Enclosure 1

21 March 1956
RR-622-D

To: Central Intelligence Agency
Washington 25, D. C.

Attn: Contracting Officer

From: Reed Research Inc.
[redacted] Secretary

STAT

Subj: Two Stage Rectification System; proposal for

Ref: (a) Conference at Reed Research between CIA Technical Personnel and [redacted] and [redacted] of Reed Research

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Encl: (1) Estimated Cost Breakdown
(2) Photograph of Two Stage Rectifying and Projection Printer

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1. As discussed during reference (a), Reed Research proposes to furnish all necessary labor, services, and material to fabricate and deliver a precise rectification system with the following performance characteristics:

A. Both the transforming printer and the autofocus projector shall be designed to accommodate film up to 19-1/4 inches wide. They shall both be capable of projecting a 19" x 19" format.

B. A between-the-lens shutter and suitable bellows will be provided on the projector so that film may be exposed.

C. The present magnification range will be applicable only to the 9-inch and 18-inch aerial photography formats. The magnification range of 19" x 19" formats will be somewhat less.

D. Careful consideration of a more suitable light source will be made.

E. The easels will be suitably compartmented and valved to assure flat, positive adhesion to the easel of small paper sizes.

F. Consideration and inclusion of a suitable method for isolating the projection system from external vibrations will be made.

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2. We have checked by means of graphical construction the rectification range of the Hypergon when working with 19" x 19" format. We have found that these portions of the curve determined by the lens field would be foreshortened by approximately two degrees. This was determined for the 24-inch and 48-inch focal length curves, as shown in our instruction manual. We are assuming that it will also be true for intermediate focal lengths or effective focal lengths of the negative in the case of two-stage work.

3. It is estimated that this foregoing can be completed and the instrument delivered and calibrated within eight months after receipt of an award. We request that the contract be negotiated on the basis of a $70,915 estimated cost plus $7,100 fixed fee, as detailed in enclosure (1). It is further estimated that for an accelerated delivery of the instruments within six months, overtime authorization would be necessary and the total cost and fee would increase 15 percent.

REED RESEARCH INC.

STAT

Secretary

MHR:TME:sk

**ESTIMATED COST BREAKDOWN**

**Reed Research Proposal RR-622-D - Rectifier Fabrication**

| | |
|---|---|
| **Direct Material** | **$19,670.00** |
| **Direct Engineering -** | |
| **1080 hrs @ 3.75** | **4,050.00** |
| **Overhead @ 60%** | **2,430.00** |
| **Direct Labor -** | |
| 7100 hrs @ 2.50 | **17,750.00** |
| **Overhead @ 60%** | **10,650.00** |
| Total | **$54,550.00** |
| G & A on above (30%) | **16,365.00** |
| | **$70,915.00** |
| **Fee** | **7,100.00** |
| | **$78,015.00** |

78,015 + 15% = $89,717 (to procure in 6 months

February 10, 1956

Subject: Proposal for desk model stereoscope and related equipment.

Dear Sirs:

This proposal is regrettably late in coming, but the last ten days have been spent on consideration of what is involved.

As I understand the task, there is a need for a modest number of inexpensive desk-type stereoscopes that can be used for long hours by a seated observer without undue fatigue. The stereoscope must be usable at various optical magnifications on prints as large as 9 x 18 inches. The prototype should be designed and constructed rather promptly to permit evaluation and lag time for production to follow. The desk stereoscope should not be streamlined unduly if extra costs are involved, but should be a good, rugged system well suited to the intended purpose. Standard parts should be used wherever possible.

Some pressure of time might be relieved by the quick design and fabrication of a light box and easel, combined in a single unit, and built mostly of wood. The use of the easel approach would facilitate reduction of the prints at an early date, using ordinary commercially available stereoscopes. The easel would have a central slot and ample clearance beneath in order that the observer can handle his large overlapping prints without need to fold them upwards. The slot in the easel would have curved walls that would prevent creasing of prints and would so far as possible cause the prints to follow natural bending. In this way any stereo overlapping of objects could be brought to the usual interpupillary distance of the observer on any matching parts of the 9 x 18 prints. The slot and easel would permit easy orientation of the prints in azimuth to permit alignment of the fields for proper stereo vision without eye strain.

The light box would be designed to illuminate the prints uniformly without shadows and without specular reflection in the direction of the observer's eyes. A special light box surface could be provided that would serve for uniform illumination of a positive transparency on either side of the slot, following the device

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developed several years ago at WADC.

The entire light box and easel would not weigh more than 30 lbs., and hence could be located on any flat surface, desk top or otherwise. The easel would have an adjustable slope for the comfort of the observer in leaning over the ordinary stereoscope without need to stand at a table. This is especially important for the large prints. The easel could be so designed as to minimize the strain experienced by the observer in looking at the top of the 9 x 18 prints. One might consider also a rotatable easel that would permit the observer to examine the lower 9 inches only, followed by a 180-degree turn for further examination of the upper 9 inches in the lower 9-inch position. The reversal might not be favorable to easy interpretation of continuous subjects, but it would prevent a crouched attitude of the observer. A sloping easel should be reasonably convenient. The observer might adjust the tilt to his liking. A retention device might be added at the top of the easel to keep the prints from sliding downwards, while at the same time permitting overlap adjustment.

The light box and easel combination is but a temporary solution, but might be a good deal cheaper for general use than production of more permanent type scanning desk stereoscopes in too large quantities.

If such a prototype light box and easel is to be contracted for from SPICA, it would be on a cost basis under AF-type practices. Because of the writer's association with the governing committee, it is feared that a conflict of interest problem might arise. It is suggested, therefore, that the writer not charge for his personal time in performance of the proposed contract. At the same time, it is clear that not too many hours could be so expended away from other, remunerative tasks. Whether there should be a fee or not to go with the proposed cost type contract should depend on the evaluation by the Government of the situation. The contractor will be willing to accept a non-profit type of contract if that should be offered, again to overcome whatever conflict of interest problem might arise. However, it is realized that a non-profit situation might not necessarily be the proper solution from point of view of the Government, since there would then be some implied lack of responsibility of the contractor, or some favor might be intended. Hence, whatever course is deemed advisable by the Government will be satisfactory to SPICA, although, of course, subject to business negotiations.

It is difficult to estimate just what such a light box and easel might cost in prototype form. In a production run the units should not cost more than $150.00 each. The prototype might run to $2,000.00 for engineering design, mock-ups, trial reductions of photographs, conference work, and the like. Nothing elaborate is planned. It is simply that good cabinet-making quality can be expected, that light switches will be good ones, that ground glass easel faces or plastic easel faces might require special attention, etc.

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The primary subject of this proposal, however, is the desk model stereoscope. I would like to consider the instrument as designed and built in two models.

These will be described below.

The writer has considered all the points raised in conferences with Government personnel on the problem of the desk stereoscope. His suggestion that rather large mirrors be used to aid in the reduction of stereo-pairs turns out on serious study to be rather clumsy in all respects. The writer believes that the ultimate users will not be satisfied with such a device, however clear the imagery may be. The curvature of the mirrors required causes such a depth of sagging that there would be considerable initial expenses in obtaining proper materials. Also, being of glass, there might well be breakage in use that should be unnecessary altogether.

After considerable study of many points and many optical arrangements, I feel that the most useful desk stereoscope would be a modified version of a periscopic type described by me in a recent conference in Washington.

The "Model I" periscopic scanning desk stereoscope would have on either side of center a double arm containing a large portion of the periscopic type optics. There would be two swivel points, where the arms connect to one another and where the two arms connect to the fixed center mounting. The double arm would permit the complete scanning of a 9 x 18 format along any path chosen from one part of the format to another. The actual motion will be basically one involving polar coordinates of the arm as a whole, but the double linkage is necessary to preserve optical path length, while permitting the radial changes.

The pick-up objective will then be fairly close to the plane of the prints, say, five inches away. The light rays would then follow a horizontal arm for a distance of about 10 inches, proceed up through a swivel joint containing prisms, follow along the second arm in a horizontal direction, then up through the second swivel joint containing prisms, and thence through an inclined arm to the eye of the observer. There would be intermediate reimaging optics of periscopic nature.

There would be an identical arrangement on the other side of center for the other eye and photograph. Interpupillary adjustment would be provided for in standard ways. The image plane before the eyepiece would be reduced to about half-scale, simply to preserve the field of view through the long tube. Magnifying and interchangeable eyepieces would be provided, permitting a range of magnification from 2 to 10 times, with respect to simple magnifiers used on the print.

The zig-zag arms in effect can move over a considerable area of the desk top, bringing the field underneath to the fixed eye-point for the seated observer. The observer would be looking in a slightly downward direction, say at a slope angle of 30 degrees, for maximum comfort. The eyepieces would be zeroed at about -2.0 diopters to prevent too much changing in focus of the accommodation of the eye between writing notes, overlays, and stereo-examination. The eyepieces would, however, be focusable, with scales, for the convenience of different observers.

So far one has a general purpose desk stereoscope, requiring rather awkward uncontrolled scanning of either arm. To allow for scanning over large picture areas in stereo, without need for continual readjustment of prints or scanning arms, one must resort to linkages between the arms that in effect position the perspective point or entrance pupil of the objective end over mating objects on the respective photographs. The scan over the picture area would then find the same field reproduced in the two eyepieces, suitable for continual stereoscope examination. The two photographs would be set up by simple rules along perspective lines so that oblique pairing will be automatically followed in the scan.

It should be noted that other linkages might be added later to the same scanning desk stereoscope to permit stereo-viewing of consecutive pictures on the same, uncut run of film. Thus, one might adapt the instrument to stereo-viewing of the charting camera pictures from uncut contact print rolls, where the picture roll is laid out across the upper side of the desk, transverse to the center plane. There might be some need to view uncut positive transparencies, for example, of the A-1 or A-2 configurations, or for any of the films so reproduced. In effect, we would be dismounting the individual eyes of the observer, using one eye over a particular object somewhere on a photograph, and using the other eye over the same object, somewhere else on another photograph. If a field rotater is provided for in one arm of the periscope, a complete scanning system of general purpose nature would become available.

Periscope optics can become very complicated and expensive. There can be many optical parts in so long a tube, and a great deal of optical design is generally required. However, here we do not lack for light. Moreover, the observer is seated comfortably, and the eyepieces can be designed to cup conveniently to his eyes in the proper interpupillary setting. Consequently, the exit pupil can be quite small. Since the instrument is to permit scanning, and since low powers are available as well as high, there seems to be no reason to strive for exceptionally large fields of view.

Thus, if exit pupil and field of view are both restricted to fairly modest values, the periscopic optics can be considerably simplified. A single erecting intermediate group might be sufficient for the purpose. The problem is all the easier if the arms can have an I. D. of about 2 inches or so, or even 2.5 inches. The objective would then have an entrance pupil not larger than 0.5 inches clear aperture. The exit pupil at 2 power would then be 0.25 inches clear aperture. At 10 power, it would be 0.050 inches, a value not at all unreasonable in microscope practice. We almost have in effect a split binocular microscope, where the objective end has been widely separated from the eyepieces by intermediate reimaging optics.

The main body of the desk stereoscope would be in a central supporting mount of minimum dimensions, from which the arms swing and extend. The picture areas on either side and across the top would be relatively unencumbered. The observer can then use overlays, rulers, and other instruments, pencils, and the like, without much interference from metal parts. There would also be a minimum shadowing on the prints. There would very likely be linkage bars stretched horizontally between the two picture areas, but these would not be large. Perhaps the gearing and linkages can be done by steel tapes along the arms, as on a drafting machine.

It is believed that the field rotating adjustment on the right arm might be indispensable to the observer to take care of plane yaw between exposures and to complete the scanning system. There might also be a very quick adjustment of one objective to permit resetting of the perspective point over one print with respect to the other, to prevent poor stereo vision where large scans are involved. The scan might be made, say, 95% automatic, once the prints are adjusted, followed by some very easy manual adjustment to improve the stereo, when needed.

Again, it is difficult to predict the total initial cost of a prototype instrument. In production the units should not cost more than $1,000.00 each. I doubt if they could be much cheaper, considering all that is being built into the one instrument. The prototype might run to $8,000.00 to allow for good design and good construction. The delivery would be of the order of four months from date of authorisation to proceed.

"Model 2" would be the same as Model I, except that certain measuring aids would be built into the optical train. It would be possible to add a reflex scale or scales that could be brought into the field of view at the choice of the observer. A series of scales would be engraved onto a rotating disc at chosen intervals, such as 1:10,000; 1:20,000; 1:40,000 etc. Then, intermediate scales would be obtained in a continuous sequence by a zoomar arrangement interpolating between one fixed scale on the disc and the next.

A step further would be to replace the engraved disc with a circular version of Katz' slide rule, or some modification thereof. The observer would then set basic data onto suitable dials, such as altitude, focal length, oblique angle, plane speed, and the like. The resulting reflex scale seen in the image field would then be correct for the stated conditions. The design of this slide rule might be somewhat involved, but it is feasible. One might even allow for azimuthal scale variations on the oblique views, such as one encounters either in the usual way on the ordinary undistorted oblique, or on the cylindrically distorted oblique of the charting camera prints.

It may be that a related version of the above proposed scale system will be an item in a forthcoming AF contract for another purpose. Clearly, there will be no overlap in expenses, since all will be under control of the AF cognizance. The AF requirements are confined, however, to much larger scales, and the basic instrument is a good deal simpler.

As to the form of contract contemplated, here again the best arrangement may be a cost plus fixed fee, or straight non-profit type, with the writer's personal time not chargeable to the contract. The delivery time for a Model 2 prototype would be of the order of six months from date of contract, if a separate instrument altogether from Model I. While Model 2 might be ordered directly, with Model 1 omitted, the longer delivery might be disadvantageous.

If more time is available, the contractor would be very pleased. However, the delivery times in question can be met if subcontracts can be considered necessary to the performance of the contract.

SPICA would undertake to do the optical and mechanical design of the hardware described above, but would find it necessary to subcontract the fabrication. Priorities or premium prices might be necessary to obtain adequate deliveries from successful bidders on the proposed subcontracts.

It is suggested that details be worked out between Government negotiators and our business management along the tentative lines discussed above.

If the contract is to be non-profit, an advanced payment arrangement would be necessary for successful performance. No large payments would be needed, but SPICA would have to have some relief from tying up funds needed for remunerative contracts elsewhere. Similarly, in any case some form of prompt repayment of direct and supportable costs, and overhead would be necessary for our successful performance.

Another form of arrangement suitable to SPICA's needs would be for the Government to enter into a contract with a larger prime contractor who would then contract with SPICA for the design and engineering services described above. In such a case, however, SPICA would enter into the sub-contract involved on a cost plus fixed fee basis, and the non-profit type of contract would not be considered. Also, the writer would enter his time as a cost factor against such a sub-contract according to his practice on other contracts on hand. It would be equally necessary that prompt reimbursement or advance payments be considered part of such a contract.

It is hoped that negotiations can begin immediately on receipt of this proposal. If extremely prompt action is required on our part, we would respond to a telegram of authorization to proceed, or to a letter, or in accordance with instructions. Perhaps it would facilitate negotiations if our Executive Vice President, currently cleared through Secret, were requested to submit application for such extra clearances as may be needed in this and other matters of the samd nature.

Respectfully submitted,

SPICA, Inc.

James G. Baker
President

JGB/ll

March 21, 1956

Dr. Roderic M. Scott
The Perkin-Elmer Corporation
Ridgeway Professional Building
Stamford, Connecticut

Dear Rod:

We have been using the IBM machines so constantly that I have not gotten the time to work out detailed proposals. However, this situation is clearing up. What I shall provide herewith is a quick sketch of what we hope to do, and then go ahead in the next several days with further details for your more formal proposal to come.

1. A Rectifier for 9 x 18 and 9 x 9-inch Negatives.

I am lending you herewith a Zeiss Catalog on aerial photographic reduction problems, which may be of interest to you. Would you please return it to me in a few days?

The Reed Rectifier referred to several times by [redacted] is laid out on a horizontal bed, making it perhaps awkward to make rectified pictures on large copy prints or negative materials. I prefer the Zeiss vertical arrangement, provided our study does not show that we need too large a vertical adjustment, which would be unwieldy on that account. STAT

I believe we should provide a condenser type of illumination, instead of a diffusion light box, as on the Reed. The condenser method tends to conserve contrast in the finer detail The condenser might be the usual thing, which would be very large (20 inches clear aperture) or might better be a cylindrical condensing lens pair, mounted on a rocking arm, driven by cam across the negative format at a variable rate to produce even illumination on the copy. Rectification near the vertical is quite easy, and the illumination is no problem. Rectification of the Metrogon high obliques is quite difficult. The illumination varies by the cosine fourth and the angles are very great in the outer field. One can rectify Metrogon 60-degree obliques to within 15 degrees of the horizon, but anything more than that would not be useful except for coast line contours, islands, and the like.

The rectifier is to be designed as a single stage device, but usable as a two stage device also. The single stage means that a rectified print can be made from the original negative even at high angles. The two stage means that the rectification can be divided between two successive photographic processes and imagings, a technique that reduces the need for wide

Enclosure 3

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angle lenses in the rectifier. However, volume production is difficult, and the work is doubled. In the two stage, you might work from a master positive copy, ending up in a positive, print or film. Even in the single stage device, you might want to start with a copy contact positive, ending up in a rectified master negative, from which contact prints can be made in quantity.

In any rectifier, the object plane, the image plane and a plane through a point half-way between the nodal points of the lens perpendicular to the optical axis all meet in a common line, about which the tilting is to be accomplished. The intersection in general is virtual, especially for low tilt angles. This setup preserves the geometry of perspective. A rectangular grid on the negative projects into a trapezoidal grid on the tilted image plane; vice versa, mapping grids on the terrain will have been imaged in effect on the tilted taking camera into the inverse trapezoidal grid, which after rectification restores to a rectangular grid.

There will also have to be an azimuthal adjustment to the negative film holding device, which should take both roll film and cut film. This adjustment restores the vertical plane through the perspective center, preventing skewing of the projected rectified image. The horizon, whether on the photograph or virtual, then becomes a horizontal line, if the image plane is horizontal. It can be assumed that the optical axis of the camera is centered in the format. Hence the vertical plane referred to above is the plane of symmetry of the rectifier, and contains the optical axis of the rectifying lens.

The Metrogon 60-degree obliques require a 140-degree lens in the rectifier. My previous wartime work proved that a Hypergon will do this job very nicely. However, we can retain more resolution if we drop back to two stage rectifying for these high angles, and use a lens of smaller field, say 90 degrees, of about f/16 instead of f/50, as for the Hypergon. In general, the rectifying lenses will be designed at f/11 to f/16 to preserve diffraction resolution. They will be designed to have the same distortion residuals as on the original negatives, insofar as practicable. I would do this only for the special 24 and 36-inch lenses I have designed, and for the C-system. The backing platen will have to be curved in similar fashion, as in the original camera, or perhaps I can calculate the distortion curve for the film held on a flat platen.

The projection throw for the 6-inch Metrogons, and the 24-inch f/8's can be accommodated on a vertical stand with large horizontal easel. The easel should accommodate cut film, cut printing paper, or have adapters for holding rolls of prints or rolls of film of large size with light protection. The rectified formats are larger than the original and for high obliques, a great deal larger. Hence, the easel will be large, and means will have to be provided to hold the prints or film flat. At high angles small departures from flatness affect the rectification seriously. Conversely, small deviations on the easel can be used to eliminate distortion residuals, especially those that change rapidly in sinusoidal or other form across the platen. We might think in terms of having an easel table built specially for elimination of the distortion not otherwise eliminated in the projection lens.

The projection throw for the 36-inch might still be done directly, but the distance along the optical axis would already then be six feet between negative format and printing surface. The lens would have a focal length producing a vertical scale in the copy, which then is constant over the copy, equivalent to what the original lens would have taken of the vertical if not in the oblique position. Thus, the 36-inch tilted at 30 degrees, say, photographs a reduced scale compared to what it obtains on the vertical views. The rectifier, however, can rectify out to the same vertical scale, but for the distant terrain, viewed obliquely. There is therefore enlargement, which can be considerable at high angles. Beyond 70 degrees it is not too useful, and of course, at the horizon the enlargement is infinite. One can produce partial rectification, however, and obtain the horizon.

Variations in elevation of terrain will cause the rectified images to lie in rectified planes, shifted with respect to one another, according to the elevation. Distant mountains will be "pushed" outwards when rectified.

As far as the rectifier is concerned, I think we should come up with something of maximum convenience for the operator with respect to film handling, marking, illumination control, focusing, etc. It will be quite a large device, particularly if we include the C-system with its long focal length. We would have to fold up the projection throw with mirrors to keep the system compact.

Perhaps we should arrange the design to accommodate the 6, 24 and 36-inch pictures on one rectifier with interchangeable projection lenses, and have another mounting for the C-system. The film holders, and easel might be identical, and even interchangeable between the two mounts, but C might have its own illumination system. The odd film size might make it desirable to have its own film holder, too.

2. Cost of a design study. At this juncture I would estimate that SPICA could complete a technical study of what is required for about $4,000.00 worth of time, ending up in a detailed report. The study would be done partially by me, partially by my mathematician, [redacted] and partially by a STAT new man I expect to obtain shortly, who is also a mathematician. I would get together pertinent information from existing literature, and do whatever is necessary to plan a rectifier for the above purposes. This would be a fixed-price estimate, including all costs and profits A more formal price and breakdown would be provided in a proposal more carefully worked out.

3. SPICA would undertake to design the optics, but leave fabrication and engineering of the mount to Perkin-Elmer. The design would also include adaptation to melt as required. It appears that these lenses are all around f/11 to f/16, involve quite wide angles and precision resolution, with minimum and controlled distortion residuals, but are not critical to color correction. We can use specified light sources and filters to restrict the color range. At the present moment I would give a round figure of $6,000 each for the cost of the optical design for lenses for the 6-inch, 24-inch, 36-inch and 180-inch throws. Each design would permit single stage rectification up to 60 degrees and two stage up to 70 degrees, or even 75 if I can do it.

4. The cost surveillance of design and construction. I would estimate this tentatively at $2,000, which would include travel and conference time.

Thus, if the full program above is planned, the tentative price would come to $30,000.00. It would be carried out rather quickly as soon as a green light is given contractually. I think the study could be completed in two months from the go ahead, and the optical designs would follow in some preferred order at the rate of about one design per month. This means everything would be completed in six months from date of contract. I think we might proceed more quickly if the urgency demanded it.

A more careful proposal and price breakdown will be forthcoming soon.

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5. The Charting Camera Rectifier:

I think the design study would in this case include the optical design, such as it is. I have in mind a single stage device, where the original negative panoramic film is wound across a spherical backing surface, which is transparent, through which condenser illumination is provided. Quite possibly I would use a beam splitter across the short width of the film to separate out the film, platen and condenser from the returning light from the primary spherical mirror.

The rectifier would consist of a Schmidt type setup with spherical primary, the platen and beam splitter above, and a special lens at the center of curvature, containing a shutter. The special lens will have to have a 120-degree flat field free of distortion, but can operate at f/11 to f/16. There might well have to be a toric field-flattener and distortion eliminator at the negative film spherical surface, to take out the difference between the Schmidt type focal surface and the original cylindrical type focal surface of the panoramic sweep.

The easel in this case will have to contain the azimuthal and tilt corrections that may be required, in case the panoramic sweep has been taken fore or aft of the vertical transverse plane.

SPICA would undertake the design study and optical design for a price of $10,000. A more detailed cost breakdown will follow, and the price may come out to be lower. However, following through all the details of the rectifying process of the cylindrical negatives, including plane movements, compression of scale cause by roll, etc., might complicate the working out of the optimum rectified copies. We might have to set up IBM programming for unsymmetrical toric surfaces, and the like. I don't want to get into a time consuming bind. Our price includes overhead, which at present is running at 84% of direct labor.

It is contemplated that the original negative roll will be used on the rectifier. The output would consist of rectified strips, framed to be rectangular, rather than fanning out, although that would be permitted, if desired, but uses more film and is redundant. The copy film or print roll would be about 20 inches wide. Where the original pictures are end to end along the roll, the copy pictures are side by side along the wider roll. (As in the proposed Eastman contact printer).

It would be possible to obtain partial rectification of the horizon by tilting the easel, sliding the film horizon image over to the axis of the rectifying system and focusing for proper conjugates. One might rectify the -60 to plus 60 sweep, and add in a partial rectification on either side of the 60 to horizon strips.

Delivery time on the proposed study and design above would run at about six months from date of contract.

6. Stereo-viewing:

I am enclosing a copy of the proposals made some time ago directly to [redacted] I have heard that some action has been taken to get funds, but have no direct word. Hence, you can take over these proposals and SPICA will not deal directly on these items, unless you fail to get the backing for some reason. STAT

SPICA would undertake to provide a detailed description of the printer, light table, and stereoscopes, including pertinent drawings, for a price of $4,000.00, but would not undertake to engineer the printer or light table. SPICA would provide a rather good mock-up of the light table from which Perkin-Elmer might carry on with the actual streamlined model to be provided the customer. The cost of this mock-up would include the drafting time and outside labor and materials, and would run to about $1,000.00.

SPICA can undertake to provide 2X, 4X and 10X Stereoscopes for use with the light table and easel. The three stereoscopes would be quickly interchangeable and would rest on a small carriage sliding back and forth along the overlapping viewing area, with the proper focusing allowed for.

The conception is that the printer will combine the initial negative frames at odd azimuths with respect to drift onto copy films as positive transparencies, with the plane drift, at least for the transverse direction, lined up along the direction of wind ofthe film copy, with a displacement as may be required to keep designated objects on successive pictures equidistant from the sides of the copy roll. Two identical copy films are required. These are spooled in reduced lengths and put onto the light table, threaded into a central slot onto take-up spools. Thereafter, stereo-objects can be brought to the vicinity of the central strip area, which is about 2.5 inches wide by up to 20 inches long. The slit runs up and down in front of the observer at the easel. The plane of the easel can be tilted from horizontal to 15 degrees for comfort. The stereoscope slides up and down, focuses, and has an azimuthal adjustment to take care of errors in the copy work or of oblique slanting perspective lines. In this way all objects can be seen in stereo with the standard stereoscopes comfortably. The work is divided between an original technician who marks the drift direction on the negative, and displacement, if any; a dark room worker who puts the negative in the printer and who makes up two identical copies on positive film with the drift lined up properly; and a group of photo-interpreters equipped with easels and stereoscopes.

The 2X and 4X Stereoscopes in small production will cost about $650.00 each. The 10X will be smaller and simpler, but will have to be designed and built in prototype form. The first one would cost about $1,500, but subsequent ones would cost about $400.00 each. The 2X can be used conveniently on stereo-prints, having folding legs, focusing and interpupillary adjustment. The 4X can be used in this way also, but is better used on positive transparencies, owing to a short working distance. It too has folding legs, interpupillary adjustment and focusing. The 10X will be mounted more simply, but will have interpupillary adjustment and focusing also. All three, the legs folded, can be placed onto the carriage mentioned above that slides up and down along the viewing area.

We have already made quite a bit of progress on the light table and easel design. Shortly, an isometric view will be made available to you that will serve to indicate to the customer what we have in mind; or at least, it will help your own draftsman to prepare new drawings with cutaways for proposal purposes.

Thus, the work referred to above comes to about $5,000.00 with delivery in three months from date of contract. We have no interest in designing the details of the special darkroom printer, but will make a study of all the pertinent details and submit a report with recommendations.

7. Desk Stereoscope:

This is a rather ambitious item and we have already expended some time on it. I have held up on any further work, since I have not heard from [redacted] The general idea is covered in the accompanying write-up. STAT
However, we have progressed further and have a good idea of the nature of the periscopes required, the pantographic linkages.

SPICA again would provide a design study, and the optical design complete for the periscopes and magnifiers. We would also participate in surveillance and follow-through to guarantee successful completion. This instrument, if made fully convenient, may become a very popular item with photo-interpreters, and I suggest that we go after it very thoroughly. It involves a nice little computer, some mechanical linkages, motor drives, rough and fine settings, powers from 2X to 10X. As described in the accompanying write-up, we have planned to view up to 20 x 20-inch formats, allowing for the widest films we might contemplate observing, such as two of our strips of 9-inch films adjacent, or rectified prints of large size, rectified positives, and the like.

The design study would not be a complete one, since your engineers will want to have a real hand in designing all the linkages and bearings. However, we would give it all we could, from which point you could take over. Much could be done in conferences.

SPICA will undertake the design study, including the optical design, for $10,000, ending in a technical report with drawings. The surveillance would come to another $2,000, resulting in a total price of $12,000.00. A breakdown will follow. In the accompanying write-up, I mention $8,000 for a prototype. The instrument now seems more complicated to me, and with overhead, profit, G & A, etc., may be much more. I also mention a production cost of $1,000.00 in modest quantities. I now think it will be much more. However, the instrument has great merit, and has some quantitative features as well. Delivery would be in six months from date of contract.

8. Night Photography:

SPICA would undertake to provide a design study, including optical design for $8,000.00. SPICA would also lend surveillance time, conference work, field work, and follow-through for $4,000.00, which includes cost of travel, and travel time.

As far as I can tell at the present moment, the system will be an elaborated form of the 2-mirror Schmidt, employing some corrective optics, aspheric mirrors and correcting plates. The system would work at f/1 and have a t-stop of at least f/1.5. Color correction, if different from full mirror correction, will still permit use from blue to deep red.

The system will have a 30-inch focal length, and would take night pictures on a 9 x 9 format for at least the included circle, and hopefully for the 9 x 9 full format. I have visited Polaroid and it seems certain that we can take pictures without snow cover within plus or minus two days of full moon with exposure times not exceeding 15 seconds. Under ideal conditions with snow cover and full moon in dead winter in high latitudes, the exposure time might be as short as 0.3 seconds. The properly exposed moonlight pictures appear hardly distinguishable from daytime pictures.

The two-mirror system will be so designed as to have the format behind the primary mirror back and cell in an accessible position. Sufficient baffling will be designed into the system to eliminate stray light. The aspheric surfaces will be quite deep because of the need for compact design. There might be as many as four aspheric surfaces quite remote even from conics to be made precisely.

I do not like to separate the optical design from the design study, since they are too closely intertwined. It would do no good to propose an optical system, and then later to find that it does not work well enough.

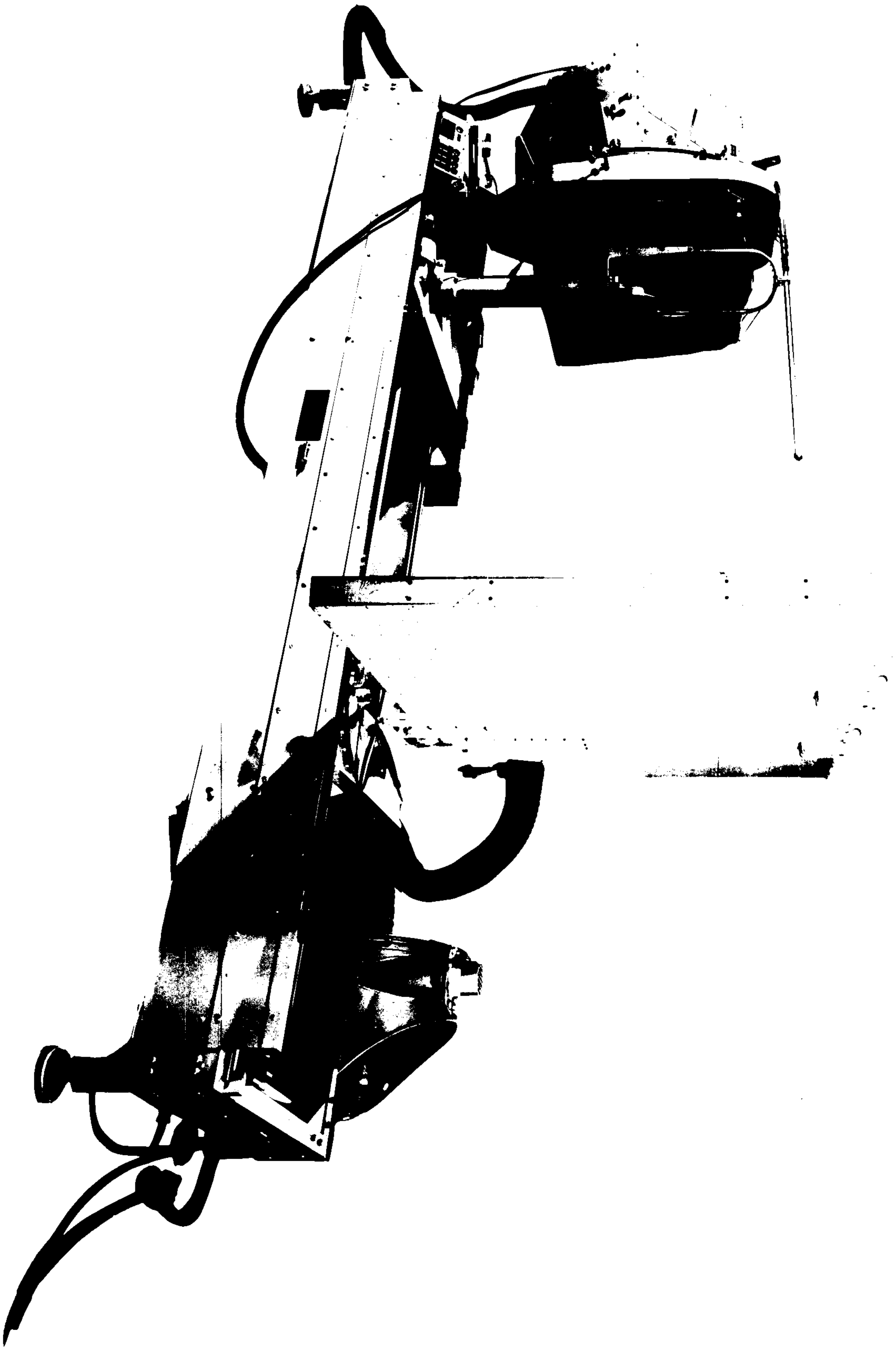
Delivery would be within ten months after date of contract.

Generally speaking the terms and conditions of the contract we propose will follow the pattern established under Perkin-Elmer Purchase Order No. 57804 and/or those terms customarily included in a fixed price subcontract under a Government prime contract.

Patent and copyright articles used will of course reserve to SPICA all commercial rights and will be equal to those granted by the Government to Perkin-Elmer. SPICA does not propose to furnish any patents or copyrights which are the result of general research not specifically attributable to this contract even though developed or first reduced to writing during the period of this contract.

Any specific requirements such as insurance on Government property or Perkin-Elmer property furnished SPICA will increase the total price or be subject to negotiations at the time such requirement is established.

SPICA would like to submit monthly invoices up to 90% of the contract price for work accomplished. Payment is to be within a designated period of time thereafter, of the order of ten days with a discount of 1/2%. The remaining 10% can be withheld pending satisfaction of all contract



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