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NEWS CONFERENCE

on

INITIAL SCIENTIFIC INTERPRETATION

OF MARINER IV PHOTOGRAPHY

Participants:

Mr. James E. Webb, Administrator, National Aeronautics & Space Administration.

Dr. William H. Pickering, Director, Jet Propulsion Laboratory, Pasadena, California.

Mr. Edgar M. Cortright, Deputy Associate Administrator, Office of Space Science and Applications, NASA.

Prof. Robert B. Leighton, California Institute of Technology, Principal Investigator.

Mr. Dan Schneiderman, Mariner Project Manager, Jet Propulsion Laboratory.

Prof. Bruce C. Murray, California Institute of Technology.

Mr. Julian Scheer, Assistant Administrator, Office of Public Affairs, NASA.

SCHEER: Ladies and gentlemen, I want to introduce first the people on the stage.

In deep conversation, Mr. James E. Webb, the Administrator of NASA.

Dr. William Pickering, Director of the Jet Propulsion Laboratory.

Mr. E. M. Cortright, Deputy Associate Administrator of NASA for Space Science and Application.

Dr. Robert Leighton of California Institute of Technology, the principal television investigator for the Mariner IV project.

Dan Schneiderman, Mariner Project Manager, Jet Propulsion Laboratory.

Dr. Bruce Murray of Cal Tech, television investigator.

I thought we'd start today by asking Dr. Murray to run through the 21 Mariner IV photographs very briefly, and we'll devote the rest of the time to questions and answers.

Dr. Murray.

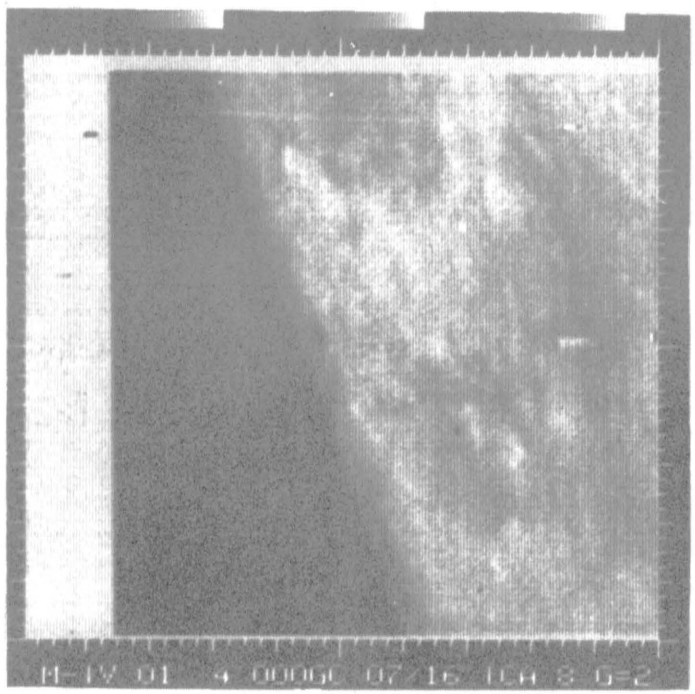
MURRAY: This is the first frame that showed the limb. We have two different representations of the picture that was released to the public.

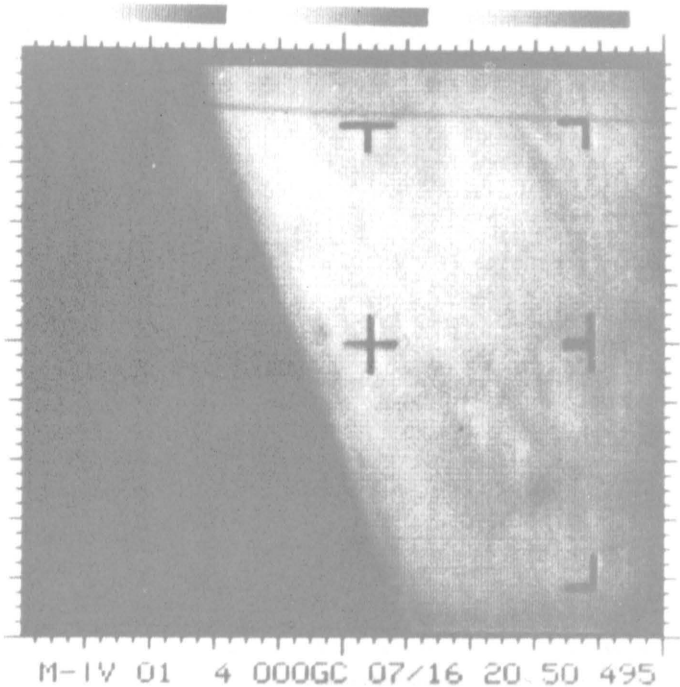
QUESTION: Can't hear you.

MURRAY: Is this all right?

We have at the base of the picture two different representations of essentially the same picture that was first released to the press about a week ago -- or two weeks ago, pardon me.

And then to illustrate the fact that we're in an intermediate form of data processing, we have shown what literally was our most current form at the time we decided to

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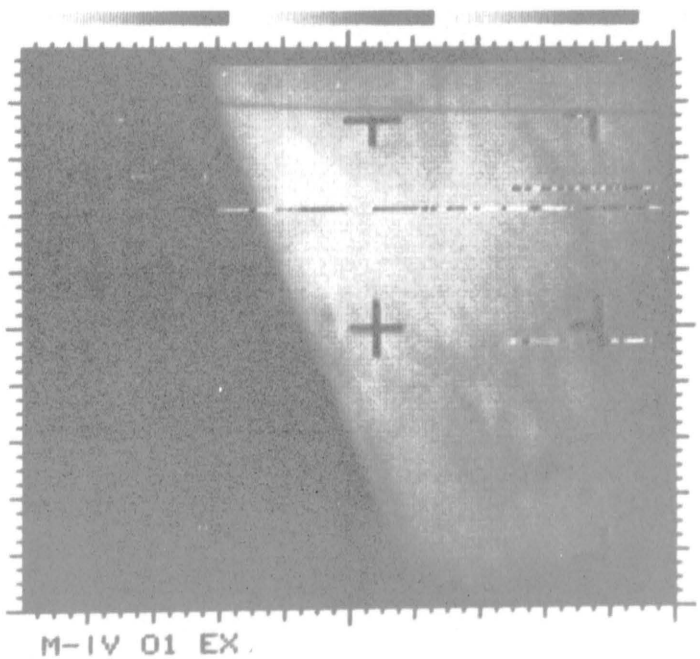
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come to Washington here, which we just printed up for you.

We hope to have a somewhat improved version of all the pictures you will see which will become available at some future time. In the meantime, we are releasing things in their current state of processing -- some of them worked on a good deal more than others.

I also would like to mention that we have a team of five people, myself, Dr. Leighton, Dr. Robert P. Sharp of California Institute of Technology, Mr. Denton Allen of Jet Propulsion Laboratory, Mr. Richard Sloan from Jet Propulsion Laboratory.

May I have the next slide, please?

This is Slide 2. Slides 2 and 3 were mosaicked together in the release that was made two weeks ago. And this just shows we enhanced the contrast somewhat from that time.

Slide 3, please.

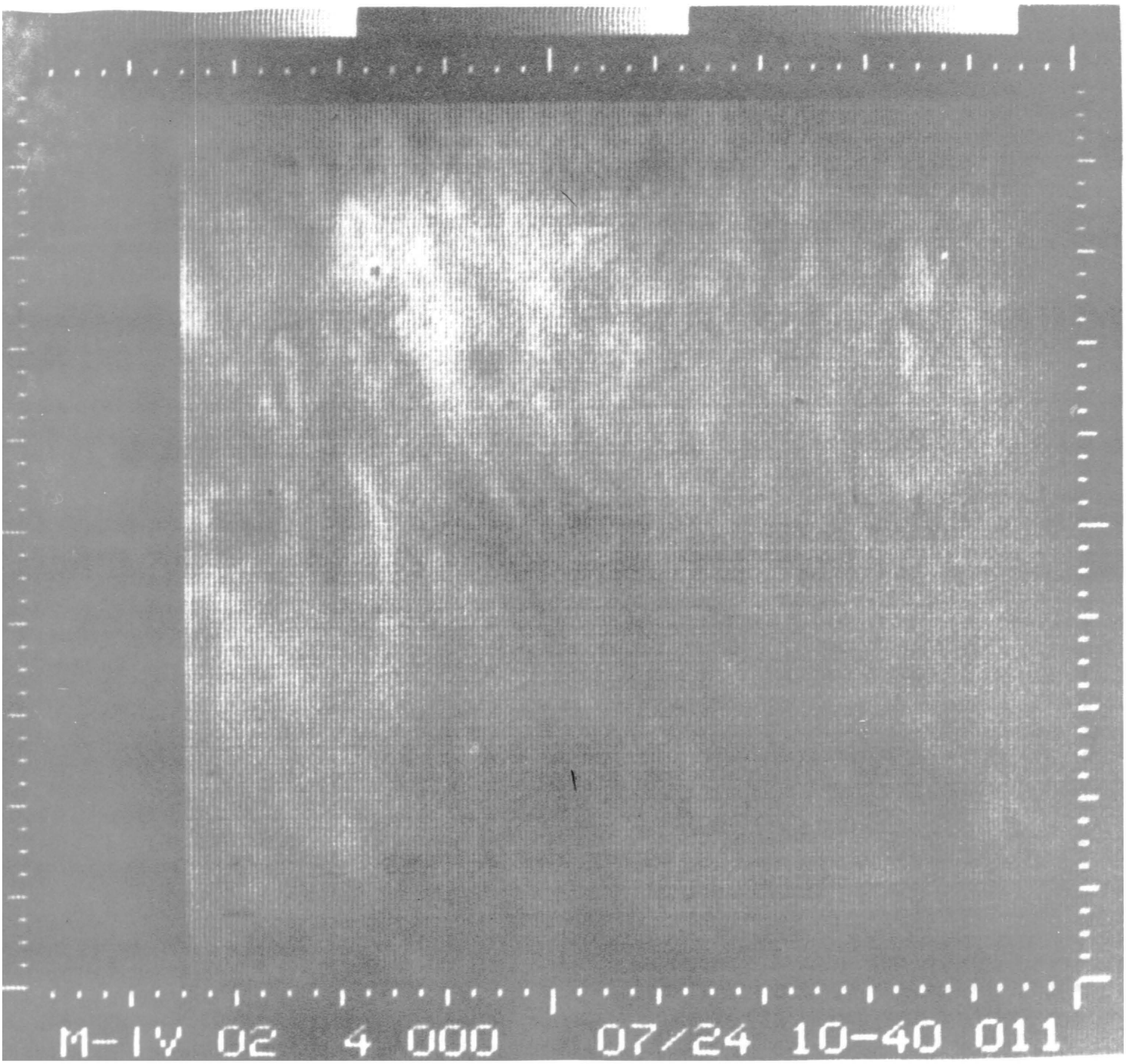
This is the first picture which showed some clear surface detail. We have enhanced it further since the time you last saw it. And it indicates I think that we can do considerably greater with some of these pictures than we have so far.

Slide 4, please.

This is the fourth slide. Remember now we were nearly at noontime on the planet Mars locally, so the sun's illumination is from a very high direction and there is very little surface detail present, even though there may be as much detail in this picture at this point on Mars if it were observed at different sun's lighting, as you saw earlier this morning in Frame 11, for instance.

May I have the next slide, please. This is Slide 5.

Again you're beginning to pick up some features. We're beginning slowly to move across, and the sun's lighting is more favorable. You begin to see some little circular features which you now probably recognize to be craters. At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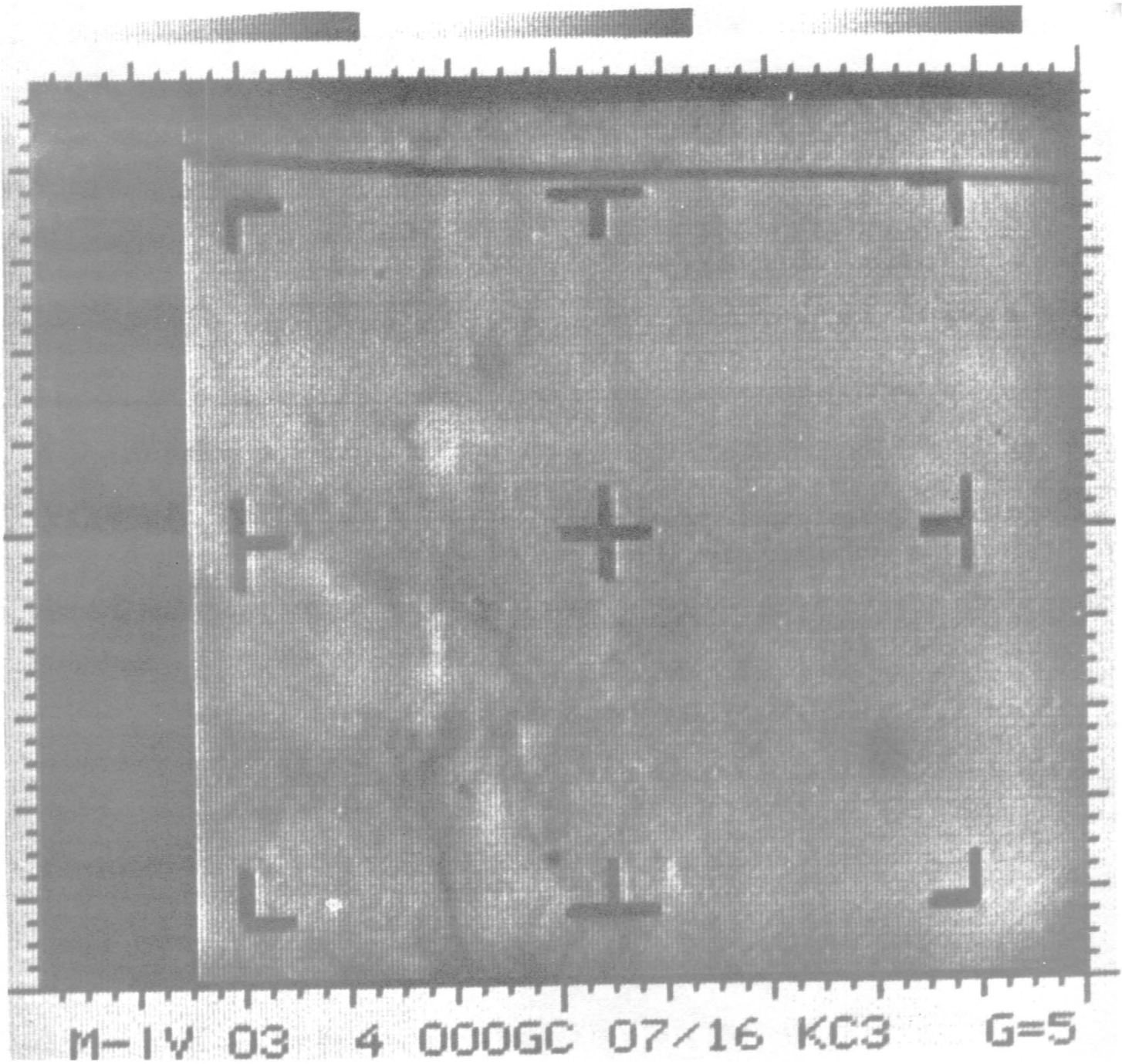
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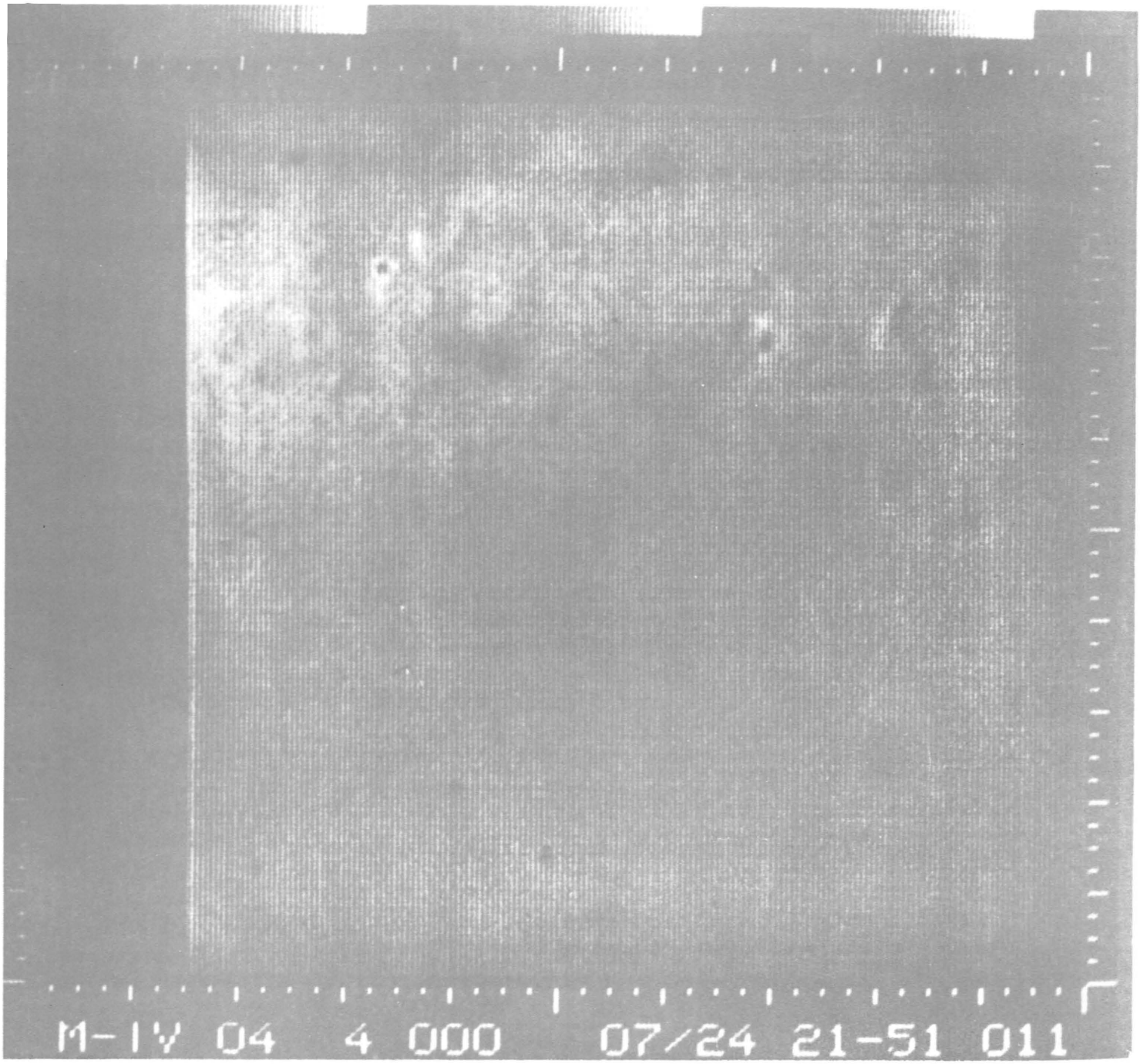
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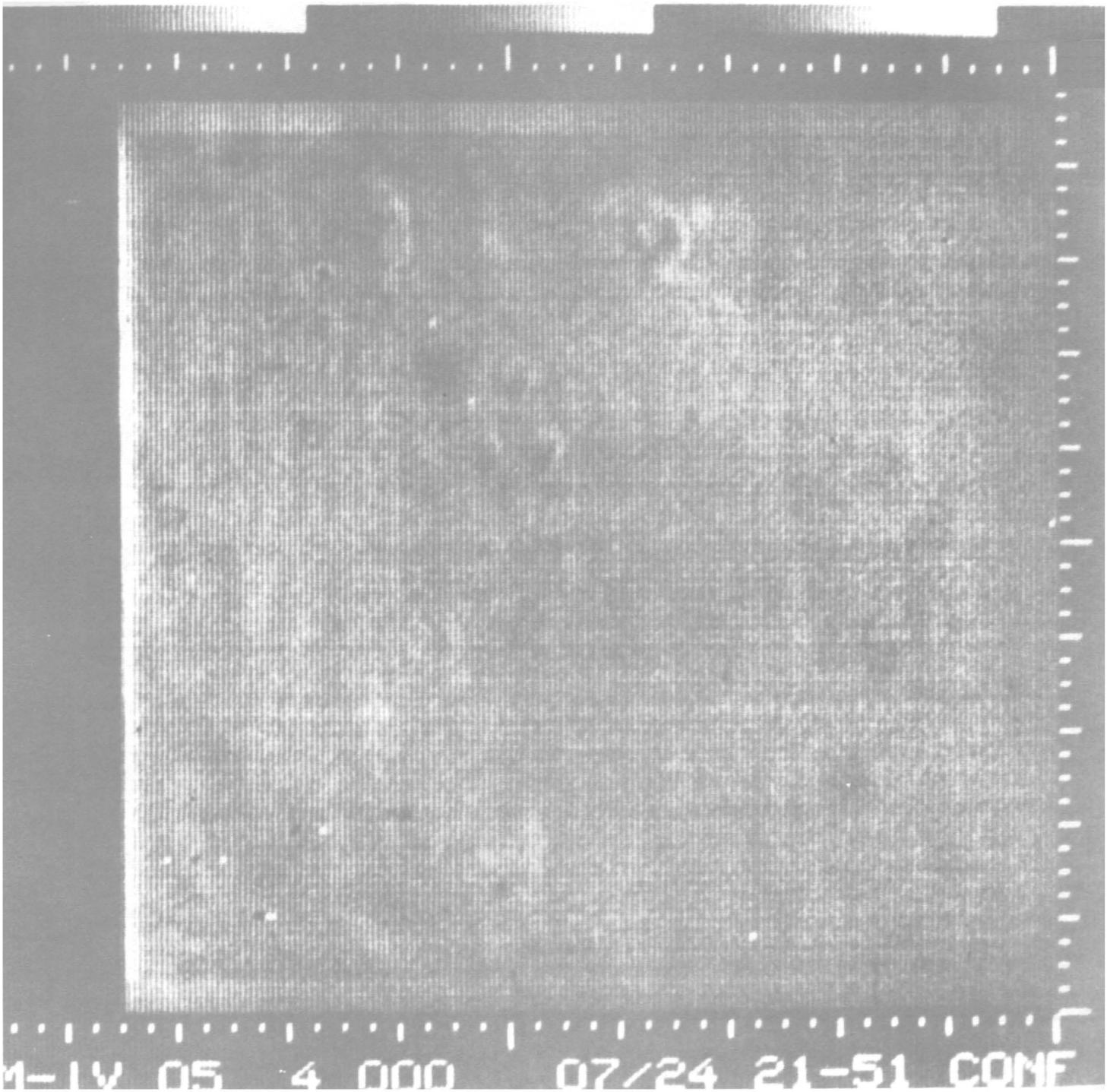
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the time they were first seen, of course, it was not sure.

Slide 6, please.

In Slide 6 we are beginning to pick up considerably more detail, again still not sufficiently distinct in its own right to be very sure what it would be at this stage of processing.

Frame 7, please. To the people working on the project, when we received Frame 7, even in its initial form, it was a very dramatic moment, because we began to recognize clearly many, many craters as well as some light to dark variations on the surface of the planet, so that we knew we were going to have a very successful experiment when we reached this point.

Frame 8, please.

Again, now, you begin to see more craters. These, incidentally, are large. That's probably 20 miles across. These are very large craters and very prominent features on any planetary surface.

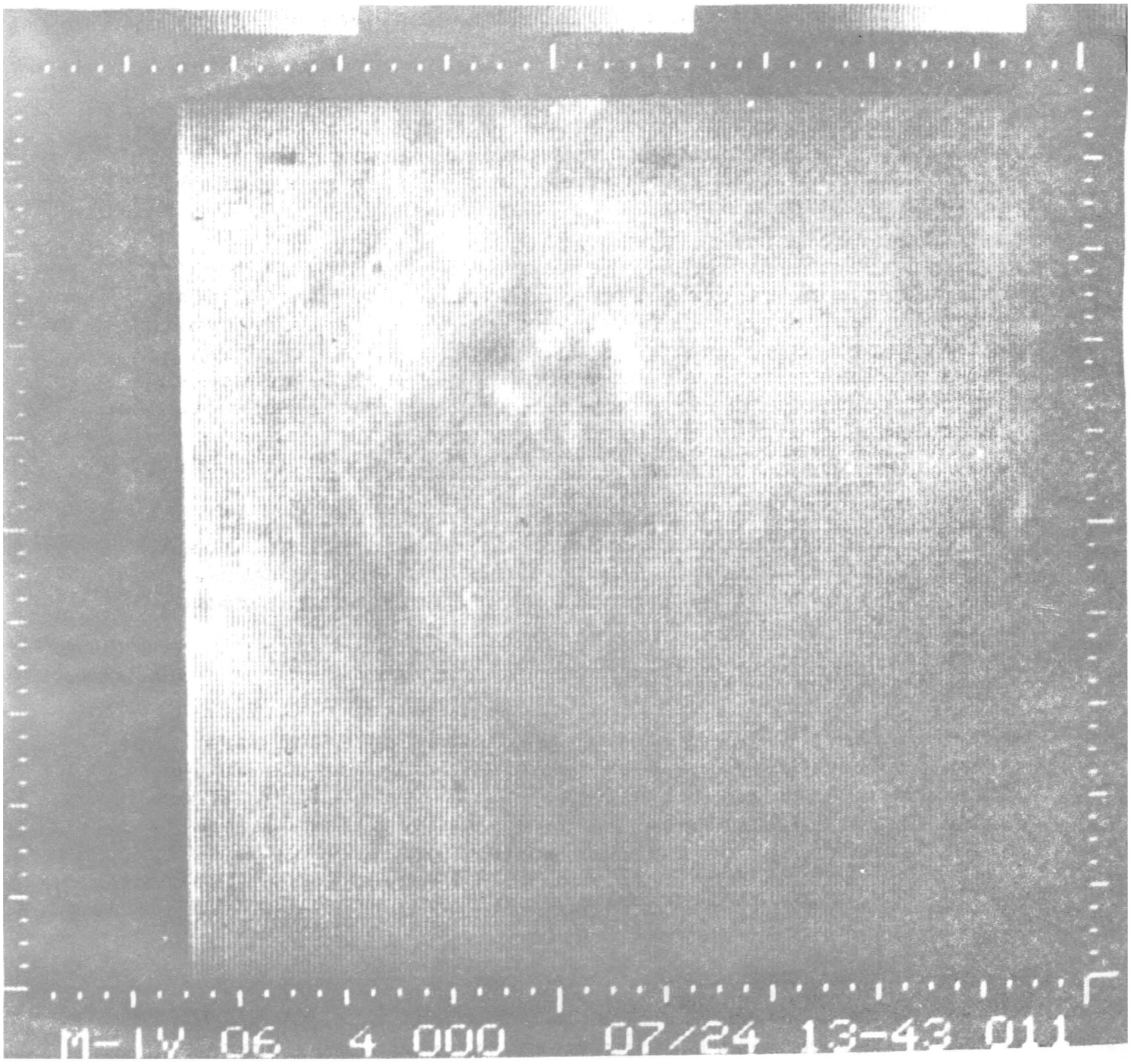
Slide 9, please.

Again we're beginning to pick up more and more. The slight waviness that one sees in this frame and some of the others is an instrumental effect. It is not on Mars. There is one torn line still left in here. Quite a few craters. In this particular one they happen to cluster almost side by side, a surprising fact. It's probably only a "chancy" effect because we have only photographed one per cent of the surface with all the pictures taken together.

Frame 10, please.

Now we're beginning to get more and more craters and the edge of a very large one here (indicating). This begins, I think, to almost everybody here, to look very much like lunar photography.

May I have Frame 11, please.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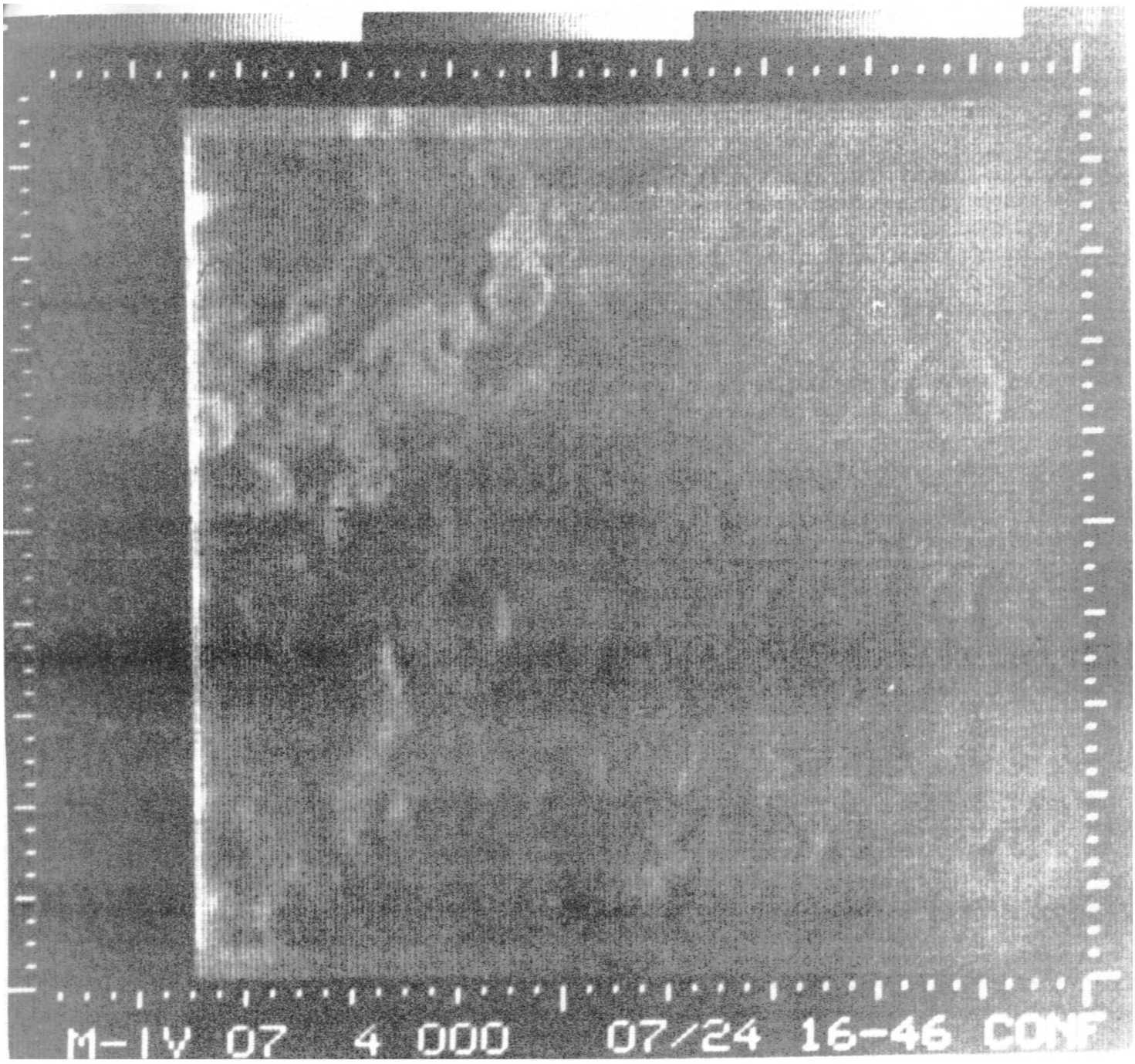
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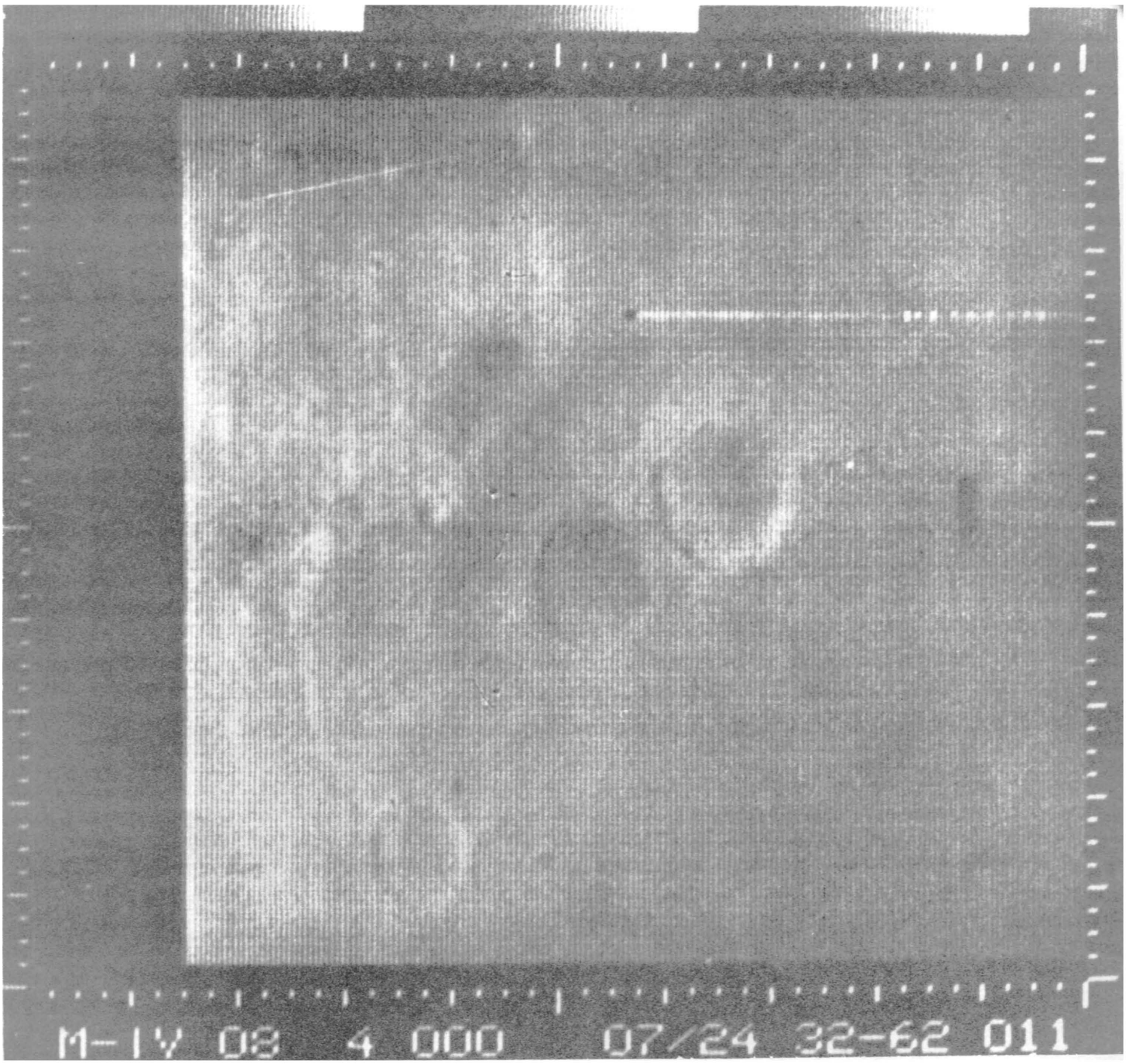
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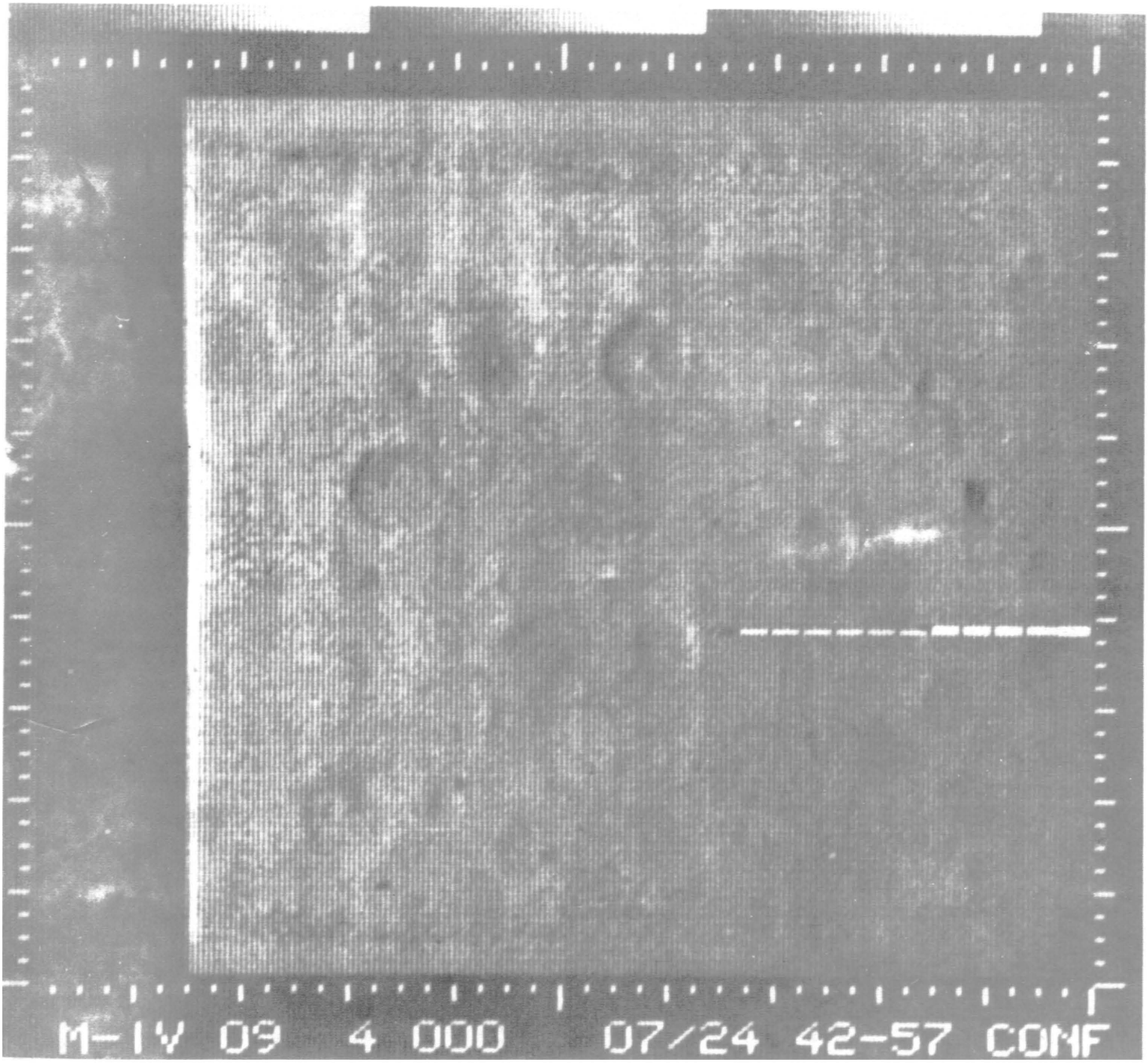
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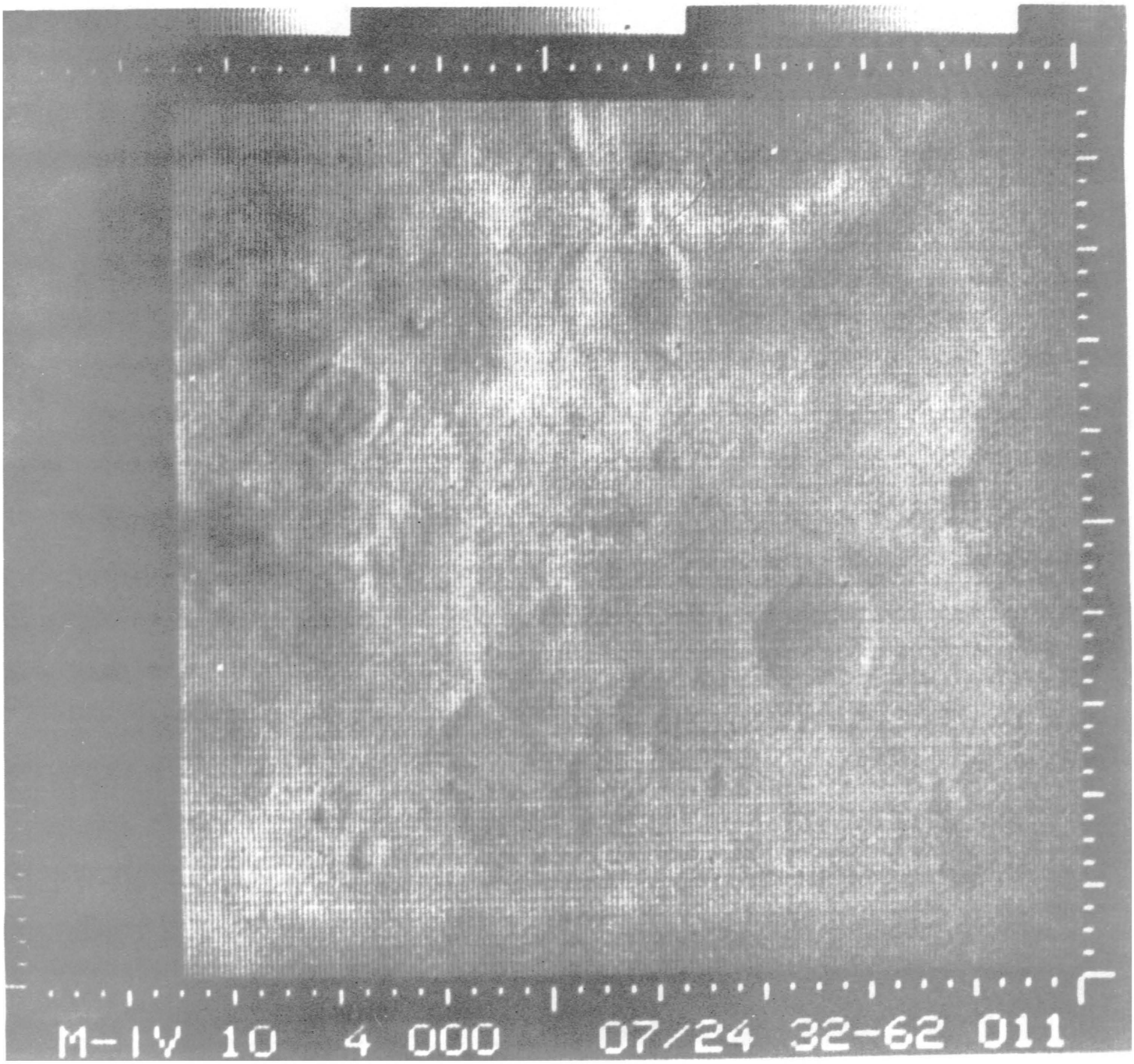
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In the case of this particular frame I think that you could quite easily be confused whether you were looking at the moon or at Mars on that one. This was kind of the pinnacle of the picture experiment, I think, because this had some remarkable things to photograph on the surface, in terms of the fact I don't think very many people had expected Mars would look like this, and, secondly, the light was such and the picture quality was such that this was a very good picture.

QUESTION: Is that the same crater?

MURRAY: No, this is not. They do not overlap.

QUESTION: What's that white stuff?

MURRAY: That white is due to the fact that the picture's contrast has been raised to such an extent that it has saturated a little bit to white.

QUESTION: Is there speculation that this is a great crater then --

MURRAY: Yes.

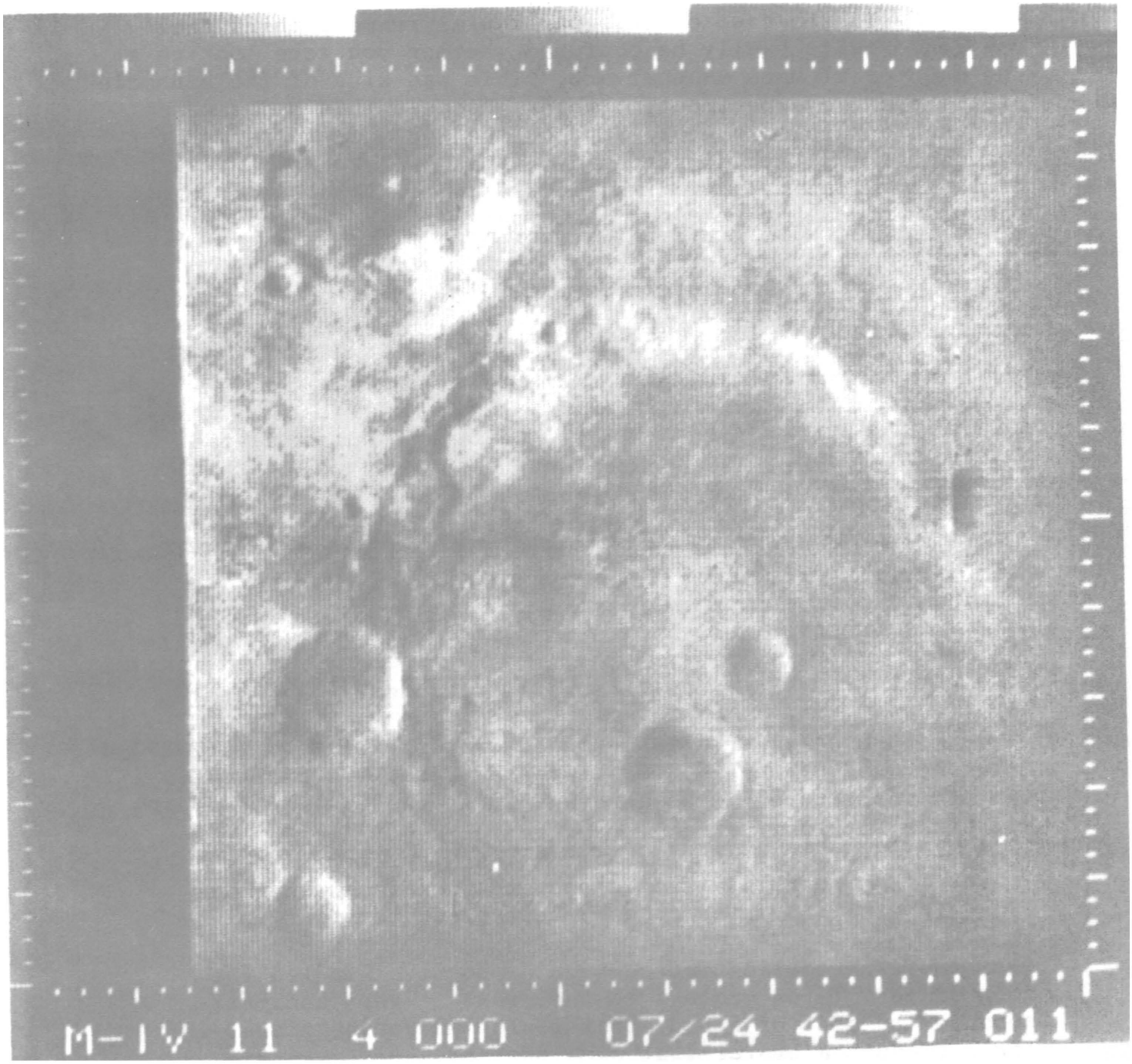
QUESTION: -- with some little ones?

MURRAY: This is a single crater. It's roughly 75 miles across. There is, for instance, a small crater here that is about three miles across and intermediate craters of all sizes within it.

So that in a single picture we have an enormous range in size and an enormous number of craters.

The implication to people who have studied the moon of very large craters is they must be very ancient, because the size of a body that would impact the planet that could produce a crater that size must be very large and, hence, very infrequent. And that is the basis for the statement that we made that the surface itself, since it has these features on it, must be two to five billion years old, a very ancient surface indeed.

QUESTION: What's the oblong on the bottom center?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MURRAY: This thing (indicating)? Oh. I'm glad you asked. We removed the fiducial marks in the computer processing, and we did not completely remove them at every point, so occasionally where the crosses had been before is a black square.

QUESTION: Not a man-made wall or anything?

MURRAY: No, no. I think we can safely be quoted we can see no man-made features on Mars. Before you put that down, may I also remind you the same kind of camera photographing the Earth from an equivalent altitude would see nothing man-made on Earth, with very few exceptions. So that is a meaningless statement.

May we go to Frame 12, please?

This has additional craters in it but not dramatically displayed as they were in --

QUESTION: Now, is this just a piece of terrain that happens to be featureless, or is there something different about this photograph than about the preceding ones?

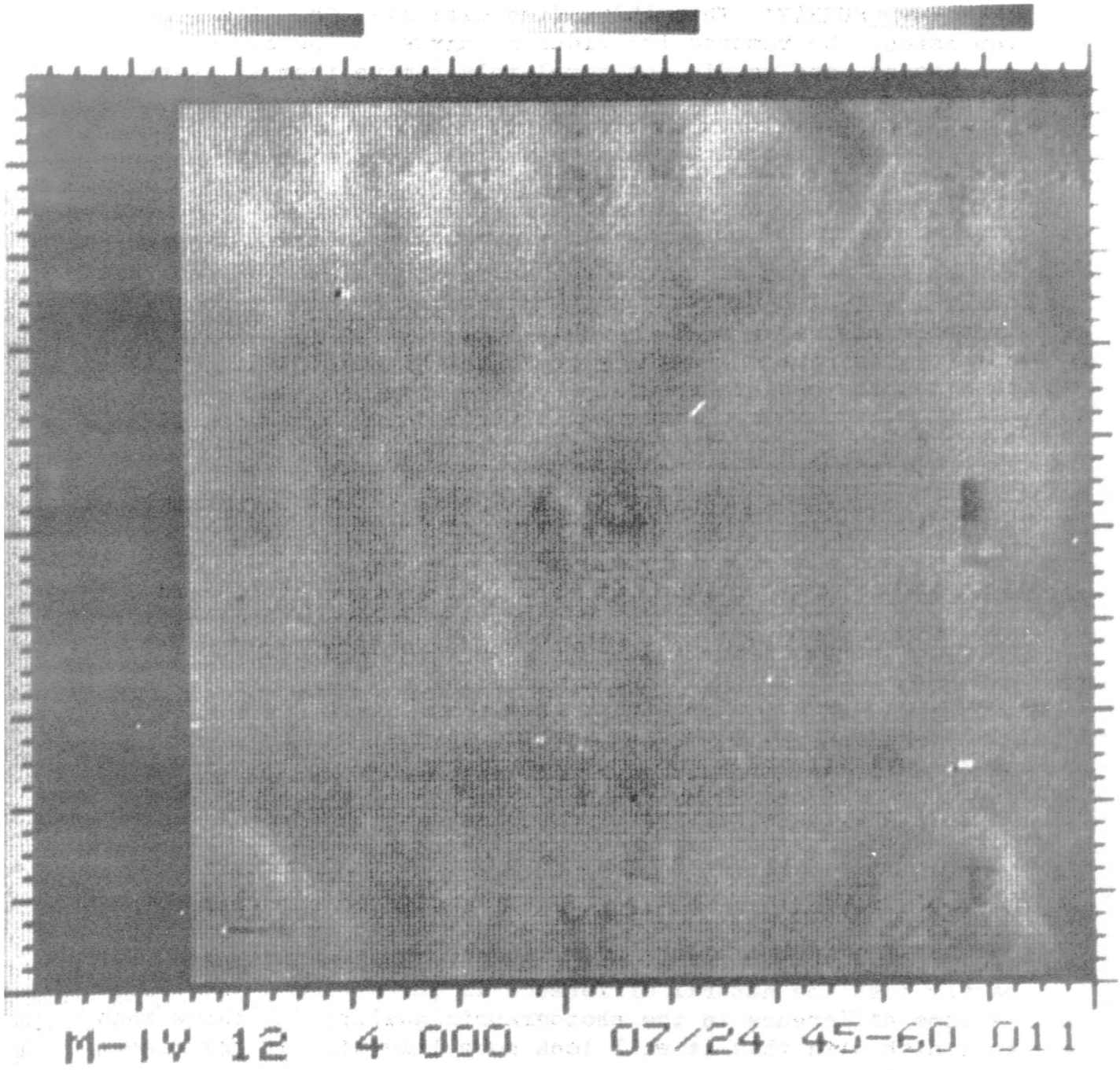
MURRAY: The photographs have been processed in a similar manner, although, as I mentioned, each has had individual attention and in not any regular fashion. We have just been working as quickly as we could to get these out. So the final ones will have much more careful controls on them, for instance.

QUESTION: Well, it isn't a difference of lighting?

MURRAY: The lighting is only changed slightly. It's partly just the natural difference in the surface, and there is some difference in the photographic quality. I think when we finish with this it will look more like 11. At the moment it doesn't seem so.

QUESTION: Where are you here geographically?

MURRAY: Picture 1, of course, was the limb. Pictures 4, 5, 6 were about at local noontime, if you want to think about this, on the planet. Pictures 18, 19, 20 are in the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vicinity of the terminator -- that is, the shadowed portion of the surface. 21 and 22 are in the nighttime surface of the planet.

QUESTION: You're afternoon here?

MURRAY: We're beginning to get into moderate to late afternoon, and we're rather far south. We're almost to the point where we go further south than the flight and reviewed from the point of view of a point moving across Mars.

QUESTION: You're in the southern hemisphere and it's winter?

MURRAY: Right. And we do not cross the polar cap. We did not go far enough south to see the polar cap.

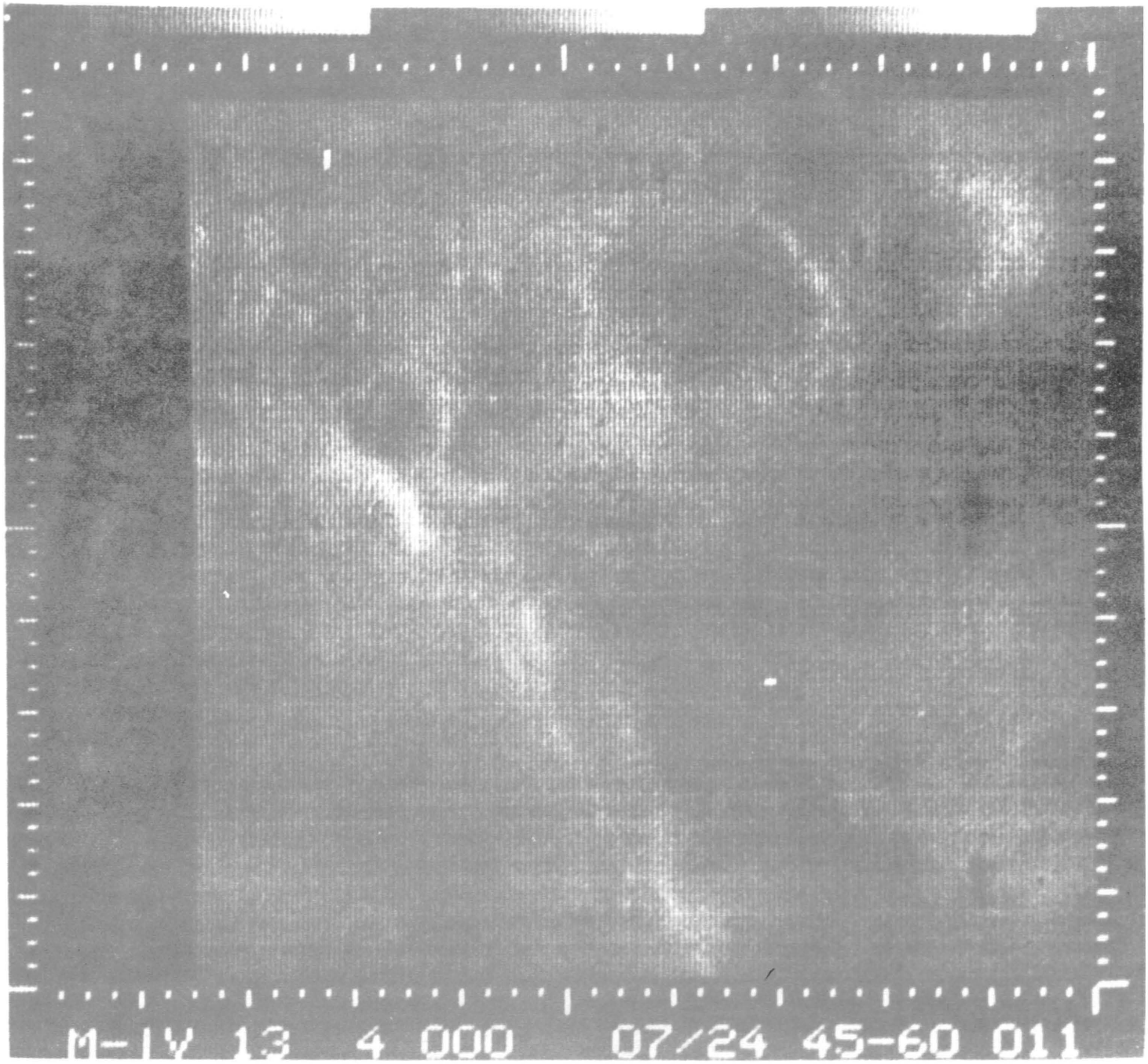
We will see in the next frame and successive ones what begins suspiciously to look like frost ringing some of the craters. The surface of Mars is very cold, so even in the afternoon water would condense out and form frost. And this has been referred to by ground-based observers very commonly. And we were looking for the possibility of this, and this may indeed be the explanation of this whitening around these craters which you begin to see. The texture of the photograph begins to change, and this is why.

Incidentally, this large feature here could be the margin of a very large crater much bigger than we can photograph and also which is in a very rough sense near one of the boundaries of the light and dark areas. We're not yet in position to know what is the significance.

QUESTION: Have you got anything to say about the height of these features that are causing these shadows?

MURRAY: Yes. We measured -- or attempted I should say -- the height of this particular feature by noting the way the light changes across it, and the number I think came out to be 13,000 feet. That's the largest height difference that we have seen in any of the photographs.

QUESTION: How does that compare with craters on the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moon?

MURRAY: That's comparable to craters on the moon.

QUESTION: Are they abrupt? Have they abrupt walls?

MURRAY: No, the slopes from what we've been able to tell so far -- and you recognize this is indeed very preliminary --

QUESTION: Did you say 13,000 --

MURRAY: Yes.

QUESTION: -- or 1,300?

MURRAY: We have measured one apparent elevation change of 13,000 feet.

QUESTION: In this?

MURRAY: In that particular picture right there.

The slopes for the craters have been measured and seem to be reasonably gentle. I caution you that this is a tricky thing to do. But at least our initial look at it indicates they are gentle slopes. I think the steepest one we have seen is ten degrees and we have seen no shadows.

QUESTION: Does that mean weathering at any time?

MURRAY: That would be the likely supposition that we're seeing eroded, rounded-off craters to some extent.

There is a lot of information of that type that will come from this -- the rates of erosion on the moon compared to Mars and a number of other things that can be worked out from this. But that will require a considerable amount of time because we have got to go over each crater and carefully measure slopes and do profiles.

QUESTION: Why do you see no shadows? They look like shadows.

MURRAY: I want to make it clear. Remember these pictures have had the contrast enhanced very greatly in order that you can see the detail. The light to dark variation is due to the fact that the slope changes across it, and, therefore, some parts of the slope are directly illuminated by the sun. Others have a very low angle of sun across it just because of the variation of slope.

And, indeed, that is a fact we used to infer the slope.

So that you see light to dark variations across a crater, for instance, on the moon and also in these pictures even if there is no shadow formed. The slopes are not steep enough to cast shadows.

We have also looked very hard for shadows and so far have not yet identified any.

You can see as we go on the pictures will get of poor quality, and there is a reason for this, and in the area where you would expect shadows to be cast -- say ten-degree slopes ought to be casting shadows -- we don't have good enough pictures to see it.

But in the range where you might have seen 30-degree slopes casting shadows, we don't see any slope casting shadows, so this confirms the other kind of measurement. The slopes are reasonably gentle.

QUESTION: Can you tell from what we know about pressures on Mars and the fact frost is formed just what the temperature would be?

MURRAY: That information was known before Mariner. We have actually observed the temperature directly. And the temperature at the hottest point on Mars, which would be at the equator or near the equator in the summertime, is about just a few tens of degrees above freezing.

And even during the daytime over most of the surface it is below freezing. Then at night it is very much below freezing over the entire Martian surface. So frost is to be expected.

And we, of course, have never sampled that white stuff to make sure it's water and not something else, water frost. But since it does freeze in about the right temperature range for water, the supposition has been made many years ago from the Earth that this indeed was frost, and so we are operating on the same assumption.

And there is indeed a real effect, there is a real whitening of these craters, further south and in the later afternoon that we are observing.

QUESTION: Bruce, are there any color changes that look like they could be vegetation?

MURRAY: We have not yet analyzed the color data, have not yet had a chance to determine what color difference exists.

QUESTION: Have you been able to establish any relationships between some of these whitened features in terms of their location and this bright radar spot reported by Arecibo some time ago?

MURRAY: We were well aware of this and very anxious to see if we could establish a connection. The answer is, from the pictures, no. Actually when we looked into it more carefully, there were good ground-based visual observations, and photographic, which showed that there was a cloud on Mars for quite some months at about the same point that is a very strong radar function.

Incidentally this was also found at the Goldstone antennas in a similar way and therefore is confirmed. There were two different operations that found this unusual radar reflectivity.

At the moment there is no formal explanation. One can speculate it has to do with the presence of moisture in the soil, which is what causes radar reflections in the Earth.

QUESTION: You did not get over Trivium Charontis?

MURRAY: We did not pass over Trivium Charontis.

QUESTION: You mentioned clouds. There is a statement in the release that there was nothing in the pictures that could be interpreted as clouds. Is that correct?

MURRAY: I think with a little more caution we said we didn't recognize any.

QUESTION: What about that irregularity on the limb in No. 1?

MURRAY: We have no further interpretation of that.

QUESTION: You were calling it a cloud, apparently a cloud, in Pasadena.

MURRAY: If I may beg to differ, we didn't call it a cloud.

QUESTION: Somebody there on that --

MURRAY: No, I think what happened was it looked like a cloud, and all we said at the time was we cannot be sure we can distinguish it from a subtle instrumentation effect. That answer still holds; until we have time, which is really a matter of months, to process the stuff very carefully, we will not know. So we have no further information on that subject.

QUESTION: Do you have any elevations higher than 13,000 feet?

MURRAY: We have not recognized any higher than that.

QUESTION: Elevations with respect to what?

MURRAY: Local differences in height. There is no way from this to get any absolute height information.

Yes?

QUESTION: If you were on Mars, how would you measure temperature?

MURRAY: Well, you would stick a thermometer in the soil I think. We're referring to the ground temperature now, of the surface of the ground, not the air temperature. The air temperature is always below freezing probably on Mars.

I hope I won't get a meteorologist after me for this. But the clouds that have been observed probably are ice crystal clouds. It would be very unlikely they are water drop clouds.

QUESTION: Would you repeat the questions as they are given? Some of us can't hear them.

MURRAY: This was the question regarding temperature on the surface of Mars, and the discussion I gave previously regarding temperature referred to ground temperatures, not air temperatures.

All right. Let's go on to the next slide.

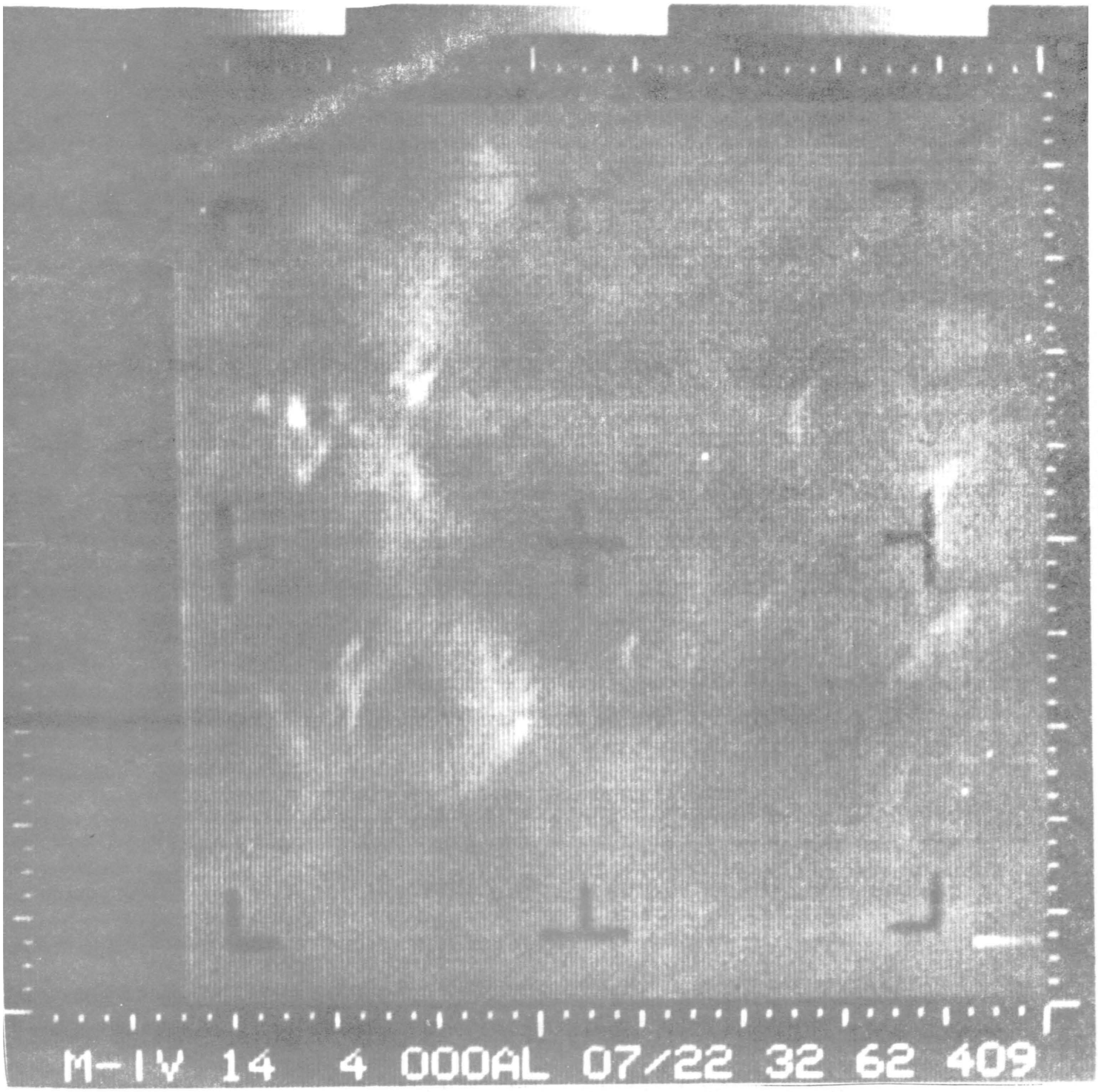
Now, there's overlap between these two frames. You remember the overlap exists in alternate sets of frames. There are two that overlap, one that doesn't, two that overlap, etc. The filters change, red, green, green, red, red, green, green, etc.

This picture, Frame 14, has this characteristic whitening that we were discussing that may well be frost as well as the illumination of the sun and some very bright spots which are real. They are on Mars. We don't know what they are.

That's one of the number of features which are clearly there which we have not yet been able to come up with an answer for -- may never. I'm certain many other people will give it a try as well.

They are very bright, and it could be that they are some kind of peak sticking up that is covered with frost, even a small one that might be very brilliantly illuminated and have frost on it as well.

QUESTION: Is this a red or green filter?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MURRAY: I have to refer to the captions. I'm not sure at the moment.

QUESTION: Have you reached any conclusions comparing red-filter pictures to green-filter pictures?

MURRAY: No, we've been unable to get that work done. That takes a good deal of time. We intend to do this carefully, because there is an overlap intentionally such that the same area has been photographed with red filter and green filter. So we can get some color information, but this has not yet been done.

QUESTION: Would it be feasible to use the Land system on that overlap, projecting it back through green and red filters?

QUESTION: Repeat the question.

MURRAY: The question is: Would it be feasible to use the system by Dr. Land which involved making colorful scenes from just two different sources of light? And the answer is I don't know. We have looked into, as a matter of fact, many ways of displaying color and trying to get color information. But this is a subtle and difficult task and will take some time before we are able to get it all done.

QUESTION: Are you going to try that particular approach?

MURRAY: I don't know yet. We are just in the process of deciding what is the best way and how to best use our resources in doing this.

QUESTION: Has any elevation been speculated for those peaks that you can see?

MURRAY: No.

QUESTION: Repeat the question.

MURRAY: Pardon me. The question was: Has any analysis been made of the heights of these peaks or, for that matter, the slopes? And the answer is no. At the present time

time we're not even sure they are peaks. They are bright white patches, and we can state that if you had little peaks of some kind there that were covered with frost they might look like bright white patches on the picture. But the converse doesn't hold.

QUESTION: Would there be shadows for the peaks?

MURRAY: If they were peaks would they cast shadows? Yes, they would cast some shadows in the sense that the sun is now getting low enough. And this requires some detailed analysis of the numbers that we receive from the spacecraft that correspond to these individual little positions across here, and we just haven't had time. With those numbers we can reach a conclusion regarding that subject, yes.

QUESTION: Have you come to any conclusion now about this bump in the upper right quadrant of No. 3 which you were reluctant to discuss back in Pasadena ten days ago, whether it was a hole or hill?

MURRAY: Right. We're still puzzled. It's surprising with this time. We certainly have looked at this carefully. It's a difficult picture to interpret because the sun's elevation is high, and it's in an oblique direction, which complicates this analysis I was referring to about the brightness for slope information.

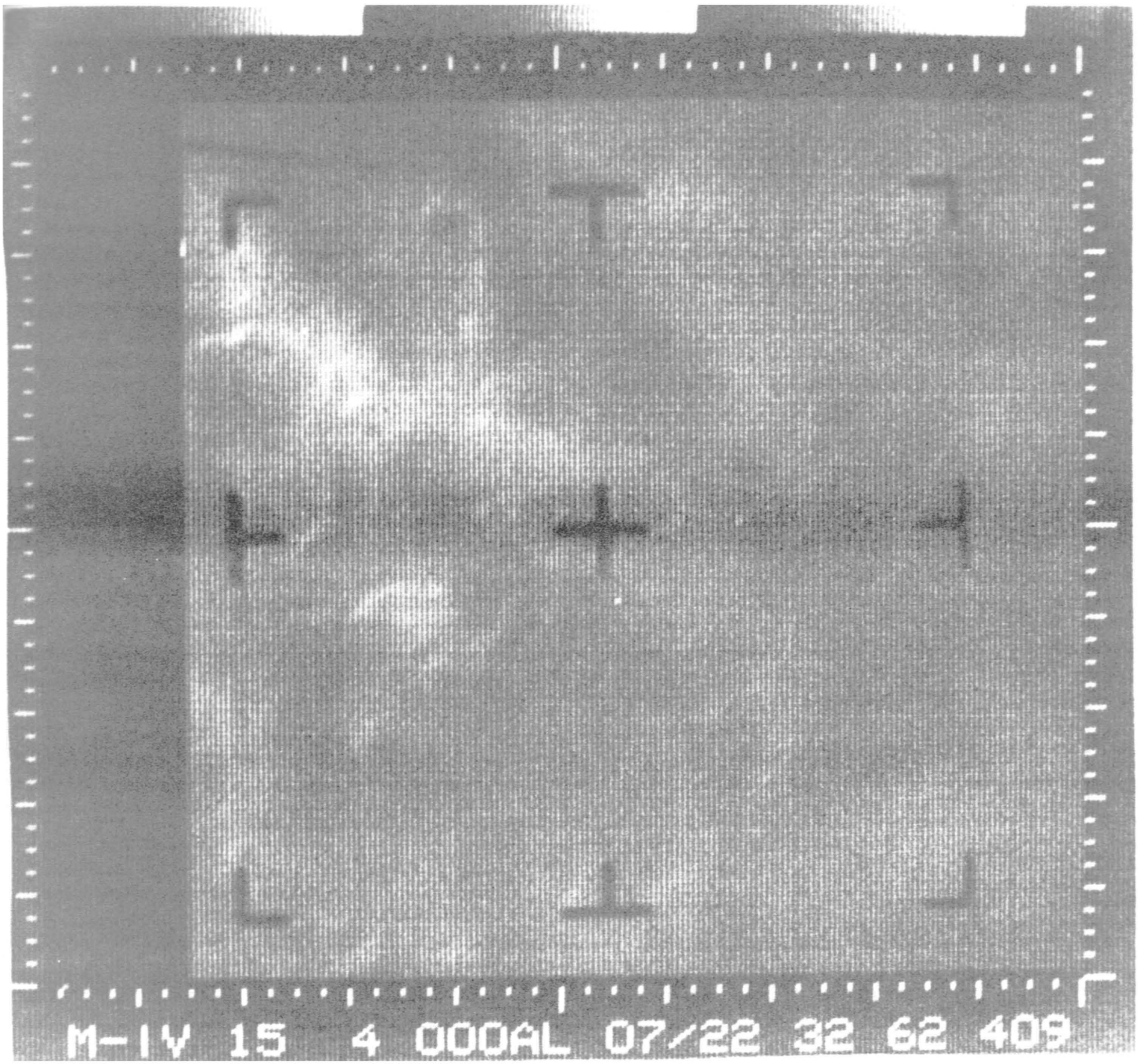
We're not going to let it go at that. There's a lot of detail and information in that one, and we intend to work very hard and try to extract it out.

Can we go on to the next slide?

Now you begin to notice that the contrast is going down now, that you see less and less in this picture, and this will get more and more as we go on. This is No. 15. This is still obviously craters and ringing of white going on here. Craters are detectable easily throughout this picture here, particularly on original or glossy prints and so forth.

Next picture, please. This is 16.

It may well be that most of what we are seeing is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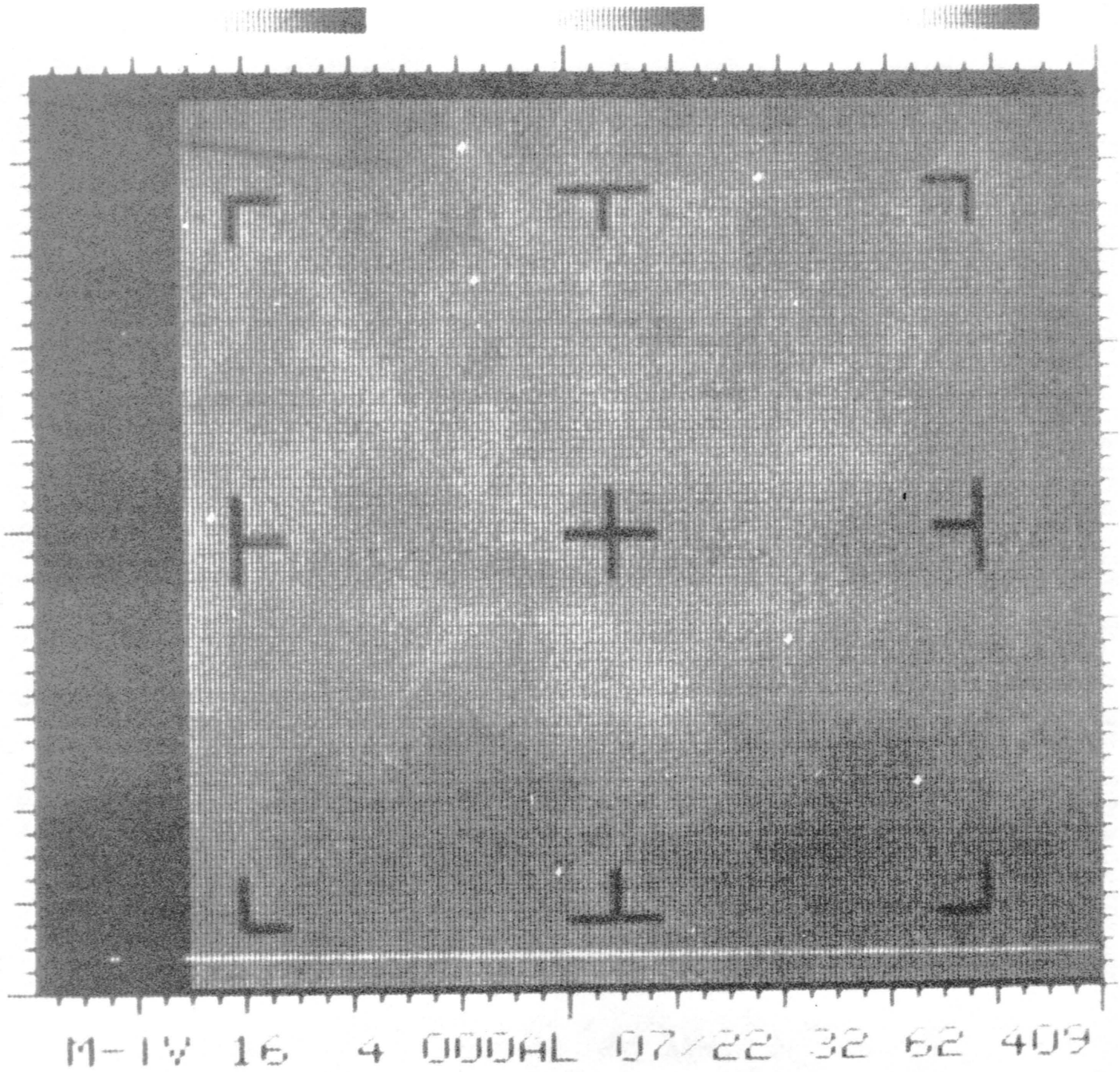
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frost enhancement.

No. 17.

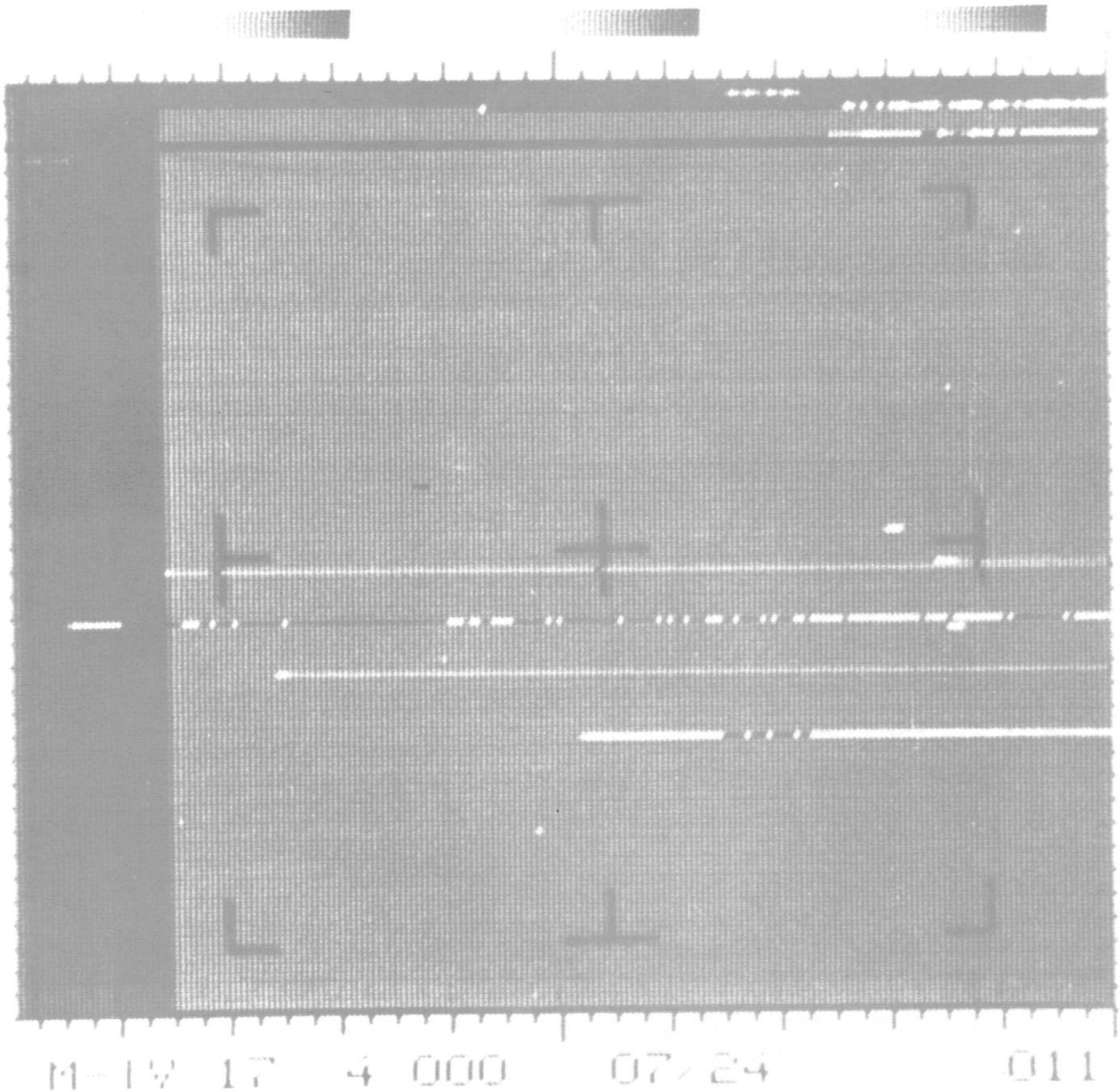
Now, I'm showing you these and letting you see for yourself what has happened, namely, that we have lost picture quality as we got beyond this area of 11, 12, 13 where things were kind of optimum, where we got our best picture. This was a surprise to us. We were not expecting this. And our preliminary analysis suggests two things:

One, that the so-called hazing or fogging of the camera lens or, more specifically, of the vidicon surface that was discussed at considerable length in the release of the first picture -- if that's an optical instrumental defect of some kind that arose during the space flight the cause is unknown -- then that might also be still operating and as the scene gets fainter and there is this reasonably high background it does two things. One is it reduces the visible contrast, which we could take care of, but, secondly, it confuses our automatic exposure system.

This is a very elaborate and very clever camera arrangement, in that it provided for changing the electrical amplification of these signals in the spacecraft before they were put on tape or anything right off the surface of the vidicon. This was done. This was done by keeping track. It automatically looked at the voltage on an existing frame and then decided what gain setting to set for the next one.

But a spurious source of light, of course, would fool this system, and that's one explanation.

The other explanation, and one that is also important to remember, is that no man has ever seen Mars from this viewing angle before. We have a phase angle of 60 degrees here, the angle between the sun and earth and moon of 60 degrees. And, therefore, we could only infer what the brightness of this particular piece of Mars would be when viewed from this angle. We could only infer it from indirect observations. And there are many reasons that that could have been wrong. There is just nothing we could do about it.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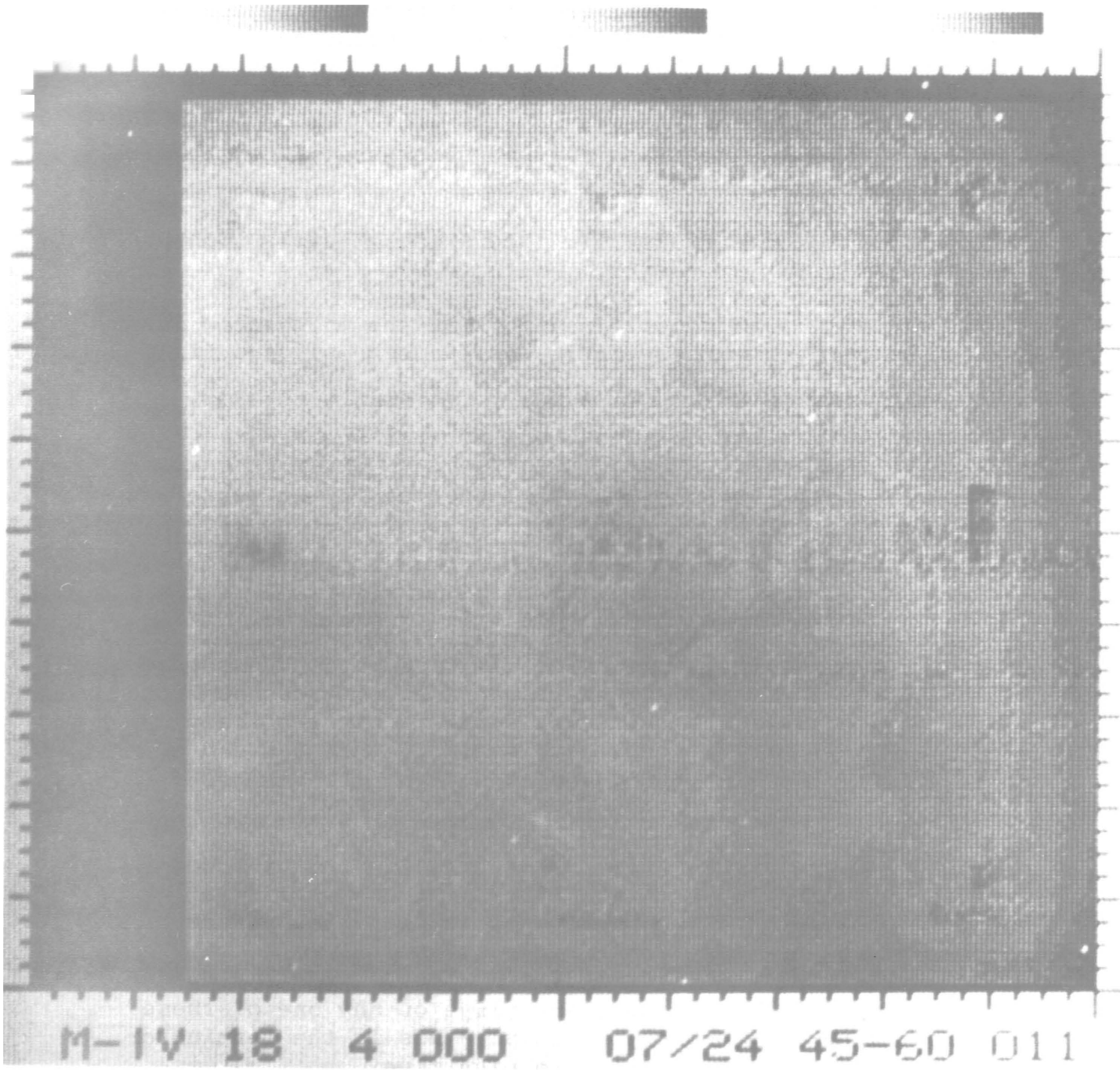
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And that by itself or in combination with the other effect could have also tended to fool and cause our automatic exposure system to not be able to keep up quickly enough with this. Because it had to change gain at each step, as it turned out, and in order to beat this problem it would have had to change two steps at once somewhere along the line. It didn't do that.

QUESTION: Did you say the angle of earth, sun and moon or earth, sun and Mars?

MURRAY: I'm sorry. I work on the moon too. Earth, sun, Mars, yes. The phase angle was 60 degrees. And, if I remember correctly, it never gets greater than 54 degrees when observed from the earth. And most of the observations which can be made are made not even at that angle.

So that we have a natural problem in the sense that we are doing something quite different from what could be done on the earth.

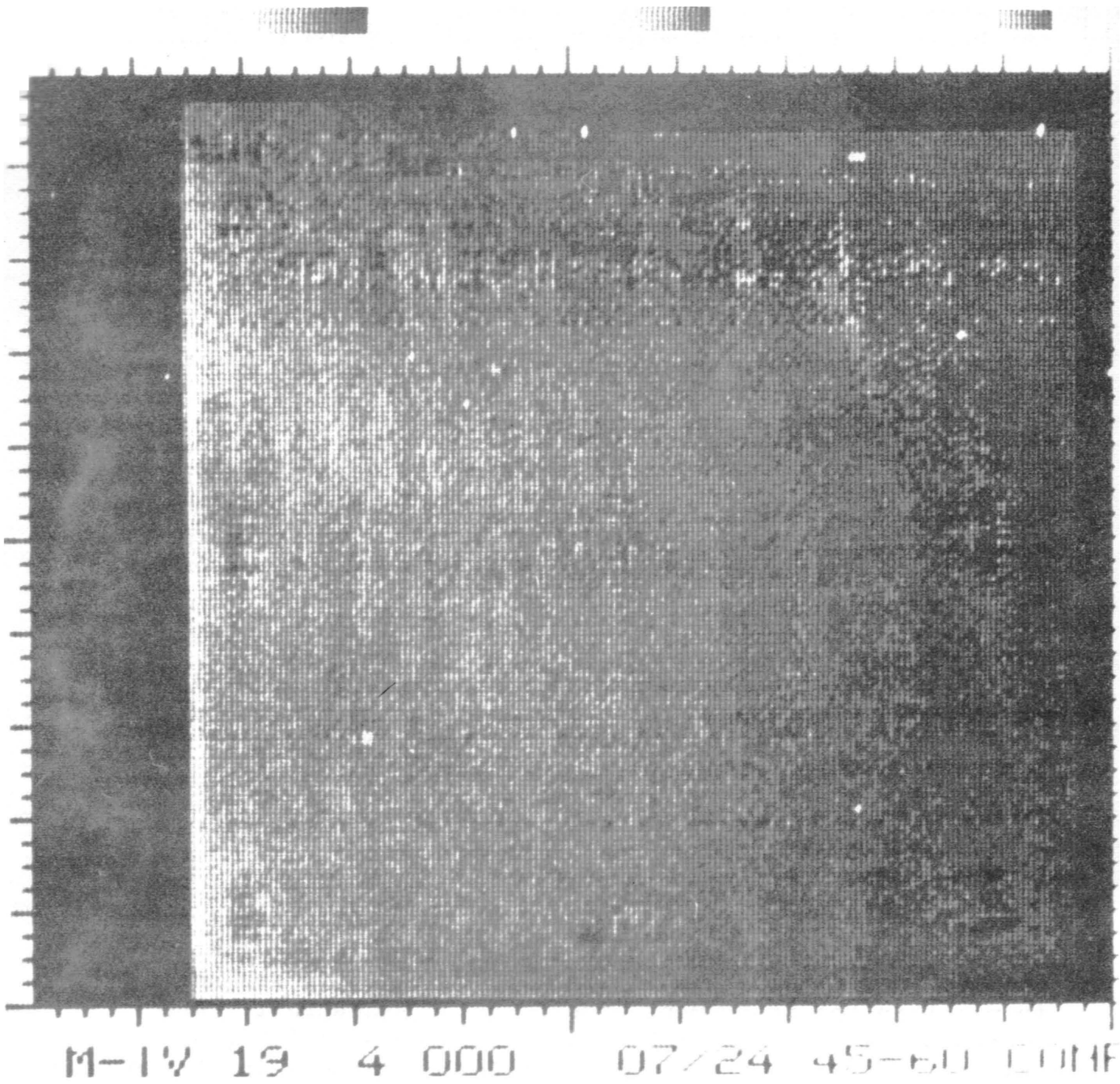
It's important to recognize that in the shading what has happened is that of our total 64 shades of gray or levels of intensity that we originally had, as the exposure dropped down we were using fewer and fewer of those near the low end or near the dark end, and so there might be only six or eight shades of gray in this picture now instead of 30 or 40 that might have existed on some of the earlier ones. And that is basically the problem.

We can always bring the contrast back out. We can always get rid of a haze. But if the original data were not recorded with a lot of intensity levels, then we are running up against a serious problem.

QUESTION: Is there any place on any one of these pictures along here where you can say this is the terminator and we're passing from daytime to nighttime?

MURRAY: Well, take a look. 19. We're going right now. 19 and 20 project as being crossing the terminator.

May we have the next slide, please?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This is 19, and we would say-- Of course, the terminator is not exactly a sharp thing on Mars. Even on the moon it is not a very sharp thing. But you can say you can begin to see the terminator, and I'd say you're right.

QUESTION: Where?

MURRAY: I believe we're seeing it across like this (indicating).

QUESTION: What is that bright spot?

MURRAY: North is this direction essentially on here.

QUESTION: What is that spot right above the midline?

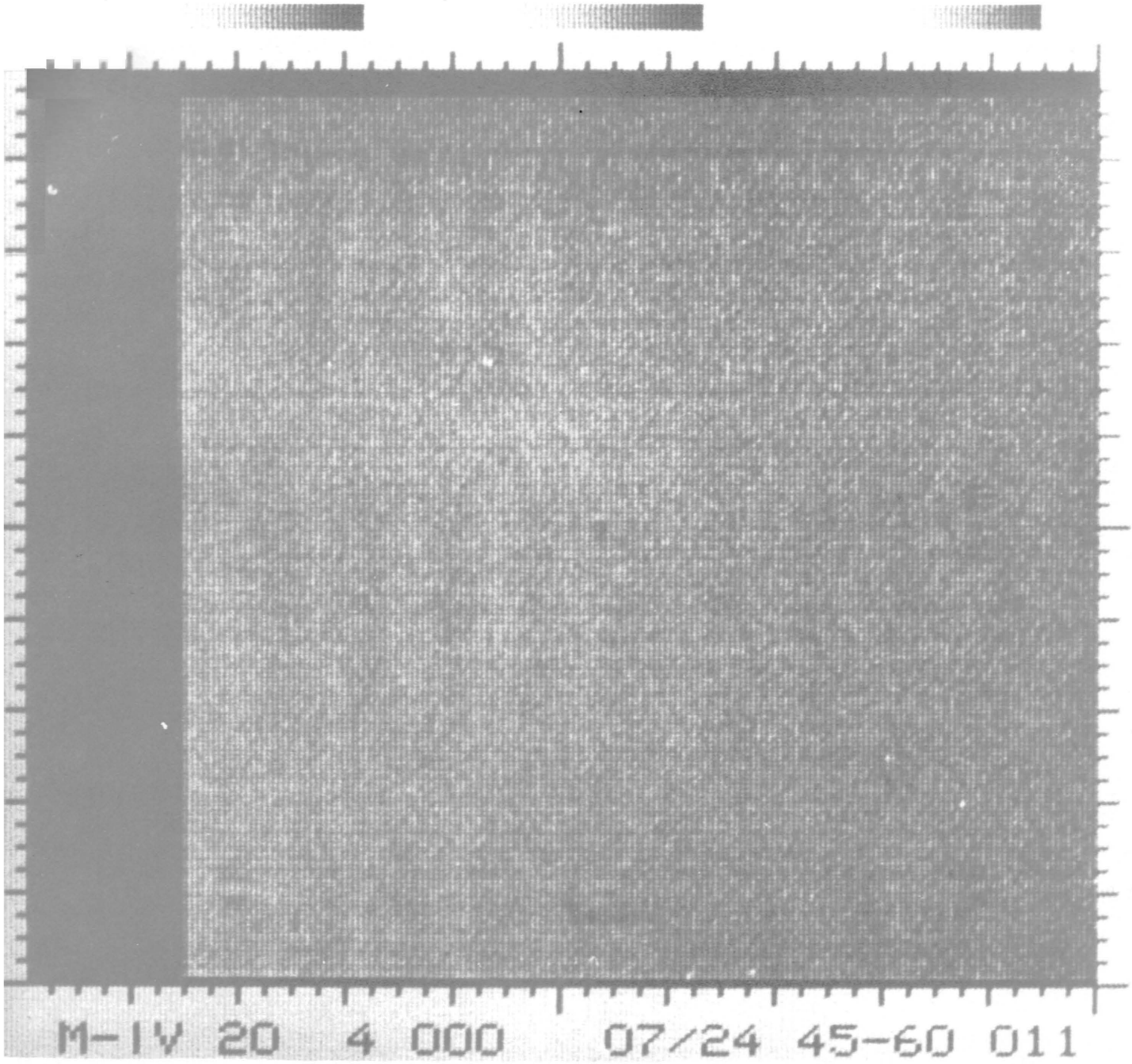
MURRAY: This is called a bit error. That is a case where a mistake was made somewhere along the line in decoding the original signal, and so instead of going from reading ten units of intensity it read 55 units of intensity, and it shows up very conspicuously. There was just a big mistake made, which can happen because of the coding system used in transmission.

There are very few of these, and this is one of the things we are most impressed with. We had spent a good deal of time worrying how to interpret pictures with a lot of bit errors in them, and it turns out that was unnecessary. We didn't have to worry about that.

May we go to Picture 20?

20 should be entirely in the dark. And what you're seeing now, this spotty appearance, is just electrical noise, remembering now the gain has been turned up fully, that we are looking at the maximum gain. So we begin to see noise from within the instrument itself on the spacecraft. And again this waviness, which is an instrumental effect, not real. That is a noise effect that is conspicuous in this picture particularly.

Finally, 21. I guess -- pardon me -- the gain went up to final step between 20 and 21. The appearance is very strong.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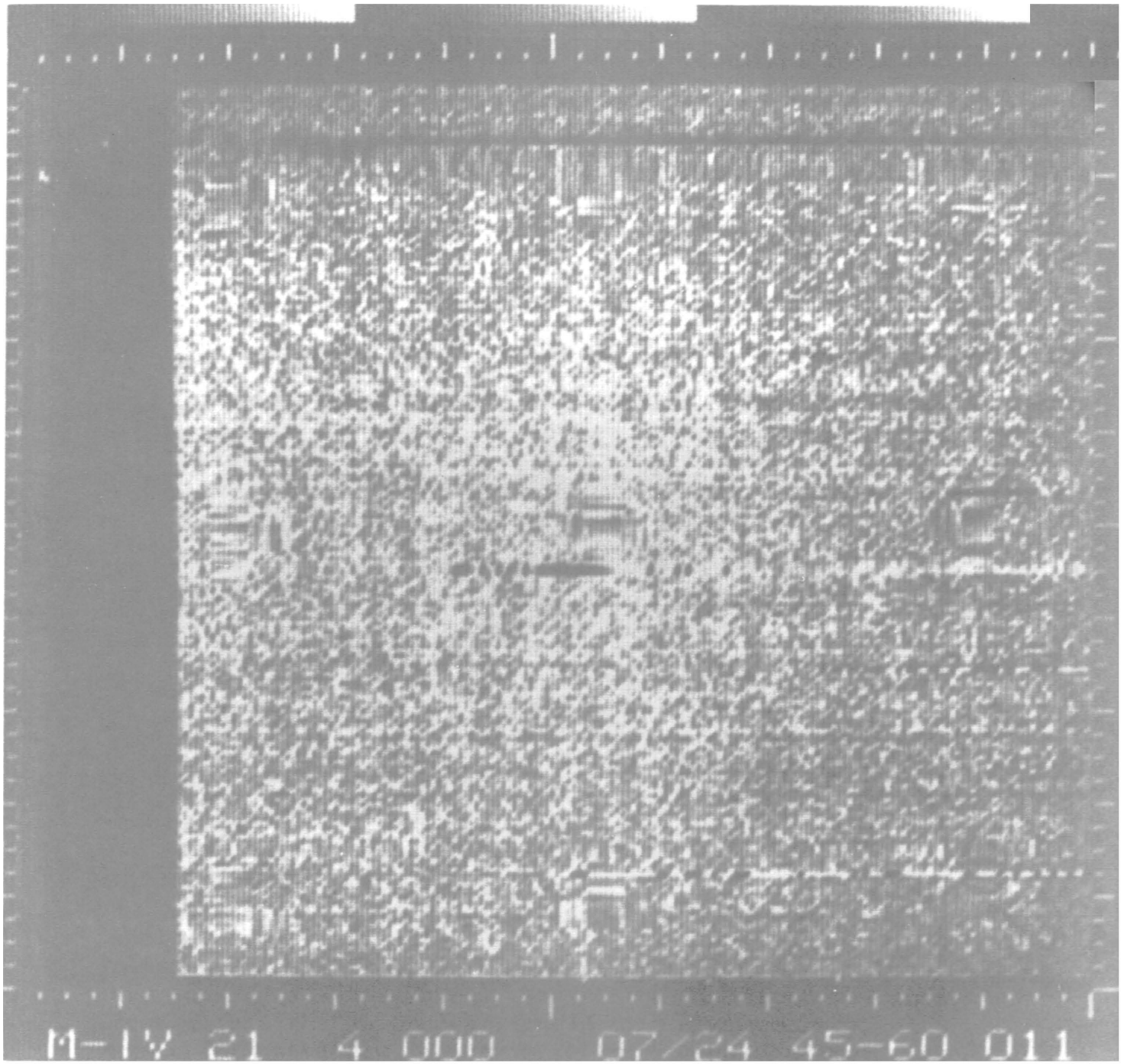
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We were very fortunate we got a little bit of 22, which is this picture here. The limit was caused by the end of the tape. The picture kept being transmitted until you ran out of tape and then switched off. Well, at least we saw something in this frame. Had there been anything unusual in terms of total illumination, we would have been able to see it.

That's the end of the pictures. Why don't we just take questions to all the people up here.

QUESTION: John Casani, Mariner Spacecraft Systems Manager at JPL, said in San Francisco yesterday that the reception of the first play of the tape was so good that there probably would not be a significant enhancement of them as a result of the second playing. Do you agree with this?

MURRAY: To whom is the question addressed?

QUESTION: Well, I guess it's addressed to you, but I just saw Dan Schneiderman nod, so I guess --

SCHNEIDERMAN: Well, the recovery of the data on the first playback was, as near as we can tell, virtually a hundred per cent. The second playback of the tape is primarily to verify this, to give us confidence and to demonstrate to anybody who might question it that we did think it was a hundred per cent.

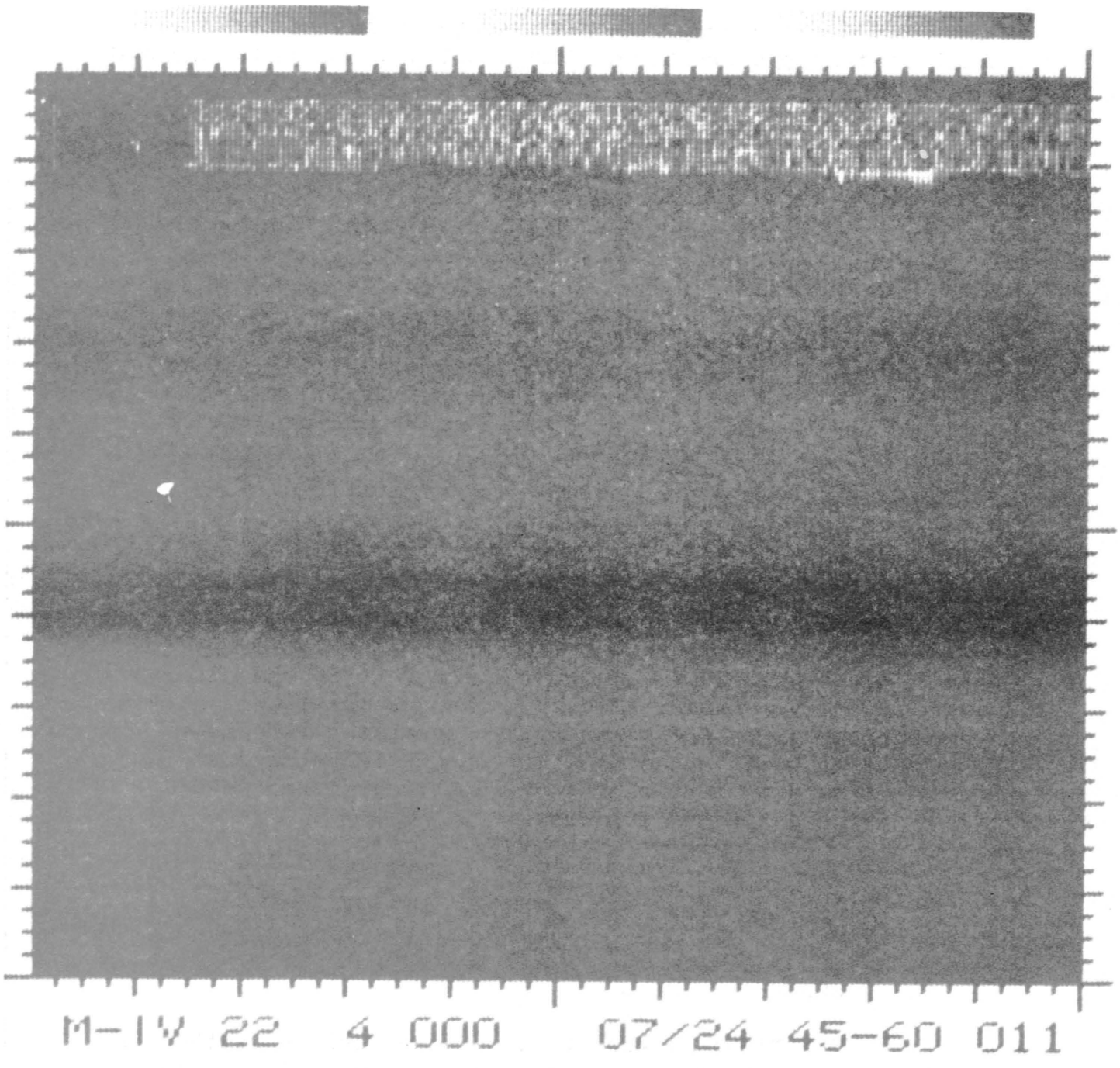
And on the second playback thus far the data also has been virtually a hundred per cent received at the station.

SCHEER: Next?

QUESTION: I wonder if someone would -- either Dr. Leighton or Dr. Murray I guess -- characterize for us the surface of Mars. What do you think it looks like from this?

LEIGHTON: You're the geologist.

MURRAY: I guess I'm hooked. I have been trying to avoid answering that question about the moon for about three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or four years now, because the difficulty in going from a very low resolution picture of the type we saw is comparable, of course, to the difficulty of taking an earth-based photograph of the moon and being asked by the Apollo people what is the surface like.

And so I ask you to carefully bear this in mind.

I think we probably would answer the question by saying: What are the differences between the moon and Mars? And the differences would probably be associated with the presence of an atmosphere that blows loose dust, not necessarily some superfine crust. The slopes do seem to be a little bit gentler; if this is true after careful analysis and careful comparison, we would infer it may be somewhat smoother and more rounded off.

But this is highly preliminary, and there are many other factors that have to be looked at carefully from other sources of information before I think anybody would really run out much neck on that particular question.

QUESTION: Is the loose dust on the moon or Mars?

MURRAY: There is known to be loose dust on Mars from ground-based observations. We see dust storms. The moon has been inferred to have some kind of sticky dust perhaps under those conditions.

QUESTION: I believe Dr. Leighton in his summary this morning referred to the lack of earth-type tectonic processes on Mars. Does that rule out, in the opinion of Dr. Leighton and Dr. Murray, any volcanic activity on Mars? Do these all appear to be impact craters?

LEIGHTON: Certainly all the craters we've been able to recognize would pass perfectly well for lunar craters. I don't think that there is any evidence for two different kinds of craters on Mars.

I think the explanation in terms of impact craters is-- They are more preponderant ones I would say overwhelmingly myself.

QUESTION: With a thin atmosphere such as the one described, can you explain, Dr. Leighton, at all how you would generate wind velocities, which to a layman would seem to have to be much higher on earth, to raise this dust? Or is this something I'm not clear on?

LEIGHTON: Well, for given temperature differences certainly the relative change of density would be the same on Mars as on the earth. And since the atmosphere-- That means for a given density change that means a certain pressure change which is much lower on Mars than it is on the earth.

On the other hand, the density is a lot lower too, so the mass that would have to be set in motion is correspondingly smaller, and so the velocities I should think to first order ought to be very comparable for a given temperature difference producing a density change.

QUESTION: I'd like to ask probably Dr. Leighton: At the end of the prepared statement the panel concludes that these photos will profoundly affect scientific views about the origin and evolution of planetary bodies in the solar system. From what you have seen so far, could you give us some suggestions of what the pictures may already portend?

LEIGHTON: Well, I think the fact that Mars is densely coated with craters -- and I think that's a fair extrapolation to make because the chance of our happening to have seen the only place that has craters on it when we have a one per cent chance of hitting it is really very small -- coupled with the fact that those craters must by our experience with the moon be extremely old -- is the great surprise, to me at least.

And in view of the fact that Mars has a known atmosphere which does move material around on the surface and has somehow been eroding the craters away, I think it makes it very surprising that in the time that must have elapsed since those craters were formed that there is so much of them left.

That's an extremely astonishing thing to me.

QUESTION: What is the size of the largest crater on earth -- diameter of it?

LEIGHTON: Impact crater on earth? Do you know, Bruce?

MURRAY: Well, the problem in answering that is that the erosion rates are so strong on earth that they get removed very quickly, and the possible old ones we're not even sure -- that is, among the geologists there is controversy -- as to whether they are really craters.

I think the largest absolutely unequivocal crater is Meteorite Crater in Arizona, which is quite small and probably only 20,000 years old or something.

QUESTION: What is it? A mile or so wide?

MURRAY: Right. 4,000 feet.

There are many geologists who believe that much, much larger features 15, 20 miles across are indeed old impact craters, but they have been so changed and so eroded and had sediments deposited in them that it's a very difficult job to be sure these are meteorite craters.

QUESTION: Like the one around Stuttgart?

MURRAY: Right. Exactly. Reis Kessel Basin. And this is one of the examples of a very large feature that might indeed be a meteorite crater.

QUESTION: Do you see the line of demarcation between the light and dark areas on a large scale as you cross? You remember, I think, you expected in 7 or 8 or 9 to cross into a dark area. And is there any evidence as to what happens when you make this transition?

MURRAY: Well, I think again the way to answer this is by analogy with the moon. The moon, for instance, at full moon shows the bright ray craters and very striking white streaks that go out. It turned out that Ranger VII hit an area that had a good white streak across it. And, of course, if you hadn't known this you would have never

picked it up in the photograph.

Because the thing that was causing this effect on a small scale when you saw it up close was an integrated effect over a number of features.

I think the same thing could exist on Mars. And one of the difficulties we will have in trying to relate the ground-based observations to the Mariner observations is just exactly the jump in resolution is so great, plus we don't have coverage of the entire planet in any way, that it may well be that very striking markings it would seem from the earth are just difficult to recognize.

QUESTION: What were those --

PICKERING: Excuse me. I'd like to add a little bit to that, Mr. Sullivan. Namely, that in the processing of the photographs so far each photograph has been treated essentially as an individual problem, and you should not look at relative brightnesses between photographs as being real.

Eventually, of course, we will get to this point where we will be able to give you the relative brightness of each of the photographs, but at the present time that has not been done.

QUESTION: Going back to the rays, what was the complex of features that showed up in the Ranger photographs? There were a number of craters, augmentation of craters, where the ray crossed the picture, were there not? Was there anything more? Was there also evidence of --

PICKERING: The question concerns the details of the rays on the Ranger photographs. And it appeared, as you looked at these in more and more detail, that the streaks broke up into clusters of craters for the most part, and this continued down even to the very small craters.

QUESTION: For Mr. Webb. With the excitement of the success of this experiment, how much consideration is there for another Mariner mission in the relatively near future at the next opportunity?

WEBB: We have decided some time ago not to fly another one of these missions with the equipment we used on Mariner IV but to concentrate on much more important work that we can do with more advanced equipment.

So I should say that it's highly unlikely that we would revive consideration of another flight.

Now, Dr. Pickering and his group are our senior lunar and planetary group. He hasn't told me whether he is even thinking of that. I don't know.

Do you want to comment on that, Dr. Pickering?

PICKERING: Well, there was some consideration given to this possibility a few months ago, because there was one flight spare of Mariner, as I'm sure you know, and the question was raised as to whether or not this should be flown in 1966.

The question was thoroughly analyzed, and it was decided that, no, we would not attempt to fly it in 1966 but put the emphasis on the future ongoing program which will become the Voyager.

QUESTION: I've got one question here in two parts. How much did the Mariner flight cost, and do all you gentlemen feel the taxpayers got their money's worth from it?

WEBB: Dr. Pickering says about $120 million for this flight.

PICKERING: For the program.

WEBB: For the program. Are you including the Venus flight?

PICKERING: No, no, --

WEBB: You mean for this flight? I think it's a fair statement to say that this flight, including the one that failed preceding it, cost over $100 million. My own view is that the taxpayers did get a very handsome return on

their investment.

Dr. Pickering and his group with the American industrial companies proved that we could move out from the earth and get to the planet and do what we intended to do.

This is a very advanced technological demonstration of a capability that can be used with more confidence in the future.

Second, the scientific experimenters worked in close harmony, and the relationship between the experimenters and the people responsible for making the flight get to its destination and bring the data back was I think a very outstanding achievement and also is a part of the learning process in the space program.

Lastly, it certainly is very important, as we have emphasized in the manned spaceflight program, to gain some knowledge, even though it is not full and complete, at as early a stage as possible, because we have planned a broad-based program over a ten-year period. But we also have the capability of change and modification in the program. And this gives us a good deal of information that in my view will have a strong bearing on the decisions to be made in the 1967 budget.

QUESTION: Could Dr. Pickering tell us what effects, if any, what we've seen in these quick looks will have on the Voyager program?

PICKERING: Well, the Voyager program, as you know, is planned as a broad-based program of exploration, and certainly the results of the Mariner flight will be factored into the decisions on the Voyager program.

As I think probably most of you know, the decisions as to the experiments on the Voyager program will be made within approximately the next year, and obviously the Mariner results will be of great interest to the experimenters and potential experimenters for Voyager.

And I'm sure we're going to come up with some new ideas for experiments as a result of this Mariner flight.

QUESTION: I'd like to ask Professor Leighton whether after further analysis you do hope to be able to tell definitely whether or not you do see vegetation there from the pictures and pin down definitely whether or not there is frost on those craters.

LEIGHTON: Well, of course, we have never expected, nor do we now expect, to be able to tell in any certain way whether there is vegetation present on the planet.

With respect to the question of the frost, the latitudes at which the pictures were taken in which we think we see frost were ones in which within a day or two of that same time ground-based observations had indicated the presence of a filminess, a whiteness in those same areas at those same latitudes.

And, as Dr. Murray explained, the very cold air temperature coupled with the fact that as the slanting rays of the sun provide less and less heating on the surface, it will lower the surface temperature of the Martian surface before the sun sets to the point where condensation of frost might occur.

The interpretation we put on those craters that are rimmed in white is hot that there is frost all the way around necessarily but that, with the crater walls slanting, one of them so that the sunlight hits it fairly directly and the other one so that it hits it very slantingly, very obliquely, this one here is brighter because the sun is brighter on it, this one here is brighter because frost may have deposited on it. Yet, even though it's relatively dark as far as solar illumination is concerned, the white frost makes it look brighter.

That's at least the way I'm thinking about it at the present time.

QUESTION: Does the frost indication suggest that there is probably more water on the planet than had been indicated by ground-based observations?

And also the other part of the question which

follows is: Does this not indicate that there is free water available for plant life on Mars?

LEIGHTON: Well, free water if it's ice I don't think does plants very much good.

There is no indication to our knowledge of any liquid water phase on the planet. That doesn't say it does not exist, but certainly not in our photographs nor I think from ground-based observations is there any distinct evidence for water in a liquid state on the planet.

With respect to the amount of water present, I don't think our pictures add or subtract anything from what is known about that already. Would you agree with that, Bruce?

MURRAY: Yes. I think that it's important to emphasize that we have talked about water and temperatures here but we don't know anything more than was known before on this subject at all. This is based entirely on a long series of observations from the ground which have led us to certain concepts, and what we see is consistent with those concepts. We don't see any differences.

QUESTION: Then your findings are the water passes through the atmosphere directly from one place to another without being water -- that is, water vapor?

MURRAY: It could do this physically, yes, but we have no evidence as to what it does, any more than we had before, except that at least the frost hypothesis, so to speak, is consistent with what we see.

QUESTION: What is the present thinking about how much water there is based on previous observations prior to Mariner?

MURRAY: The amount of water observed by looking at the reflected sunlight on the planet, which was done in 1962 at Mt. Wilson, was a very, very small amount of water, which was consistent with the tiny amount of water vapor one would get over ice.

So that this was just consistent again with the

presence of frost on the surface.

QUESTION: There has been speculation that early in the life of Mars water might have frozen and maybe subsurface masses of ice which would be exposed by meteoritic impact. Have you seen anything in the bottom of the craters to give any indication on that?

SCHEER: Please repeat the question.

MURRAY: The question was, as I understand it: Could there have been a thick layer of frozen water, I presume, ice, in the soil at some depth, which is then uncovered occasionally by meteorite impact and perhaps lead to some special effects?

I think what Dr. Leighton said earlier about the craters is about all we can say -- that the analysis we have made so far of the form of the craters shows high analogy with impact craters on both the earth and the moon and that we have not yet detected any differences from that.

QUESTION: Quite aside from the problem of atmospheric breaking, does this newly revealed geology of Mars indicate that you will have technically a tougher problem of landing a payload up there?

PICKERING: I don't think we should jump to any conclusions about that. It is obviously vitally important to know as much as possible about the atmosphere of Mars, because that will, in fact, determine the design of the landing device.

The question as to whether one can jump to any conclusions about the detailed nature of the surface as far as actually sitting on it is concerned I think will have to await further study.

WEBB: I think you could say that our view is that this flight revealed nothing that would indicate we could not land there, that there is no negative information here that would seem to indicate more difficulty or an impossibility than we have contemplated heretofore.

QUESTION: I'd like to ask Dr. Pickering and Dr. Leighton whether what we have found so far from both the pictures and the scientific data still makes Mars seem such an attractive target, or would you rather shoot straight for Jupiter at this point?

PICKERING: Well, if you ask me, I think Mars remains a very attractive target. Here we have had one flyby of the planet and we have had a look at approximately one per cent of its surface with a resolution of the order of two miles. There is a lot to be done there yet.

QUESTION: You know how to get there too now.

PICKERING: Yes. We have demonstrated we can get there and communicate while we are there.

WEBB: Bear in mind also that the Voyager program is not directed only at Mars. It is a program that gives us a broad capability so that we are reserving options beyond Mars with the program.

QUESTION: Dr. Pickering, I wonder if you would, as a result of seeing all the pictures now and at this stage of your investigation, summarize the overall program, what it told you and all of the JPL crew. And also have you changed your mind about possible life there in your own personal view?

PICKERING: Well, let me take the second question first, the question concerning whether I have changed my mind about life on Mars. As I said some time ago, Mariner IV was not planned to answer the question of life on Mars. And as far as I'm concerned, the evidence for possible life on Mars which had been adduced from ground-based observations is still there, and we still have to investigate this point.

As far as an overall view of the experiment is concerned, I feel that Mariner was a magnificent demonstration of what we can accomplish both in the technological and in the scientific sense with our abilities in these days.

In other words, in order to carry out the mission, the requirement of building a device which can live in space,

which can communicate with the earth, which can accept commands from the earth, which can arrive at a target at this distance, this is an astonishing technological achievement, engineering achievement.

And then, on top of that, to be able to conduct scientific experiments enroute to the planet. Let's not forget that the measurements that were made enroute to the planet were made in an area of the solar system which had not previously been explored, of course, so we get measurements of the environment of the micrometeorites, and so on, enroute to the planet, which were a new type of measurement or measurement in a new area of the solar system and were vitally interesting.

And, incidentally, these measurements are continuing, and we will expect to continue our observations with Mariner for at least another couple of months.

And this again is reaching further out into the depths of the solar system with these measurements.

Now, as far as the measurements as we went past the planet, again we received vital information quite independently of the photographs. The occultation experiment and its determination of the atmosphere and of the ionosphere of Mars is of tremendous interest.

Similarly the measurements of magnetic field and the radiation around Mars were likewise of very great scientific value.

QUESTION: Dr. Pickering, since the photographs are able to define areas down to two miles across, does the fact that you didn't find anything other than the craters that we've seen rule out entirely any thought of any intelligent life there at any one time?

PICKERING: Well, again this is a question which is pure speculation. I will point out that if you look at photographs of the earth taken say with a Tiros, which is at an altitude of only about 500 miles above the earth and has a resolution of about half a mile, isn't it? --

CORTRIGHT: Two miles.

PICKERING: Tiros? Oh, yes. It has a resolution about two miles, about the same resolution. And of all of the thousands of Tiros photographs that have been taken, I believe there is only one which shows any evidence of intelligent life on the earth. We have only taken 20 pictures of Mars.

LEIGHTON: If I may add just a word to that, I think I agree with the editorial cartoonist of I think the VANCOUVER STAR who put out the cartoon in which the caption was: "I still think that one word from Mars would be worth a thousand pictures." (Laughter)

QUESTION: To put the question another way, Dr. Pickering says that you still have to explore the possibility of life on Mars. Does that include the possibility of intelligent life, sir?

PICKERING: Life forms exist in such tremendous variety here on this earth that I think it's futile to speculate on just what forms of life might exist on the planet Mars.

QUESTION: In view of the fact, Dr. Leighton, and Dr. Murray I think might want to answer this, that the flight path of this spacecraft went over an area that on maps of Mars is pretty well criss-crossed with canals, so-called, and in view of the fact that you don't find any indication of the existence of these canals, could you comment at all on what this indicates to you? That there are no canals? Or what?

LEIGHTON: First of all, it indicates we haven't seen any. But my canal-gazing friends tell me that we picked a very poor place on Mars and a very poor season. So I'm afraid I have to defer to their judgment and say that we don't yet know for certain whether there are canals on Mars, but we can say we have not seen any.

We don't claim to be infallible. We can just say we've never made a mistake. (Laughter)

QUESTION: Assuming that there was intelligent life on Mars and they sent an instrument similar to Mariner to us, would we influence it so that they would know that we were here?

PICKERING: Would we influence this hypothetical spacecraft? Oh, I don't think so.

MURRAY: I think this is getting a little bit "red herring," isn't it?

QUESTION: Dr. Pickering, in view of the fact that some scientists think the hot temperatures of Venus may be in the atmosphere and not the surface, are you planning to send a probe to the surface of Venus to look for life?

PICKERING: We hope that our exploration of the planetary system is not only going to be limited to exploring Mars. We certainly haven't finished with Venus.

To return to your original statement, though, we believe that the Mariner II measurements did confirm that the high temperatures were on the surface rather than in the atmosphere because of the limb docking which was observed.

QUESTION: The question isn't meant to be irreverent but just in case there are credits that haven't been given, has any reputable scientist ever postulated craters? Everybody seemed surprised. I'm certainly surprised but I'm not a scientist.

MURRAY: Well, you have a lot of company being surprised. The people involved in the photographic team were shocked really beyond belief.

We have been trying to check the literature, as a matter of fact, to find out, because that is, I think, a very important point. If somebody was correct in figuring things out, he deserves credit for being a good guesser.

So far we haven't yet found it, but this may well be a case of just not having been thorough enough.

There certainly are a number of people who were concerned with the fact that Mars might see a lot more meteorite bodies than the moon does because it's near the asteroid belt, and the idea was thatperhaps the asteroid belt was the source of the impacting bodies.

On the other hand, I think the fact that there is what appears to be a many billion year old surface on Mars that hasn't been eroded away is the significant fact. And I don't think very many, anyway scientists, dreamed of this possibility.

WEBB: As a layman, let me say that at the meetings with the Space Science Board at Woods Hole this summer and reviewing their findings and interests, it was perfectly clear that the prediction made by Dr. Newell two or three years ago that you would see a tremendous increase in interest by the geophysicists and the astronomers in this area of the earth and the planets and their comparison is taking place and will probably be accelerated by this kind of a surprise.

And I believe one of the most important results of this flight will be a stimulation of a larger number of very able minds to approach the problems and the opportunities that are opening up here.

I think we have not yet seen what some of the theoretical approaches to the data already received may produce in the way of new ideas and concepts.

QUESTION: Why is it a surprise that the surface of Mars is two to five billion years old? Isn't the earth four and a half or five billion?

MURRAY: First of all, since we're getting into a rather detailed scientific discussion here, we have written up a scientific article in the conventional professional way and submitted it to a journal, and this will come out in due time -- I hope not very long.

And there will at that time be many scientists who would perhaps want to comment in many different ways.

I think this is important, because one doesn't do

science in a press conference. We are here to release and help explain a very unusual social and human phenomenon -- that is, man's first look at another planet. We are not here to arbitrate on what is really the most profound science to come out of it.

QUESTION: Why is it a surprise --

MURRAY: I didn't answer his question. I want to. I think, to word the statement a little more accurately, there are surface topographic features present on Mars we infer to be perhaps between two and five billion years of age, those very features, not the minerals of which they are made. There are no surface features on the earth, physiographic or topographic features on the earth, that are a fraction of that age.

This is the fundamental and surprising fact about Mars.

QUESTION: Mr. Webb, much has been said over the past eight years about the Soviet lead. It is obvious in the field of big booster thrust. However, they have not achieved anything such as we have in the unmanned fields and Mariner II, Mariner IV, Ranger VII, VII, IX. Does this indicate to you that we do lead them in space technology?

WEBB: I think a yes or no answer to that is extremely difficult. If you remember, Dr. Dryden and Dr. Seamans and I laid out the program we have and compared it with theirs last January or February to the Congress. I don't think we have changed our mind. But I do think it is increasingly clear that theyhave a broadly based program, that they're developing and advancing their scientific as well as their technological capability, and that they are also substantially increasing the booster capability which they had a year ago.

These recent flights show a capability very much beyond anything they have demonstrated before.

My own view is that there is not very much difference between our total capability and their capability at this time but that we are both moving into a period when we will

be able to select certain options for further emphasis and development.

And I do not believe you have yet seen the demonstration of what they will come up with as options to benefit the interests that they have.

I think any statement that we are ahead of them in any of these fields would be extremely difficult to substantiate, because there are increasing evidences from a very vigorous flight program that, while we have been able to go to the moon, to Mars, to Venus and demonstrate the capability Dr. Pickering has referred to, they also are in a stage of development and demonstration with a larger, generally speaking, group of equipments than we are yet able to put up.

SCHEER: Can we have one more?

QUESTION: Professor Murray, in which journal did you say the results would be published?

MURRAY: It's been submitted to the journal known as SCIENCE.

SCHEER: Thank you very much.

(Whereupon, at 1:00 p.m., the news conference was concluded.)

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