The Great Escape and the Moon

EXACTLY 50 YEARS ago a stirring example of human cunning and bravery played out under inhuman conditions and against slim odds. The events leading up to March 24, 1944, have been recounted in a book by Paul Brickhill and in the classic 1963 movie *The Great Escape*, starring Steve McQueen, James Garner, and Richard Attenborough.

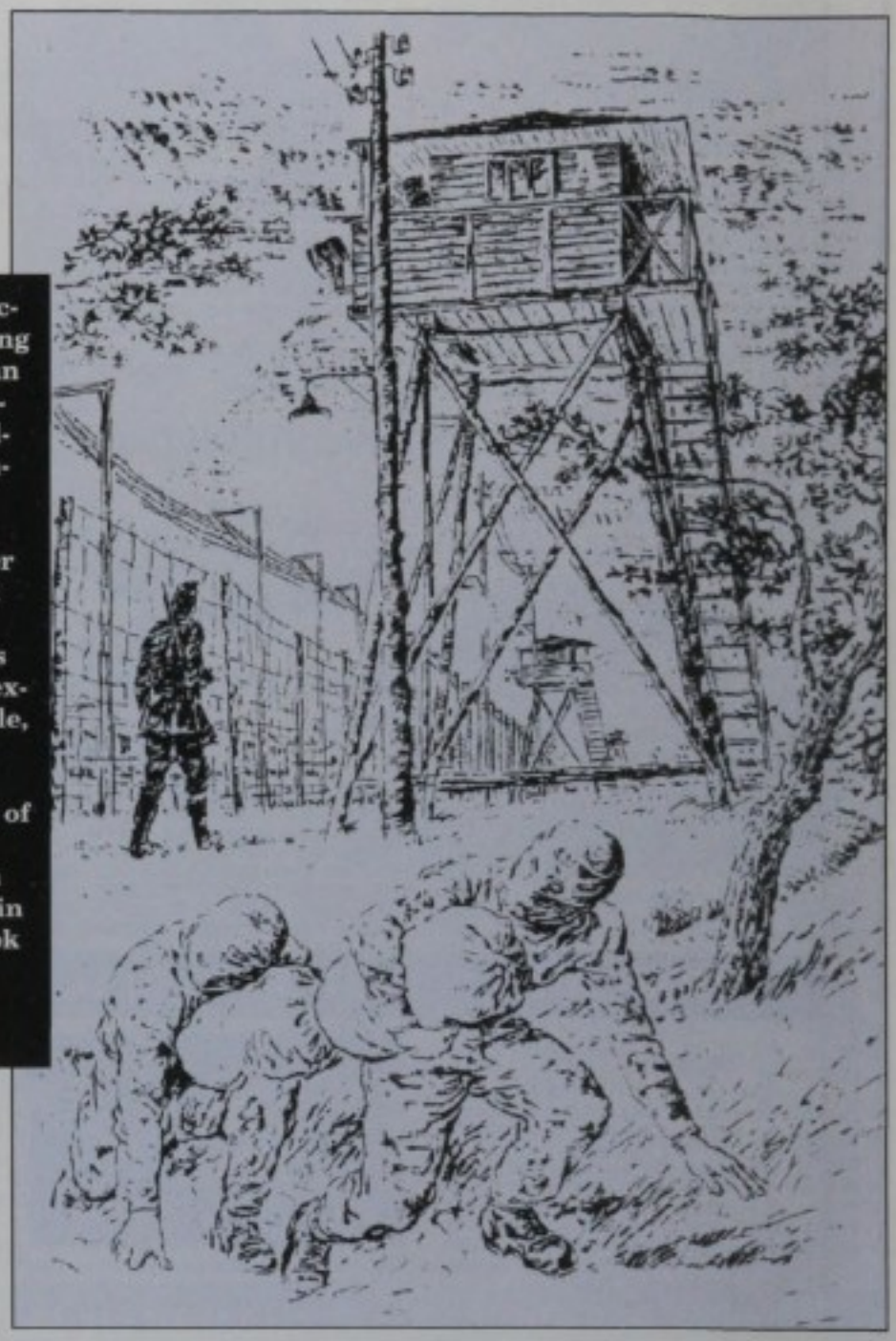
In 1942 the German Luftwaffe constructed the prison camp Stalag Luft III (near Sagan in Silesia) with all the latest refinements to prevent escape. The camp held officers of the Allied air forces shot down in the bomber offensive. While these officers were not starved and worked cruelly, as were Russian prisoners, the hardships of prison life kindled an active escape organization.

The escape committee decided on an ambitious plan designed to free many men. The idea was to simultaneously dig three long, deep tunnels. If one tunnel were discovered, they reasoned, then the Germans would stop looking and the digging could continue. Codenamed Tom, Dick, and Harry, the tunnels were sunk 30 feet and each was to extend several hundred yards.

The massive project required sophisticated engineering with crude equipment. For example, the prisoners had to construct an air pump with ducts, an electrical lighting system, and trolley cars. But the tunnels were only part of the work, as each escaper needed civilian clothing, well-forged papers, and a convincing cover story. The whole operation occupied more than 600 inmates for a year. In June 1943 work was stopped on Dick and Harry so as to concentrate on Tom, but Tom was discovered in late summer.

Work on Harry resumed in January 1944, but snow on the ground made the dispersal of dirt a major problem. The solution was to carry the dirt under cover of darkness to the theater and hide it under the floor. Tunnel work had to stop when the Moon would have illuminated this traffic of theatergoers. Harry was completed in the middle of March.

The plan was to try to get 200 men out through Harry in one night. This meant that the tunnel would have to be used all night, and that the woods would be full of suspicious-looking people. Moonlight at any time during the night could have exposed all this activity to the restless eyes of guards around the prison or spread across the countryside. Thus, the breakout had to take place at new Moon.



On two different occasions, before being detected by German prison guards, captured officers of Allied air forces managed to crawl through tunnels they had dug under Stalag Luft III and slip into the surrounding forest. As Bradley Schaefer explains in this article, both escapes were carefully timed to occur in the "dark of the Moon." This drawing by Martin Thomas appeared in Eric Williams's book titled *The Wooden Horse* (Abelard-Schuman, 1958).

When the last dirt fell down as the tunnel was opened, the diggers were horrified to learn that the exit was still roughly 20 feet short of the tree line. This is when the choice of a dark night paid big dividends, as moonlight would have easily exposed the men scurrying for the cover of the forest. As it was, the escapers could exit only when the guard outside the fence was at the far end of his beat, which slowed down the exodus. The escapers were discovered at the tunnel exit only at dawn when the twilight proved as much a hazard as moonlight. But by then a total of 76 prisoners had fled into the woods.

The Germans reacted with a police action occupying over five million men for up to several weeks and thus fulfilled one of the prisoners' goals. Most of the escapers were recaptured, but the trouble caused by the massive manhunt so infuriated Adolf Hitler that he ordered 50 Allied officers shot in cold blood. This infamous massacre chilled the escape fever in Allied prisoners, who soon realized it was better to sit out the short remainder of the war. The escapers' second goal was to make a

"home run" to family and friends. Three lucky men actually did make it to England and freedom.

Another famous escape from Stalag Luft III involved the "vaulting horse" tunnel dug over several months in autumn of 1943. The ingenious idea was to greatly shorten the tunnel by placing its mouth near the fence under the cover of a vaulting horse brought out by a group of gymnasts every afternoon. The wooden horse had sidings that concealed the digger, the trap door when it was open, and the excavated soil needing dispersal. Even so, the tunnel could not reach all the way to the distant tree line, which implied the escapers would have to make a run for it under cover of darkness. As such, the day of new Moon was selected, the guards failed to notice the emerging men, and three more officers made home runs by way of Baltic seaports.

LUNAR CYCLES

For help in investigating these and other historical events involving the Moon, I have written a Fortran computer program that is short yet valid for more than five millenniums from the present. A Basic version is given in the box on page 88. For any input date, the program returns values corresponding to four different lunar cycles.

The first of these is the familiar cycle of illumination phase, where the Moon's age is given in days from new Moon (day 0). First quarter occurs at 7 or 8 days, full Moon at 15, last quarter at 22, and new Moon at 29 or 0 days again. The second cycle is the Moon's distance expressed in terms of the Earth's radius. This value ranges from about 56 when the Moon is nearest our planet (at perigee) to 64 when it is farthest (at apogee), the average being 60.

Next the program gives the Moon's celestial latitude, which varies between about +5° and –5°. A value near 0° means the Moon is crossing the ecliptic. Finally the program gives the Moon's approximate celestial longitude, which ranges from 0° to 360°.

The program does not treat fractions of a day, and it also omits the many periodic terms in the Moon's complex motion. The age, distance, and latitude are accurate to whole units in each case. The longitude is only a rough guide because it increases about 13° per day. Yet these values are good enough for most historical questions. The program uses the Julian calendar before October 15, 1582, and the Gregorian calendar from that date on. Years before A.D. 1 should be

World War II and the Moon

PRISON ESCAPES were just one class of events in World War II influenced by the Moon. The timings of many others were dictated by lighting conditions, tides, or holidays tied to the lunar phases.

Some attacks required a bright moonlit night: The Japanese air attack on Pearl Harbor, Hawaii, was timed to have a bright Moon illuminating the carrier decks when the planes were launched in the early morning (*S&T:* December 1991, page 651). The great battle at El Alamein in North Africa was scheduled for full Moon so Allied engineers could use the added light to aid in crossing the extensive minefields defending the German positions.

Conversely, some assaults were made on moonless nights to maximize stealth: Italian frogmen relied on darkness to slip undetected through the harbor defenses of Alexandria, Egypt, and attach torpedoes underneath the only two British battleships defending the Mediterranean. The Battle of the Bulge was deliberately timed for new Moon so that nighttime troop movements could go undetected and surprise be maintained.

Many engagements were scheduled to occur at high tide. For example, the German submarine U-47 was able to sneak into the Scapa Flow anchorage off Scotland and sink the battleship *Royal Oak* by gliding over some rocks during an extraordinarily high tide caused by the near coincidence of new Moon and perigee.

The amphibious assault by the U. S. Marines on the atoll of Tarawa was timed for high tide so as to minimize the width of exposed beach that the soldiers had to cross — at least that was the plan (*S&T:* November 1987, page 526). Such landings are usually made just after sunrise, and high tide occurs when the Moon is near the meridian (or 180° from it). Thus there is a remarkable clustering of these invasions near the first- and last-quarter Moon, as the chart below shows.

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During World War II, the major (strongly opposed) amphibious landings by the Allies in the Pacific show a startling concentration near a lunar phase of first or last quarter. Such Moons can provide high tide near dawn. For many landings, the high-tide requirement is to minimize the width of exposed land the soldier must cross.

OTHER WORLD WAR II EVENTS TIMED BY THE MOON

Italy invades Albania	8 Apr. 1938	Battle of El Alamein	23 Oct. 1942
U-47 into Scapa Flow	13 Oct. 1939	Bordeaux shipping raid	12 Dec. 1942
Air raid on Taranto, Italy	11 Nov. 1940	Möhne and Eder dams	16 May 1943
Rudolph Hess to Scotland	10 May 1941	Skorzeny rescues Mussolini	12 Sept. 1943
Bismarck breakout	22 May 1941	Vaulting-horse tunnel	29 Oct. 1943
Attack on Pearl Harbor	7 Dec. 1941	Great Escape	24 Mar. 1944
Torpedoes in Alexandria	19 Dec. 1941	D-day landing at Normandy	6 June 1944
Bruneval radar raid	27 Feb. 1942	Battle of the Bulge	16 Dec. 1944
St.-Nazaire naval raid	28 Mar. 1942	Montgomery's Rhine crossing	23 Mar. 1945

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10  '          MOON EFFECTS by Bradley E. Schaefer
20  DEFDBL A-Z
30  P2=2*3.14159: ' Radians in a full circle
40  INPUT "Year, month, day";Y,M,D
50  YY=Y-INT((12-M)/10)
60  MM=M+9: IF MM>=12 THEN MM=MM-12
70  K1=INT(365.25*(YY+4712))
80  K2=INT(30.6*MM+.5)
90  K3=INT(INT((YY/100)+49)*.75)-38
100 J=K1+K2+D+59: ' JD for dates in Julian calendar
110 IF J>2299160# THEN J=J-K3: ' For Gregorian calendar
120 ' J is Julian date at 12h UT on day in question
130 '
140 ' Calculate illumination (synodic) phase
150 V=(J-2451550.1#)/29.530588853#: GOSUB 400: IP=V
160 AG=IP*29.53: ' Moon's age in days
170 IP=IP*P2: ' Convert phase to radians
180 '
190 ' Calculate distance from anomalistic phase
200 V=(J-2451562.2#)/27.55454988#: GOSUB 400: DP=V
210 DP=DP*P2: ' Convert to radians
220 DI=60.4-3.3*COS(DP)-.6*COS(2*IP-DP)-.5*COS(2*IP)
230 '
240 ' Calculate latitude from nodal (draconic) phase
250 V=(J-2451565.2#)/27.212220817#: GOSUB 400: NP=V
260 NP=NP*P2: ' Convert to radians
270 LA=5.1*SIN(NP)
280 '
290 ' Calculate longitude from sidereal motion
300 V=(J-2451555.8#)/27.321582241#: GOSUB 400: RP=V
310 LO=360*RP+6.3*SIN(DP)+1.3*SIN(2*IP-DP)+.7*SIN(2*IP)
320 '
330 PRINT USING "Moon's age from new (days):      ###";AG
340 PRINT USING "Distance (Earth radii):          ###";DI
350 PRINT USING "Ecliptic latitude (degrees):     ###";LA
360 PRINT USING "Ecliptic longitude (degrees):    ###";LO
370 PRINT: INPUT "Continue (y or n)";Q$
380 IF Q$<>"N" AND Q$<>"n" THEN GOTO 40
390 END
400 ' Normalize values to range 0 to 1
410 V=V-INT(V): IF V<0 THEN V=V+1
420 RETURN
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entered astronomically (so, for example, enter 0 for 1 B.C., and –99 for 100 B.C.).

For the date of the Great Escape, March 24, 1944, the program returns a value of 0 for the Moon's age — indicating that it was indeed exactly new. And while the other three cycles have no bearing on this particular event, they often come up in other questions about military history. World War II offers bountiful examples (see the box on page 87). One can also plot their distributions for major battles and Zeppelin raids in World War I. How did the tides affect the choice of date for the amphibious invasion of Inchon during the Korean War? The fun is not so much in finding such correlations, but in understanding how they are dictated by sound military principles.

Religious holidays are another way that battles can be tied to the lunar phase. Italy's invasion of Albania took place in 1938 on Good Friday (Orthodox), which is determined from the date of full Moon. Other famous attacks timed to occur on lunar holidays include the Easter Rebellion in Ireland (1916), the Tet Offensive in South Vietnam (1968), the Yom Kippur War in Israel (1973), and the siege of the Grand Mosque in Mecca (1979).

The program is also handy for exploring other astronomical or historical questions. For example, rapid trials can identify potential eclipse dates as times when the Moon's latitude is near 0° on the same date when its age is 0 or 29 (for a solar eclipse) or 15 (for a lunar one). The Moon's distance is a clue as to whether a solar eclipse is total or annular.

A good illustration is the solar eclipse of May 28, 585 B.C., described by the Greek philosopher Thales. Enter the date as –584, 5, 28, and you should obtain 29 days for the Moon's age, 56 for its distance, 0° for latitude, and 55° for longitude. We see that the Moon was near perigee and thus presented a larger-than-average disk, implying the eclipse was total (as it was).

Archaeoastronomers can check their hypotheses about dates when the Moon was observed at its greatest declination north. Or they might attempt modern, confirming observations from old monuments by seeking dates when the Moon's latitude is +5° and its longitude 90°. Tourists can time their travels to Newfoundland's Bay of Fundy, Britain's Severn River, or Alaska's Turnagain Arm to see the tidal bores; simply look for dates when the Moon is at syzygy (age near 0, 15, or 29 days) and at perigee (distance close to 56).

Astronomy often deals with physical events long ago, far away, and seemingly remote from human experience. But through tides, illumination, navigation, philosophy, and symbolism, astronomy relates to worldly concerns as well — more often than many of us realize.

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