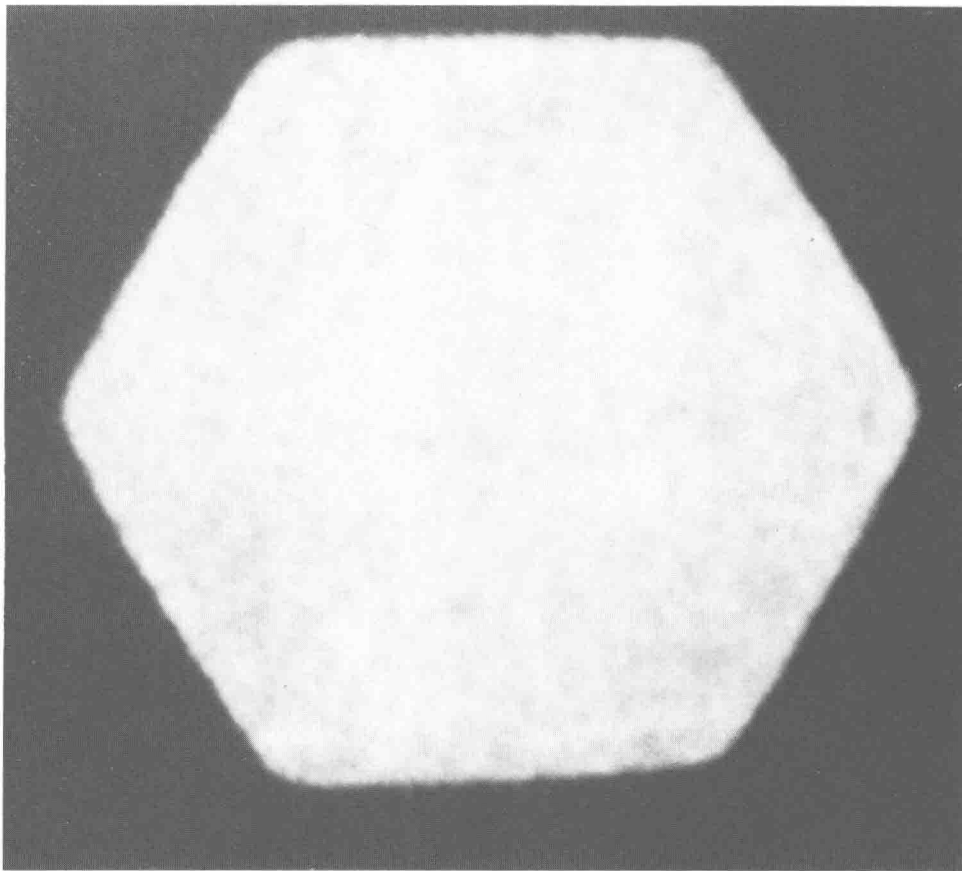


Fig 4

5

ARTIFACT: *The Incredible Egg*

CAUSE: Shift of gain and/or balance

METHODS OF TROUBLESHOOTING: Recognize image distortion.

METHODS OF CORRECTION: Call service representative.

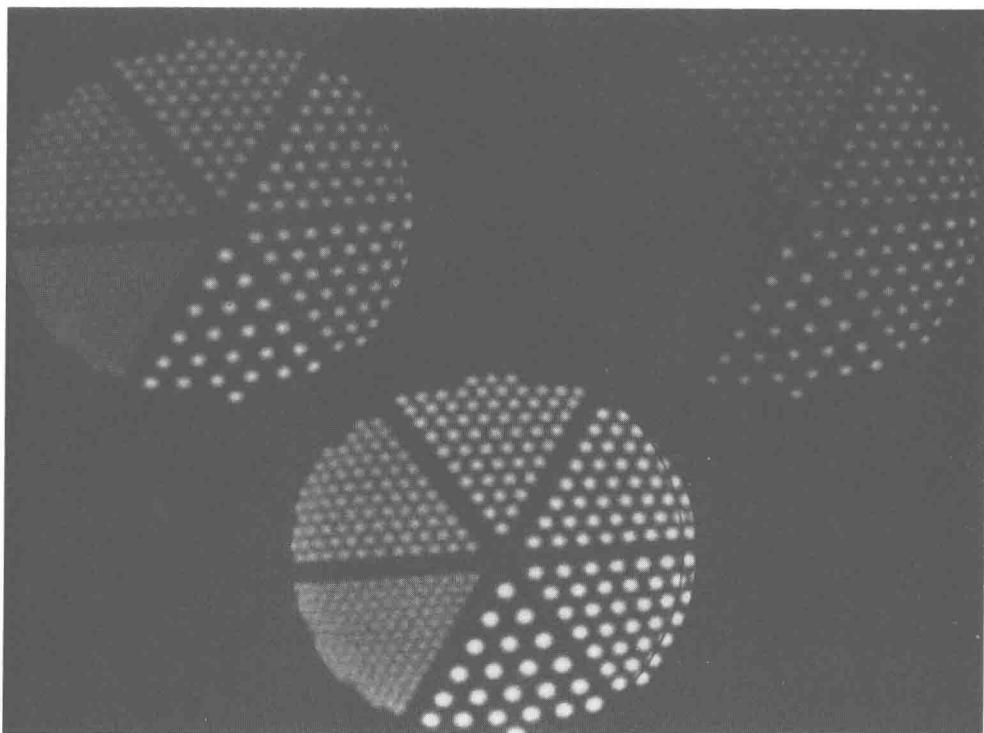


Fig 5A