SCULPTURES IN THE SKY

APPENDIX

The Adjusted Planck Standard International Unit:

After several notable mission failures in the late twentieth and early twenty-first centuries, an attempt was made for the United Near-Earth Stellar Survey Program (UNESSPRO) to develop a single system of measurement to prevent conflict between data or software from nations contributing to joint space projects. A working group was established in 2043 to examine the issue, drawing on expertise within both scientific and political communities. Two of the main criteria of the working group was that such a system of units should be as similar as possible to existing systems, in order to ease the transition between them, and that it should be as independent of arbitrary criteria as possible. That the system would be decimal was a starting assumption.

The working group chose Planck units as an early starting point. These values are based on fundamental constants of the Universe and thus make a good foundation for a system of units. The basic Planck measures for mass, length and time are:

Planck mass	= 2.177×10^{-8} kg
Planck length	= 1.616×10^{-35} m
Planck time	= 5.391×10^{-44} s

These values are too small to be useful for everyday measurements. One Imperial inch would be equivalent to over 157 billion quadrillion quadrillion Planck meters; a thin person might be alarmed to discover that they now weighed almost three trillion Planck kilograms; one old hour would drag on for over a trillion quadrillion quadrillion quadrillion Planck minutes. Clearly, these units would not be suitable either as a mission standard or for general usage.

The solution was to apply a simple fix to each unit, bringing them into more familiar territory. The Adjusted Planck second was simply derived from the "pure" Planck second by multiplying it by 10^{43}. The other two base units were derived in a similar fashion. Thus:

Adjusted Planck mass	= 2.177 kg
Adjusted Planck length	= 1.616 m
Adjusted Planck time	= 0.5391 s

All other fundamental units (electric current, magnetic flux, energy, etc) can be derived from these three units plus a number of other universal constants such as e (the magnitude of charge on a single electron) and the Boltzmann constant. Since the layperson is most likely to encounter the units of mass, space, time and temperature, we will restrict our discussion mainly to these four units.

1. Time

The length of a second, along with the number of seconds in a minute, the number of minutes in an hour, the number of hours in a day, the number of days in a week or a month, and the number of months in a year, are all arbitrarily determined figures. They are not fixed by nature. The only two units of time that could be considered to be relatively permanent (for humans in the relative short-term) are the rotational period of the Earth and the sidereal year. These two durations were key considerations in development of the Adjusted Planck time scale, although neither were considered essential for a system of time measurement intended primarily for use on missions to other solar systems, upon which relativistic effects would play havoc with calendars.

As the following chart shows, the new scale of time measurement bears a strong resemblance to the old: the new minutes and years are particularly close, and days, weeks and months are not radically removed, either. The division of minutes and hours into 100 equal portions facilitates more intuitive time-keeping; a day of two 10-hour halves preserves a sense of familiarity without sacrificing practicality; ten months of six five-day weeks allows great flexibility when it comes to scheduling rosters and planning in the medium term. Nations used to decimal measurements in other areas would, it was assumed, adapt naturally to the new scale, while those unfamiliar with them would still find "natural" time periods more or less unchanged.

1 new second		= 0.54 old second
1 new minute	= 100 new seconds	= 0.90 old minute (54 old seconds)
1 new hour	= 100 new minutes	= 1.5 old hour (90 old minutes)
1 new day	= 20 new hours	= 1.2 old day (30 old hours)
1 new week	= 5 new days	= 0.89 old week (6.2 old days)
1 new month	= 6 new weeks	= 1.2 old month (5.3 old weeks)
1 new year	= 10 new months	= 1.025 old years (12 old months)

It is true that over time the year as recorded by the Adjusted Planck method (which was adopted by UNESSPRO on 1/1/2050, the midpoint of the 21st Century and projected launch date of the first crewed interstellar mission) would drift from that recorded on Earth. As mentioned above, however, this was considered immaterial for missions to other solar systems. Adjustment is readily made between the two calendars. The need to provide space-going humanity with a practical method of time-keeping ultimately outweighed the need to maintain an impractical terrestrial tradition.

2. Space

While the Adjusted Planck decimal time scale was perhaps the most contentious issue facing the working group, the issue of measuring distance, area and volume was considered no less important since a handful of contributing nations -- notably the United States of America -- had still not adopted a metric system of measurement. Although the change to metric was widely considered inevitable in the long-term, the following compromise was agreed upon because of its congruence with old units.

1 new centimeter		= 1.6 old cm / 0.64 inches
1 new decimeter (dm)	= 10 new cm	= 6.5 inches
1 new meter	= 10 new dm	= 1.6 old m / 3.3 feet
3 new meters		= 10 feet
1 new kilometer	= 1000 new meters	= 0.97 miles

The Adjusted Planck meter is still considered by many to be too large for everyday use, but its derived unit, the decimeter has many practical applications. The centimeter, falling neatly between the old centimeter and the inch, has also been touted as a compromise between the two systems. But the similarity between the old mile and the new kilometer and the new liter and the old gallon -- plus a number of other convenient measures arising naturally out of the figures (see point 4) -- convinced the US delegates that to change would be advantageous.

1 new hectare	= 2.6 old hectares	= 6.4 acres
1 new liter (dm^3)	= 4.2 old liter	= 1.1 gallons

3. Mass, Current & Temperature

Once measures for space and time had been accepted, the fundamental units of mass, current and temperature were foregone conclusions. The mantra that five old pounds equals one new kilogram was concocted to ease the transition for Imperial users. Confusion between Fahrenheit and Centigrade scales was already common, especially when combined with the shifting zero arising from scientific usage of the Kelvin scale. The new scale, with its base set firmly on absolute zero, was adopted alongside the others to ensure congruity between data-sets.

1 new g		= 2.2 old g
1 new kg	= 1000 new g	= 4.8 old pounds
1 new tonne	= 1000 new kg	= 2.1 old tons

1 new ampere		= 2.972 old ampere

(new)	(Centigrade)	(Fahrenheit)	(Kelvin)
1	= 1.415	= 2.563	= 1.415
0	= -273.15	= -459.67	= 0 (absolute zero)
193	= 0	= 32	= 273.15 (freezing point of H_20)
264	= 100	= 212	= 373.15

		(boiling point of H_20)

4. Contributing Factors

Adopting an entirely new set of unit measurements is nothing to take lightly. The working party took many considerations into account, one of them being elegance. This property, although ill-defined, is a factor in the acceptance of any novelty, be it a scientific theory, a fashion of dress, or a style of writing. The simple annotation of several frequently used constants in Adjusted Planck Units contributed to the decision to adopt them. For instance:

c (the speed of light)	= 1.00×10^{10} ms^{-1}
1 light-year	= 6.00×10^{15} m
1 light-hour	= 1.00×10^{11}m
1 parsec	= 2.0×10^{16} m
1 g	= 1.0 light-year/year^2
1 solar radius	= 430000 km
1 Earth radius	= 4000 km (equatorial)
geostationary orbit	= 22220 km (Earth)

These figures have many practical applications in space exploration (the field for which these units were developed). The simplicity with which they can be expressed in the new units contributes to the ease of communication between scientists -- the main point the new system was created to address.

5. Conversion Table

The following conversions were provided for rapid calculation from old Standard International Units to the new Adjusted Planck SIU's.

(unit)	(conversion)	
m/s^1	0.334	(velocity)
m/s^2	1.76	(acceleration)
g/cm^3	1.92	(density)
Pa	0.216	(pressure)
N	0.0818	(force)
J	0.0506	(energy)
Hz	1.86	(frequency)
Ω	0.241	(resistance)
V	0.0811	(voltage)

Authors' note: Acknowledgement must go to Erik Max Harris for (to the authors' best knowledge) first proposing a scale based on Planck units. We have adapted his ideas to suit our needs, and any errors introduced in the process are ours. See his site for more information on the basic concept:

http://www.alcyone.com/max/writing/essays/planck-units.html