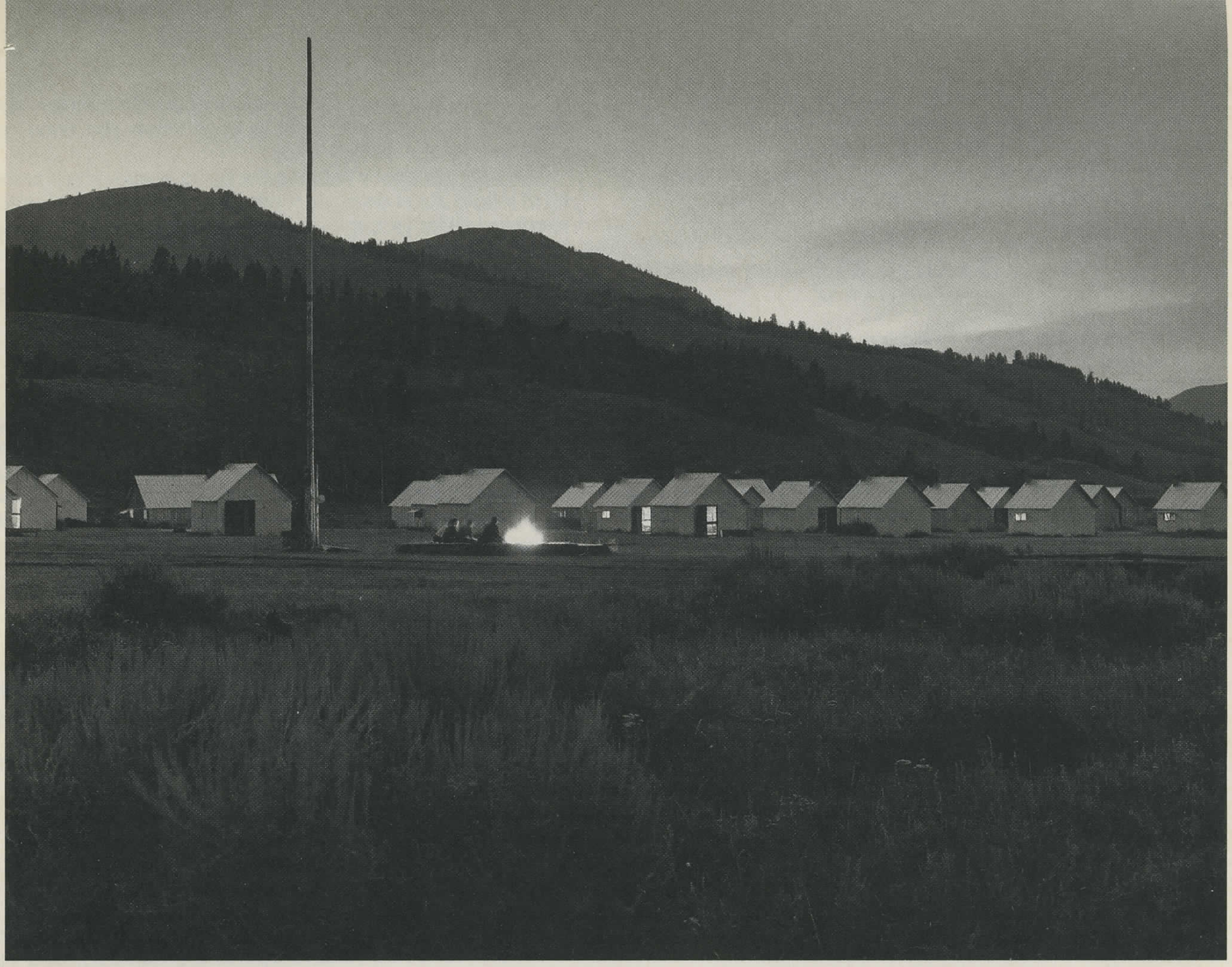

*UNIVERSITY OF MICHIGAN GEOLOGY CAMP* ***was photographed by the author with a Leica M-3 camera, 50mm Summicron lens on Kodak Tri-X film.***

# What A Pocket Computer Can Do For You

### By Phil Davis

Response to my exposure and development computer program for the Radio Shack PC-5/6 (March/April 1987 issue) was enthusiastic, and several photographers asked for more programs and more information about ways to put computers to work on other photo-related problems. Although I'm not at all sure that wholesale computerization of photography is a good idea, there are certainly times when a machine can help with calculations that are awkward or time-consuming to do with pencil and paper.

With that thought in mind, and in response to specific requests for useful formulas that can be plugged into the PC-5/6, I've tried to identify a few of the problems that face us from time to time, and stated their equations in PC-5/6 syntax. Some of these are obviously too simple to *require* the use of a calculator of any sort, but if you have one handy, why not use it? Others are slightly more complex equations that most of us would prefer to avoid if there were no electronic help available.

If you've experimented with your PC-5/6 at all, you've probably discovered its **CALC** function. If you're not familiar with it, you should get acquainted; it's a very handy feature that combines the power of a good calculator with some of the programming ability of a computer. In other words, it allows you to type in a formula or equation that contains several variables, store it temporarily (by pressing the **IN** key), and invoke it repeatedly (by pressing the **CALC** key) for sequential calculations. The formula will remain in memory even when the computer is turned off and is ready for immediate use when you turn the machine on again.

Unfortunately, the PC-5/6's user's manual is not a model of clarity, and some of the machine's functions are not well-explained. If you investigate it carefully, though, you'll find instructions for storing equations (or other material) in the **MEMO** bank from which they can be transferred into the **CALC** memory for use. You will also discover that the **CALC** function can handle several equations in sequence, passing the result of one on to the next for further calculation. You can see the result of each calculation in turn just by pressing the **EXE** key to step from one answer to another.

As an example of the **CALC** function, suppose you'd like to use a published formula for a developer. The ingredient weights are given in grams and your scale measures only ounces. Most of us will have to look up the conversion formula, then work out the individual values laboriously on paper. This is just the sort of thing the **CALC** function does best, so pick up your PC-5/6 and type in this simple formula for converting grams to ounces. Let O=ounces, and G=grams:

$$\boxed{O = G/28.35}$$

Then press the **IN** key to save it.

Now, just to make sure the formula is in there, press the **OUT** key to display it. If it's correct, press the **CALC** key to begin the calculation.

The screen will immediately display: "G ?" which indicates that it wants you to enter some value in grams. Consult the developer formula to find the first weight, for example, 85g. Type **85** and press **EXE**. You should get: O=2.998236332, which is substantial overkill, accuracy-wise!

To make this a little more realistic, limit the number of decimal places by using the **SET** key. If you choose 2 decimal places (**Set F2**), run the program again, and you should get: 0=3.00, which is a little more sensible. You won't have to reset the decimal place limit again until you turn the computer off and on again.

You can make this little "program" more useful by expanding it a bit. Most avoirdupois scales measure fractions of an ounce in grains, and because there are 437.5 grains in an ounce, it's very awkward to make this final conversion in your head. A two-stage conversion can be done using the PC 5/6's **INT** and **FRAC** functions, which are essentially the opposite of one another. The expression **INT(X.YY)** returns only X. The expression **FRAC(X.YY)** returns the number 0.YY. In the following equation, R=grains; O=ounces; and G=grams.

$$\boxed{\begin{array}{c} 0 = INT(G/28.35): \\ R = FRAC(G/28.35)*437.5 \end{array}}$$

Now eliminate decimals in the answer by typing **SET F0 EXE** and press **CALC** to start the calculation again. This time when you enter the number 108 (for example) and press **EXE,** you'll get 0=3, indicating that there are at least 3 ounces in 108 grams. Press **EXE** again and you'll see R=354, which shows that there are also 354 grains. The total weight, therefore, is 3 ounces, 354 grains. I leave you the relatively minor problem of breaking the grains down into ½ and ¼ ounce units.

It's probably more likely that your scales weigh in grams and that the old formulas you find specify ounces and grains. Fortunately, the PC-5/6 can work both ways. Type in this equation:

$$\boxed{G = ((O*437.5) + R)/15.432}$$

then limit the decimal places. Press **CALC** to display the first prompt, 0 ? Then, to check the program, reverse one of the calculations above (for example, 40g=1 ounce, 180 grains) by typing in **1 EXE**; then when the R ? prompt appears, type 180. The screen should display 40.0, indicating that 1 ounce and 180 grains equals 40g, and confirming the accuracy of the previous equation.

Now that you're familiar with the **CALC** function, I have several other useful equations that you can store in your PC-5/6 (or PC-7) for use whenever you need them. You can use the **MEMO** bank for this semi-permanent storage but, if you're using the "printerless" version of my exposure and development program, the equations may conflict with day-by-day storage of zone system information. Be sure you don't overwrite data that you want to keep when you enter new material into the **MEMO** bank.

The next equations express the basic relationships among focal length, focal distance (bellows extension), and camera-to-subject distance. Let B=focal distance; D=subject distance; and F=focal length. To find the focal distance when the focal length and subject distance are known, enter:

$$\boxed{B = (D*F)/(D - F)}$$

There are several ways to compute the exposure increase required for closeup photography (when the subject distance is less than about eight focal lengths). When the focal length (F) is known, the focal distance, or bellows extension, (D) can be measured, and the normal shutter speed is (S), the corrected exposure time (T) can be found by:

$$\boxed{T = S*(D/F)\uparrow 2}$$

You can also compute the exposure increase by working with image magnification, which involves dividing some image dimension (I) by a corresponding subject dimension (D). To find the corrected exposure Time (T), when the normal exposure time is S:

$$\boxed{T = S*((I/D) + 1)\uparrow 2}$$

If you prefer to compensate by changing the lens opening, let X=the corrected relative aperture (f/number), and use this little equation:

$$\boxed{X = (F*A)/D}$$

It's sometimes necessary (or at least interesting) to know the angular field coverage of a lens, relative to some specific format. For example, what is the horizontal coverage angle of a 6-inch lens on 4×5 film? The following equation is used for finding the field coverage (C) in degrees, when F=lens focal length and D=the selected image dimension. F and D must be the same type of units (usually either inches or millimeters). Incidentally, the **ATN** function returns the arc tangent of the argument.

$$\boxed{C = ATN((D/2)/F)*2}$$

We're all familiar with the field coverage and perspective effects that (for example) an 85mm lens will produce on 35mm film, but how many of us know (quickly, now!) what focal length will produce the same effect on medium or large format film? The following equation will tell you. Let L=the focal length of the view camera lens (or the focal length you're trying to find); let F=the known focal length; let V=some dimension of the view camera format; let S=the corresponding dimension of the small camera format. Be sure to express all variables in the same units (inches or millimeters, etc.)

$$\boxed{L = F*(V/S)}$$

If you do your own sensitometry, or are curious to know how published development data relate to your personal zone system data, you may be able to use some of the following formulas. Unfortunately, such relationships are valid only if your procedure for determining N-numbers is logical and consistent (which most conventional methods are not). Assuming that your data have a firm mathematical foundation, you may be interested in seeing them translated into other familiar forms. First, the fundamental formulas for finding average gradient or subject range (SBR) values involve the density range (DR) or scale index (SI) values. Let G=average gradient (or CI value); R=density range in log numbers; and S=subject range in stops.

```
G=R/(S*.3) and S=R/(G*.3)
```

To make any translation involving N-numbers, it's necessary to know the difference, or "spread" between the metered zones: for example, the spread between Zones III and VII is 4. In the following formulas, let N=N-number; and D=difference (spread) in stops.

To convert a known value of average gradient to an N-number:

```
N=D-((R/G)/2.1)*D
```

To convert a known value of SBR (in stops) to an N-number equivalent:

```
N=D-(S/7)*D
```

To convert a known N-number to a value of SBR in stops:

```
S=7*((D-N)/D)
```

To convert a known N-number to an average gradient:

```
G=(R/.3)/(7*((D-N)/D))
```

If you mix your own chemical solutions from scratch, or if you're involved in any of the historic processes (whose chemicals can't be found in familiar packages), you'll be faced, sooner or later, with the problem of calculating the percentage strength of chemical mixtures. These are not difficult procedures, but they send most of us scurrying for some reference book. Your PC-5/6 can handle these problems easily.

The following formula finds the percentage strength of the solution that will result when you combine known volumes of two solutions of known strength. In these equations, A= percentage strength of the concentrated solution; B=percentage strength of the diluting solution (use 0 if it's water); M=percentage strength of the final mixture; X=volume of Solution A; Y=volume of Solution B; T=total volume of combined solutions.

```
M=((A*X)+(B*Y))/(X+Y)
```

The next formula computes the number of parts (volumes) of Solutions A and B that are required to produce a specified volume of solution of specified strength. Use it (for example) to determine how many ounces of glacial acetic acid (99-percent) and how many ounces of water (0-percent) are required to make, say, 32 ounces of 28-percent stopbath stock solution. This formula takes advantage of the PC's ability to use the result of one calculation in another. The first part of the equation finds the volume of Solution A, and the second part (following the colon) finds the volume of Solution B. To activate the second calculation, simply press **EXE** after the first answers appears.

```
X=(T/((A-M)+(M-B)))*(M-B):Y=T-X
```

Depth of field calculations need not be particularly precise for most view camera work (or most other applications, for that matter), but it is sometimes useful to know what will and what won't be in acceptably sharp focus. The following formula is based on a circle of confusion diameter that's a fixed fraction of the lens focal length (F/1720). This, in effect, requires short lenses to form sharper images than long lenses do, and thereby compensates for the fact that small-camera images are typically enlarged considerably for comfortable viewing. This method is conventional and many published depth of field charts are based on it.

There are several variations of the basic formula relationships, but this one seems appropriate for PC-5/6 use, because it is relatively simple, and it permits the values of focal length and subject distance to be entered into their obvious form: inches for focal length, and feet for distance.

In the following equations, let N=the nearest plane of acceptable sharpness, in feet; D=the most distant plane of acceptable sharpness, in feet; F=the focal length of the lens in inches; A=the f/number (relative aperture) of the lens; and P=the plane of focus, that is, the subject distance in feet. Of course, the actual depth of field is the difference between the near and far planes of acceptable sharpness.

To find the near plane of the depth of field: A negative value of D indicates infinity (∞).

```
N=P-(P↑2/((143.3*(F/A))+P))
```

To find the far plane of the depth of field:

```
D=P+(P↑2/((143.3*(F/A))-P))
```

You can enter these two formulas together to speed up the calculations and display the near plane, far plane and total depth (T) in sequence. I suggest that you **SET** a 1-decimal-place limit before running the program. The **CALC** memory can hold the following line:

```
N=P-(P↑2/((143.3*(F/A))+P)):
D=P+(P↑2/((143.3*(F/A))-P)):T=D-N
```

These are a few of the ways in which the PC-5/6 can lighten your chores. This computer is a truly useful device that can make your life easier in the darkroom as well as in the field. I hope you will find these examples interesting and helpful and that they will inspire you to find your own solutions to problems of this sort as they arise. □

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