The Meaning of the Singularity: 2. Astro-Sociology: Predicting the Presence of Twin Planets (extended version)

==

Alon Retter, (PhD, Astronomy, Tel Aviv University, 1999; postdoc 1998-2006, Keele, Sydney & Penn State Universities), 86a/6 Hamacabim St., P.O. Box 4264, Shoham, 60850, Israel, alonretter@gmail.com

Abstract

This paper presents a remarkable analogy between the human society and Astronomy. Please keep an open mind as **the resemblance is not only qualitative but also quantitative.** We point out many similarities between stars and people, such as properties of grouping – single stars vs. singles, binary stars vs. couples, cities vs. clusters, countries vs. galaxies, etc. Men and women are linked with cool and hot stars. We match planets with children and attribute the two genders to gas and solid planets. Moons are related with pets or grandchildren, asteroids with germs / viruses, accretion disks with bellies and jets with pukes. Suicide attempts in people are associated with supernovae in stars. Inflation is connected with the rapid growth of the embryo, and the time the universe became transparent to light is linked with the human birth. A simple analogue to the cosmic background radiation is the bellybutton, and the universe acceleration is coupled with the pace increase in modern life. **The mean values of the distributions of star multiples and the number of US households are almost identical (2.04 and 2.03). Moreover**, **an amazing resemblance between the two curves is evident (Fig. 1)**. The distribution of gas (or solid) planets is similar to that of boys (or girls) as well, and the fit could improve once selection effects are considered. **Monte Carlo simulations suggest that our results are significant at a confidence level higher of ~99.9%!** The surprising linkage between humanity and stars can lead to many predictions. It is proposed that about a third of stars harbor planets. We predict that stars are equally divided between hot and cool stars and planets between gas and solid planets. The presence of four gas and four solid planets in the solar system supports our prediction. We also forecast that the mean number of planets around host stars should be near two, larger around binaries than in single stars and higher in hot stars than in cool stars. We vision the presence of **twin planets** that share the same orbit. The wealth of known extra-solar planets should already contain a few such systems. We forecast the presence of a new astronomical phenomenon, which we alias '**planova**' – an eruption in a planet that may destroy it, and speculate about the presence of planet jets. The ideas and results of this paper are clearly unusual and unbelievable. A brief explanation to our findings is presented in the discussion and further developed in forthcoming papers.

1. Introduction

Astronomy is the observational study of stars while Astrophysics is the theoretical research in this field. Sociology is the scientific or systematic study of human societies. Apparently, there should not be any relation between the two fields. However, in a new series of papers, we present new ideas in Physics and Cosmology, and novel concepts for particles, motion, space, time and light as well as an intriguing solution to the two major riddles of Cosmology – dark matter and dark energy [1-3]. In the first paper, it was demonstrated that physics cannot really exist in a single particle universe, and thus at least two particles are required to form the known world. It was, therefore, concluded that there is no detachment at all [1]. It follows that the universe is not really separated from the observing scientist, and links between astronomical objects and people can surprisingly exist. In this paper, which is the extended work of the short version [2] we point out many similarities between stars and the human race and set the foundations of a novel multi-disciplinary research area, which we name Astro-sociology.

2. The analogy between stars and humans

2.1 Stars

The basic brick in Astronomy / Astrophysics is a star, which we link with a human being. Each person represents an expression of the singularity, thus it is unique - different than the others and no two are the same, not even identical twins. Similarly, any star should be different than the other. This is consistent with current observations. In example, the search for a solar twin, a star with the same astrophysical parameters, such as age, mass, temperature, luminosity, radius, etc. as the Sun, is still ongoing [4].

Stars are found in hierarchical structures: clusters, galaxies, clusters of galaxies and super clusters, while people live in villages, cities, countries and continents. Deserts, isolated areas, are linked with voids, in which the observed stellar density is poor. Stars are regularly found on the main sequence branch, where they burn hydrogen into helium and heavier elements. There are also young stars. Old stars such as white dwarfs, neutron stars and black holes, as single stars are generally more passive and less energetic than main sequence stars. The analogy to people is obvious. Stars have envelopes and planets may have atmospheres while people have skin. The human blood flow is related with convection in stars. People eat in analogy to mass accretion in stars. Stars may have accretion discs – mass is accumulated around the center, similar to the human belly. Note the resemblance between stomach creases and Saturn's rings. Human disposal can be matched with stellar winds.

Main sequence stars are broadly divided into two major groups. The historical separation into the classes of cool and hot stars is based on their internal structure. Types O to A9 are the hot stars and types F0 to M (the new classes L, T and Y can be included as well) are the cool stars. The hot stars have a convection zone next to the core, with an outer radiative zone, while the cool stars have the inner radiative zone with the outer convective zone. Hot stars burn hydrogen through the CNO cycle, while cool stars through the proton-proton chain. The hot stars have strong winds due to radiation pressure, while the cool stars are characterized by their magnetic fields as displayed by the corona [5-6]. We link the two kinds of stars to the two human genders. Since O - A stars are warmer we match them with women and the F - Y stars with men.

It is well accepted that stars are commonly found in binary systems [7]. A similar behavior is found in humans [8]. Many combinations can be found – e.g. two young stars, two main sequence stars ('adults'), two old stars, a main sequence star and an old star, etc. [9-11]. Similarly, in human society various couple possibilities are found and in some large age differences do exist [12]. There are encounters between people as well as between stars. If one member in a human couple has an affair, this may lead to a divorce, to the rejection of the third part, or rarely to the formation of a triple. A similar behavior is found in stars as described by simulations of binary-single star scattering [13]. There are also close as well as detached binaries, similar to human relationships.

Children are coupled with planets. Planets can be found around single stars as well as in binary and multiple systems [14] like the human society [8]. Stars can have a few planets while there can be several children in a single family. Planets can be found around old stars [15] as children sometimes live with their grandparents [8]. Planets also 'eat' by planetesimal accretion [16]. Asteroids can be associated with germs or viruses. Note that an impact of a massive asteroid on Earth can cause a severe 'sickness' to the planet with a strong effect on weather.

According to our ideas the bond between stars and people should also be expressed by numbers, distributions etc. This approach is studied below. In the absence of a reliable source of detailed information on the total Earth society, for the comparison between mankind and stars we used the updated statistics of the American population, which is easily available on the US Census Bureau website [8]. The USA inhabitants may not fully represent the global world population, but we believe that the differences between the two are small and thus would not alter the results presented in the paper.

The multiplicities of stars were recently collected for a set of 4559 stars with Hipparcos magnitude brighter than 6 [7]. The observed sample contained multiplicities up to 7, and a multiplicity average of 1.53 companions per system was found. Taking into account the observational biases, it was concluded that the real population has a mean multiplicity slightly over two [17]. It was estimated that the actual distribution of stars in 1, 2…7 multiples is respectively 1459, 2179, 517, 202, 101, 44, and 48, which are 32.1, 47.9, 11.4, 4.4, 2.2, 1 and 1%. Note that there were only 4550 stars in the simulated data. We compared these numbers with the figures of the USA adult population in 2009 [8]. The numbers of 1, 2…5+ members in the age interval of 18-65 years old in 1000 units were 14900, 43479, 9190, 2878 and 739 for all households. These data correspond to 20.9, 61.1, 12.9, 4.1 and 1% of 1, 2…5+ adults in household, and yield a mean of about 2.03 adults in household, which is remarkably consistent with the average stellar multiplicity – 2.04 [17]. In Fig. 1 we plot the two distributions. They have a very similar Gamma function-like profile with a peak at two. It is carefully noted that only the US statistics, which we consider as a representative sample for the whole world, was used instead of the figures of the total mankind population, and that the distribution of star multiples is based on observations and a detailed selection effect expert study rather than pure observational data, yet the resemblance of the two distributions is outstanding. Indeed, we estimated from extensive Monte Carlo simulations that the two distributions are consistent with each other with a probability level higher than 97% (see Appendix).

2.2 Planets and children

We continue the analogy between humans and stars by linking children with planets. The search for extra-solar planets has been very fruitful in the past decade, and as of March 3rd 2010, 429 planets have been discovered by various observational techniques [18]. Planets are regularly divided into two types – gas Jupiter-like planets and solid Earth-like planets. According to the mass estimates, the vast majority of the identified planets are gaseous, which are much more massive than solid planets, and are thus easier to detect. Note that Jupiter's mass is about 300 larger than Earth [19]. Now we go one step further with the match between planets and children, and respectively associate gas and solid planets with boys and girls under 18 years old. Thus, since very few Earth-like planets occupy the list of known extra-solar planets, the correct comparison of most planets should be made with boys instead of children.

The bordering mass between gas and solid planets is unknown and depends on several parameters. A reasonable assumption for this limit is 20 $M_\oplus$- twenty times the Earth's mass [20-21]. Adopting this value implies that 38 known extra solar planets are solid, so they only comprise less than 10% of the planet list. Utilizing different mass limits of 10 or 30 $M_\oplus$, which respectively correspond to 25 and 48 solid planets, only leads to minor changes to the statistic of gas planets and to the conclusions of this paper.

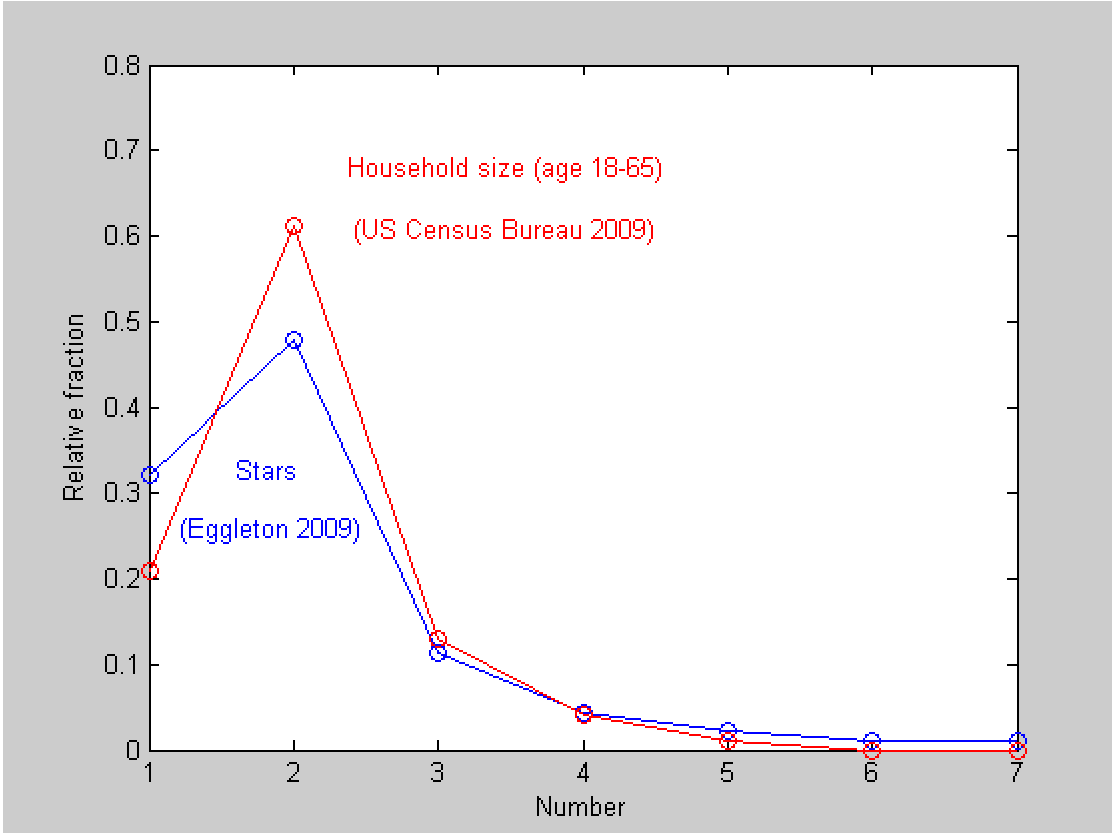

Fig.1 – A comparison between the star multiples distribution (in blue) with that of American households in 2009 (in red). There is a remarkable similarity between the two curves with a peak at two. The mean value in humans is 2.03 [8], while that of stars was estimated as 2.04 based on observations and a thorough analysis of selection effects [17]. From numerical simulations we deduced that there is less than 3% chance probability to randomly achieve this result (Appendix).

We attempt comparing the two distributions of gas planets and boys populations. Among the 391 selected massive exo-solar planets 304, 62, 21 and 4, which are 77.7, 15.9, 5.4 and 1%, have 0, 1…3 'sibling' planets, i.e., with the same host star. The distribution of boys only is not available on the US Census Bureau website, and thus it is estimated from the data of their siblings. In 2009, among the 37,959,000 American boys, 8106, 14683, 9375, 3826, 1159 and 810 thousand boys had 0, 1…5+ brothers or sisters [8]. The frequency of the two genders is very similar - boys comprise ~51.1% of all children. The binomial distribution thus implies that about 18053, 13990, 4600, 1073, 215 and 28 thousands boys had 0, 1…5+ brothers. Thus, about 47.6, 36.9, 12.1, 2.8 and 0.6% of American boys had 0…4+ brothers. The distributions of planets and boys are plotted in Fig. 2. They display the same descending trend and we believe that a better match will be produced once taking into account the selection effects as was done for star multiples (Section 2.1), because it is clear that current surveys only find part of all gas planets in a host star system.

The distribution of girls and solid planets can also be compared. Among a total 36,269,000 American girls, 7645, 14111, 8895, 3695, 1134 and 789 thousand girls had 0, 1…5+ brothers or sisters [8]. Using the binomial distribution it is concluded that about 17787, 13185, 4154, 942, 179 and 22 thousands girls had 0, 1…5+ sisters. Therefore, about 49.0, 36.4, 11.5, 2.6 and 0.5% of American girls had 0…4+ sisters. Unsurprisingly, this distribution is almost identical to boys'.

Adopting the maximum upper limit of 20 $M_\oplus$ for solid planets, it was found that 52.6, 13.2, 23.7 and 10.5% have 0, 1, 2, 3 sibling light planets. This distribution was added on Fig. 2, and the similarity to the distribution of girls, which is nearly equal to boys', is clear. It is clear that more data are required in order to improve the statistics of solid planets.

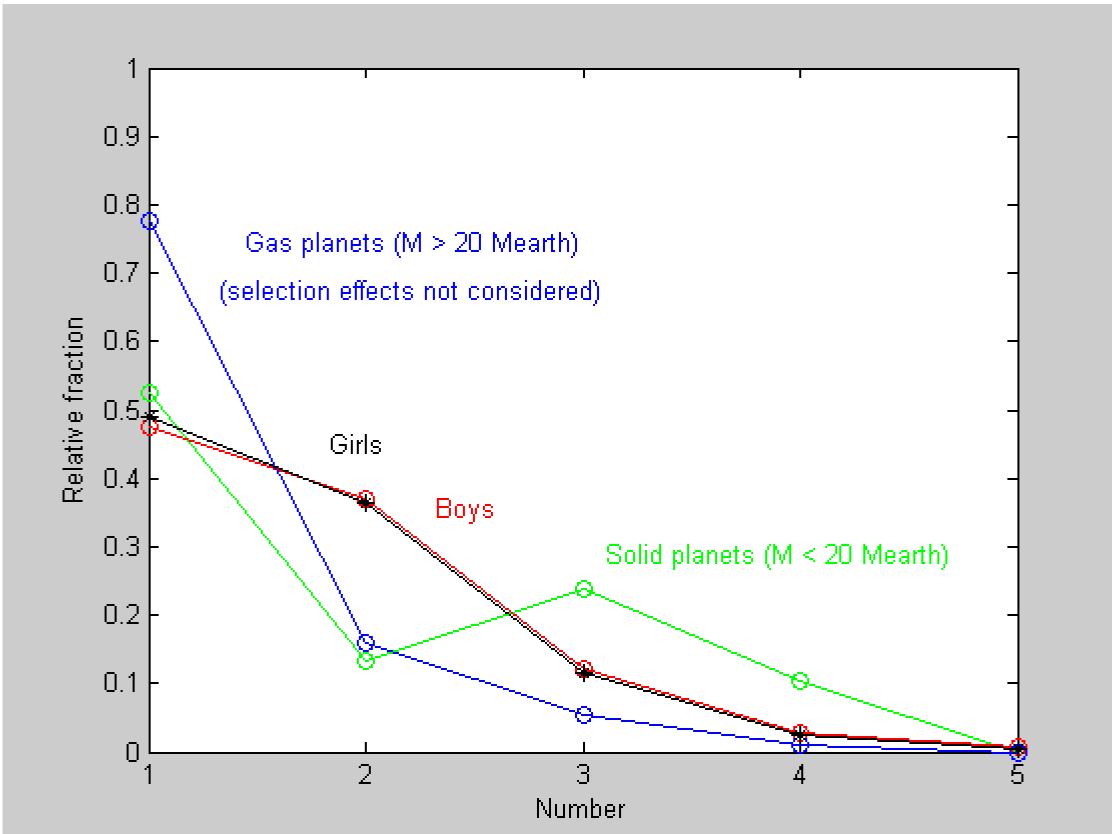

Fig. 2 – A comparison between the distributions of boys in USA families in 2009 (in red) and number of gas planets around host stars (in blue). The distribution of American girls (in black), which is almost identical to boys', is compared with number of solid planets around parent stars (in green). Note that we respectively link boys and girls with massive gas Jovian and light rocky Earth-like planets. The mass limit between these two populations was taken as 20 $M_\oplus$, implying that more than 90% of recorded planets are gaseous. There is an apparent resemblance between the distributions. The current qualitative difference between the distributions of boys and gas solid planets could be explained by not considering the impact of the observational selection effects that are involved in the planets search. The distribution of solid planets suffers from sparse data.

The 391 massive planets, which are presumably gaseous, are found in 343 stellar systems, which yield a mean of 1.14 planets per host star. The average number of boys younger than 18 years old in an American family with boys concluded from the values above is about 1.41. Since it is clear that selection effects prevent the detection of other Jovian planets around a known system with gas planets, we regard these two mean numbers as consistent with each other. Finally, we comment that the frequency of observed Jupiter-like planets around solar mass stars was estimated as 5-10%, but it is probably larger in more massive stars and may reach 18-35% [22]. These numbers agree with the value of ~23% found in humans – about 27 million families with boys below 18 years old among 117 million US households [8].

2.3 Miscellaneous

We further extend the analogy between Astronomy and people. Moons are linked with pets. Note that moons are found around many planets in the solar systems and some have several moons orbiting them [23]. A similar behavior is found in the human society, where typically the pets are found closer to children, and some children possess many pets. Alternatively, moons may be matched with grandchildren.

Stars have stellar pulsations with various amplitudes [24], which we relate with heart beats and breathing in people. Some stars are unstable and they show erratic behavior. This occurs both in single and multiple stars. Flares are observed in many stars, and some binary stars show cataclysmic events like dwarf novae and nova eruptions. During these outbursts, the system brightness significantly increases. These events are understood by mass accretion from one star to its companion that leads to some kind of instability [9]. We link these eruptions with bursts of anger in people. Note that during nova outbursts the outer shell of the compact star is ejected away from the star, which is similar to throwing things during severe human anger events.

Suicides attempts in people are matched with supernovae, which can occur both in single and in binary stars. The blast can completely demolish the star with no remnant in some cases of supernovae type II. Alternatively, a residual neutron star or a black hole can be formed [25]. Likewise, in people a successful suicide attempt causes death, while it can fail, but it may change the mental status of the person. Supernovae type Ia are believed to occur in binaries as a result of mass transfer from the companion star [25]. Similarly, suicide attempts sometimes happen in couples, where a person suffers from a bad relation with its partner. We also note that in binary systems the massive star rotates more slowly than its companion and that planets orbit stars. This is like humans as obese people are less mobile than skinny persons and children are more active than adults. In addition, massive stars stay less time on the main sequence branch [26], which is akin the shorter lifetime of obese people [27].

A remarkable similarity between people and Astronomy is found in the early stage. It is well accepted that the universe is expanding as a result of the Big Bang that occurred some 14 billion years ago [28-29]. Inflation, a fast expansion in the primordial stages of the universe [30], can be connected with the rapid growth of the human embryo. Returning back in time the universe was denser and hotter, therefore, there was an epoch when the cross section for photon-photon collisions was so large that the universe was opaque. Only when the temperature cooled down below a certain value, the universe became transparent to light [31]. Note the resemblance to the human birth. The world is obscure to the fetus, and becomes visible only after birth. The detection of the cosmic background radiation is considered as convincing evidence of this transition, and the bellybutton is our analogous mark left from birth. Finally, a person has a body, a mind and a consciousness, while the universe displays matter, dark matter and dark energy, which will be discussed in the next paper of the series. Table 1 summarizes the analogy between astronomical objects and people and predictions based on this similarity are suggested.

Table 1 – The analogy between the human society and Astronomy / Astrophysics.

	Human society	**Astronomy / Astrophysics**
Objects		
Individual	Adult	Star
gender	Men	Cool (F-Y) stars
	Women	Hot (O-A) stars
Offspring	Child	Planet
gender	Boy	Gas Jovian planet
	Girl	Solid Earth-like planet
Family	Parents and children	Stars and planets
Single family	Parent and children	Star and planets
Grandchildren	Grandchildren	Moons?
Accompanied	Pets	Moons?
Minors / Hostiles	Germs / viruses	Asteroids
Cover	Skin	Envelope / atmosphere
Circulation	Blood flow	Convection
Concentrations	Villages, cities, countries	Clusters, galaxies, clusters of galaxies
Isolated areas	Deserts	Voids
Properties		
Age	Young people	Young stars
	Elderly	White dwarf, neutron star, black hole
Coupling	Singles, couples, triples…	Single / Binary / triple… stars
Affair	Affair	Scattering of a binary by a 3rd star
Divorce	Divorce	Scattering of a binary system by a 3rd star and formation of a new binary
Children with grandparents	Children with grandparents	Planets around neutron stars, white dwarfs (and black holes)
Stability	Heart beats and breathing	Stellar pulsations
Temperament	Anger	Flares, dwarf novae, nova outbursts
	Throwing away things	Envelope ejection in novae
Suicide attempt	Suicide attempt	Supernova
	Successful suicide attempt	Some supernovae type II
	Unsuccessful suicide attempt	Most supernovae
	Suicide attempt in couples	Supernova type Ia
Food	Eating	Mass accretion, planetesimal accretion
accumulation	Belly (at center)	Accretion disk (at center)
	stomach creases	Saturn's rings
disposal	Disposal	Winds
	Puke (after gluttony) (sometimes in suicide attempts)	Jet (after mass collapse) (occasionally in supernovae)
Mass effect on age	Obese people-shorter lifetime	Massive stars - faster evolution
Mobility	Obese-low, skinny-high,	Massive stars - lower velocities than

	adults-low, children-high	their companions (including planets and moons) in binary systems
Universe		
Early fast development	Embryo growth	Inflation
Transparency	Birth	Universe is opaque at the beginning and becomes transparent at early time
Birth Sign	Bellybutton	Cosmic microwave radiation
Acceleration	Acceleration in modern life pace (note change in movies pace, music rhythm etc…)	Cosmic acceleration
Matter and spirit	Body, mind, consciousness	Matter, dark matter, dark energy
Numeric similarities		
Mean adult members in household	2.03 = mean number of adults in USA households	2.04 = estimated mean multiplicity in stars (based on observations)
Adults distribution in household	Distribution of adults number in household (Fig. 1)	Distribution of stellar multiples (Fig. 1)
Mean number of boys in household	1.41 = mean number of boys in household with boys	1.14 = average number of gas planets in host star (ignoring selection effects)
Boys distribution in households	Distribution of boys number in households (Fig. 2)	Distribution of gas planets number around a stellar system (Fig. 2)
Mean number of girls in household	1.39 = average number of girls in household with girls	1.41 = mean number of light (solid) planets per host star in the systems with the 38 lightest (solid) planets
Girls distribution in households	Distribution of girls number in households (Fig. 2)	Distribution of (solid) planets number around a stellar system (Fig. 2)
Predictions		
Frequency of the two genders	Men and women each comprise ~50% of the total population	We expect that the frequency of F-Y cool stars would be similar to O-A hot stars
	Children are about equally divided between boys and girls	Expect similar frequency of gas and solid planets around host stars. Single test case: Solar systems – 4 gas and 4 rock planets.
Frequency of households with children below 18 years old	About 30% of USA households have own children under 18 years old	Planets should appear in about a third of all stellar systems
Frequency of single and classical families	Single-father, single-mother and classical families are 6, 24 and 70% of all families	Expect division of planet host stars between single F-Y, O-A stars and hot-cool binaries, as ~6, 24 and 70%
Mean number of offspring	1.9 = Mean number of children under 18 years old in family	Mean number of planets in host stars should be near 2. It is 2.04 for the 38 lightest (rock) planets with $M<20\ M_{\oplus}$
Mean number of offspring in singles and couples	Average children number in singles (1.76) is slightly lower than in couples (1.96)	Mean number of planets around single host stars is expected to be smaller than in binaries
Mean number of boys and girls	Average number of boys in family with boys (1.41) is	Expect ~1.4 solid planets in systems with solid planets, and same for gas

	similar to average number of girls (1.39)	planets.
Twins	Twins	Twin planets – in co-rotation - have the same orbit
frequency	About 3% of births and 6% of children are twins	About 6% of planets should have a twin planet
Identical twins	Identical twins	Planets with the same mass that share the same orbit
Identical twins	Unidentical twins	Planets with different masses that share the same orbit
Triples frequency	Triples frequency – 0.15%	~0.5% of planets should have two more planets at the same orbit
Orphan children	Orphan children	Orphan planets (no host star). In example around supernovae type II remnants
Adopted children	Adopted children	Orphan / rejected planets may join a new host star system
Teenagers suicide attempt	Teenagers suicide attempt	Planova – planet outburst
Teenagers puke	Teenagers puke	Jets in planets - may appear during planovae
Offspring creation	A couple is needed to give life to a child	A binary system (a hot and a cool star) should be required to form a planet
Offspring evolution	Children grow up to adults	Planets should evolve into stars
Unclear sex identity	Androgyny	Massive rock planets, light gas planets
Massive grouping	Communes	Stellar multiples with a few dozen members may rarely be found.
Large families	Up to about 20 children below 18 years old in family or even more	Unusual stellar systems with up to at least ~20 planets may exist.

3. Predictions

In the previous section we demonstrated many striking similarities between Astronomy and the human society. We believe that this analogy bears many predictions, some of which we list below.

3.1 Stars and Planets frequencies and means

It was proposed to identify hot and cool stars with the two human genders (Section 2.1). In 2009 among a total of 189.1 million adult (age 18-65) Americans, 95.4 millions were females and 93.7 millions were males [8], thus females and males respectively comprised ~50.5% and ~49.5% of the total population. We therefore predict the all main sequence stars will be nearly equally divided between O-A and F-Y stars. The number of families with own children below 18 years old were about 35.6 millions compared to a total of 117 million households [8]. Thus, we predict that planets should be found around about a third of all stars. Among the 35.6 million families with children, ~6, 24, and 70% were in single-father, single-mother and married couples. Therefore we predict that planet host stars systems will be similarly divided between single F-Y, single O-A stars and binary stars. We also predict that most binaries that harbor planets are composed of a hot star and a cool companion. Naturally, it is suggested that planets would be less abundant around old stars than other stars.

The rates of American boys and girls among the total children population are also almost similar: ~51.1% vs. ~48.9% [8]. Therefore, we anticipate that the average number of the equivalent gas Jovian and solid Earth-like planets around parent stars should be nearly equal. Note that a priory there is no reason to believe that the two types of planets will be evenly divided. Moreover, the average number of children under 18 years old in American households with children in 2009 was about 1.9. In married couples it was ~1.96, somewhat larger than the value 1.76 found in single-parent families [8]. Note that the mean children number in single-mother families was 1.81 – larger than in single-father families – 1.58. We therefore forecast that the average number of both gas and rock planets in single and in binary systems behaves like the values in humans, i.e., close to two, while it should be slightly higher in binaries and lower in single stars with a preference to hot stars. It is also predicted that the average number of Jupiter-like planets around parent stars with gas planets should be ~1.4 – similar to the number of boys under 18 years old in an American family with boys. Thus, we estimate that about 25% of Jovian planets are missed by current observations, whose mean is 1.14 (Section 2.2). A similar value of ~1.4 solid planets is expected in host star systems with Earth-like planets.

The mean number of planets around stellar systems can be estimated by considering only the planets with the lowest masses and their 'siblings'. If light Earth-like planets are detected in these systems then presumably all other planets are likely to be observed as well. The 38 known lightest planets are found in 27 stellar systems and have 17 massive 'sibling' planets [18]. These figures yield an average of 55/27=2.04 planets per parent star, which is consistent with the mean value of 1.9 found in American children. Note that the correct comparison should be with all families without those with boys only, which have a mean of 2.1. The average number of light (solid) planets in systems with light (solid) planets is 1.41, which is compatible with 1.39 - the mean number of girls in American families with girls. This nice consistency should be rechecked when the statistics improves.

Due to the mass difference, it is obvious that the relative frequency of gas extra-solar planets detected so far is artificially increased compared with currently known rocky planets. Therefore, our prediction for a similar frequency of gas and solid planets should be tested by future surveys that can easily observe Earth-like planets, or by estimates that carefully take into considerations these selection effects. This prediction can be easily evaluated, however, by a single example - the nearby solar system, where all planets are clearly observed. Notably, the Sun harbors four gaseous planets and four solid planets [32]. This equality supports our prediction.

One may wonder why the number of planets in our solar system is so large, much higher than the average of 1.2 gas and solid planets per system found so far [18] and than 1.9 - the mean number of children under 18 years old per family [8]. According to our belief, the number of planets in the solar system reflects the average number of children per family when the members in the solar system were discovered some centuries ago [33]. The family size was much larger then than today. So, we predict that the solar system has an exceptional large number of planets relative to other stars.

3.2 The presence of 'twin planets'

In 2006 more than 3% of births among the US population were twins, while 0.15% in triples [34]. The analogy between children and planets (Section 2.2) suggests that twin, triple and multiple planets should be found around stars as well. We interpret this as the existence of more than one planet at the **same orbit**, despite preliminary intuition, which suggests that such a configuration may not be stable. The higher the number of planets at the same orbit, the less stable they should be, similar to humans, as unfortunately some babies do not survive long after a multiple birth. We expect that more than 3% of planets-bearing systems have twins. Naively, this implies that among the 429 of known extra-solar planets, about a dozen may possess twins and one could be triple. However, the detection of such systems in radial velocity searches may be difficult because the effect they impose on the parent star may be reduced and even canceled for identical twins, which presumably have the same mass. Thus, the actual number of twins among the known planets may be somewhat lower. Imaging offers a higher potential to detect twin planets either identical or unidentical, which we suggest have different masses. Identical twin planets may appear similar in transits making the observed period shorter than the correct orbital period by a factor of two. We thus encourage observers to fold their transit data by twice the orbital period to test this hypothesis. Non-identical twins would have different transit profiles and depths, probably like the light curves of hot Jupiters, which are very close to their parent star and have very short orbital periods [35]. Thus, unidentical twin planets should be easier to detect by this method. Among the 69 known transiting planets two systems may have twins. In fact, we suggest that KOI-74b and KOI-81b, two unusual transiting objects, which were recently found by Kepler photometry [36], could be unidentical twins. Radial velocity measurements, imaging and light curve modeling should test this idea.

It is interesting to note that theoretical studies allow the possibility of twin planets – in co-orbital motion [37], and it was actually proposed that the pairs of planets in two systems (HD 128311 and HD 82943), which are believed to be involved in a strong first order 2:1 mean motion resonance, may be Trojan planets – in a 1:1 mean motion resonance – twin planets [38]. The presence of multi-orbital elements in communication satellites demonstrates that stability is not a problem. For example, the Iridium Global Network has 66 satellites in six orbits around Earth [39].

3.3 Planovae - eruptions in planets

In Section 2.3 suicide attempts in people were linked with supernovae in stars. Unfortunately, some children (especially teenagers) do try killing themselves as well. Therefore, we argue that planets may have some equivalent unusual events with a significant increase in brightness. The effect may destroy the planet and could be accompanied by jets as in some supernova cases. Suggesting detailed mechanisms that can lead to such outbursts is beyond the scope of this paper, but we meditate that mass transfer from the parent star, from a 'sibling' planet/s or from an accretion disk could do the job. Jets may also rarely appear in planets at other occasions than planova eruptions as children do puke. We comment that the planet does not have to be massive for the formation of jets and planovae.

3.4 Miscellaneous

Current theories of stellar and planet evolution propose that they were formed during the collapse of large gas clouds. Stars are born at the center, while planets are formed in proto-planetary accretion disks left over from the proto-stellar disk of their newly formed host star [40]. It is obvious that the concepts presented in this paper have strong impact on stellar and planet evolution. In accordance with our ideas, like human evolution, planets should be mainly formed from binary systems, and the vast majority of them should evolve to become stars themselves. Lately, an additional planetary formation route was suggested [41]. It was proposed that planets may subsist in old binary systems, in which mass transfer from the expanding evolved star to its binary companion could form an accretion disk around it. Such a disk can provide the necessary environment for the formation of a second generation of planets in both circumstellar and circumbinary configurations. This suggestion opens the door for an equivalent planetary formation scenario in young binary systems. Note that it is also accepted that a star-planet system can evolve to a binary system in some cases [42].

In humans there are uncommon examples of communes where up to a few dozen persons live together [43]. These communes are very unstable with people frequently joining or leaving the group. We predict that a similar behavior could be found in stars. Multiple star systems with as much as a few dozen members could exist, although they should be few and unstable. Human families often have many children below 18 years old. Assuming about one birth per year and the possibility of twins we predict the presence of solar systems with as many as twenty planets or maybe even more. It is again clear that such configurations should be very unusual.

An androgyny is a person who does not cleanly fit into the typical masculine and feminine gender roles of their society. Many androgynies identify as being mentally between woman and man, or as entirely genderless. It is suggested that a similar phenomenon could be found in planets. Thus, we speculate the presence of androgynous planets – objects whose gender is unclear. We therefore vision the scarce existence of rocky planets with Jupiter-like masses and light gas planets with Earth-like masses.

Unfortunately, some children do not have a warm home. We thus predict that planets with no parent star can be found. Their detection would clearly be difficult. Orphan planets may also exist and we urge observers to look for them. They may be found around the location of certain supernovae type II that destroyed the central star, if they survived the catastrophic event. Note that similarly some people kill their children before performing suicide. Sometimes rejected children are adopted by other families. Therefore, we suggest that planets may be ejected from their parent system and join another stellar system, which may have planets of its own. Note that planets can be ejected from their parent systems [44]. Likewise, we believe that 'solitary', 'orphan' and 'adopted' moons should exist.

4. Discussion

We are the first to admit that the results presented in this paper are quite shocking and difficult to believe and to understand for any astrophysicist, scientist or layman. A remarkable similarity was found between the astronomical objects observed in the night skies and humans. If one or two features were alike this could be explained by a coincidence. Table 1 demonstrates, however, that the analogy between people and stars is quite extensive. This striking similitude could be attributed to the fruitful childish imagination of the author and regarded anecdotal and childish, but it is also numeric. The distributions of star multiples in a few thousand bright nearby stars and number of adults in American households are compatible (Fig. 1), and the averages of the two are almost identical (Section 2.1). Fig. 2 shows that the distributions of boys (or girls) and gas (or solid) planets have a similar decreasing trend and we believe that by taking into account the selection effects involved in the detection of extra-solar planets and better statistics, the resemblance significantly improves. From numerical simulations we estimated that the three pairs of distributions are respectively significant at confidence levels of 97.4, 63.1 and 85.1% (appendix). Combining these figures with the assumption that they are independent in each other, we conclude that our results are significant at a confidence level of about 99.9%.

It is pointed out that we do not think that the matching between astronomical objects and people is absolute. One should not expect to find a specific star for himself. In fact, we can point out numerous differences between stars and people. In example, the number of stars in the observed sky, which was estimated as 10^{22} [45] is much higher than the world population, which accounts to about seven billion [46]. Another example is that stars are nearly spherically symmetric while (most) people obviously don't. In addition, the analogy between Astronomy and people is not precise and sometime seem to depend on interpretation. We are not sure whether the best match of moons is with pets or grandchildren (Section 2.3). Yet, the extensive resemblance between the Astronomy world and humans is disturbing and requires an explanation. One may argue that Nature acted the same way when the universe, the stars and people were created. This is a nice solution however we think that our results bear a more profound meaning. We believe that the ideas presented in this work strongly suggest that the human perception is linked with the universe and undetached from it. The whole manifested universe and in particular the human society are understood as reflections and expressions of the unmanifested consciousness (the singularity).

We believe that the observations of the current universe should reflect the present status of human society and changes in time seen in the humanity will have equivalents in the observed sky. The accelerating pace of modern life is such an example, which can be related with the universal acceleration [47-48]. This unexpected finding was connected with dark energy. Dark energy and dark matter are currently the major problems in Astrophysics and probably in Physics as well. In the next papers of the series we offer a simple explanation of these riddles and further argue that the universe is not real, but it is a reflection of the human mind, something like a hologram, an allegory for the human consciousness!

5. Summary and conclusions

1. A fascinating similarity between stars and the human society was found. This resemblance is expressed by small and massive grouping, by the presence of offspring, by the existence of two genders, by making an analogy between supernovae and suicide attempts, by associating the human birth and the bellybutton with the time the universe became transparent to light and with the cosmic microwave radiation and much more. We propose to open a novel research field, which links Astronomy / Astrophysics with the human Society and we alias it Astro-Sociology.

2. We demonstrated that the analogy between stars and people is also quantitative. The distribution of star multiples is consistent with that of US households, and they have almost the same mean value. In addition, we found that the distribution of boy (or girl) members under 18 years old in American families has the same trend as gas (or solid) planets in stellar systems, and clearly better statistics and / or a detailed study of the selection effects involved in their detection should improve the fit. Statistical tests show that our results are significant at a confidence level of about 99.9%.

3. Some of the results obtained in this work were concluded using the USA statistic. This is a large population with typically several tens million items of the specific parameter examined. Our findings should be tested in the future by other Earth populations and optimally by its global statistic. While the statistical sample utilized for the distribution of stars mentioned in this work is relatively large – a few thousands, the number of known exo-planets is still relatively small – a few hundreds. Our findings should be re-examined when this statistic significantly improves by current and future ground-based and space missions.

4. The analogy between the two disciplines yields numerous predictions. According to our ideas, the total number of O-A stars should be nearly equal to the sum of F-Y stars. About a third of all stars should have planets. The average number of planets in host stars is predicted to be close to two, slightly higher in binary systems and somewhat lower around single stars, with a preference to hot stars. A mean of about 1.4 planet members is predicted for stars with solid planets, and alike for gas planets. We thus estimate that about a quarter of gas planets are missed by current observations. In this context we believe that the solar system with its eight planets is extra-ordinary rich, but it supports our prediction for a similar frequency of gas and rock planets around host stars. In addition, the statistic of the systems with the 38 lightest (solid) planets, where presumably all planets are detected, is very consistent with that of American girls.

5. We vision the presence of twin planets that share the same orbit. The statistic in humans suggests that among the 429 known planets, about a dozen could have a twin planet. Imaging seems to offer the best method to find such systems, but unidentical planets could also be detected by transits. We also predict the presence of abrupt eruptions in planets, which we name ‘planovae’. These may be followed by jets. Among all predictions given in this paper, the suggested presence of twin planets and the proposed equality between hot and cool stars seem the easiest to test with current technology, while most others may take many years or even decades to confirm or refute.

6. If the ideas suggested in this paper are validated, they would have a strong impact on all theories of stellar and planet evolution. We believe that the dominant channel for planet formation requires a binary system, which consists of a hot and a cool star, and that nearly all planets should evolve into stars.

7. The similarity between Astronomy / Astrophysics and Sociology, which was presented in this paper, suggests future fruitful mutual feeding between the two fields. New ideas for research in Sociology may be taken from Astronomy / Astrophysics and vice versa.

8. The results of this paper strongly suggest that the universe is not detached from the human consciousness as implied from the first paper in the series. Further implications of this concept are discussed in the next papers.

Acknowledgement

It is a pleasure to thank Shlomo Heller (Kartar) for many stimulating discussions and Mercedes T. Richards for a very useful correspondence.

References

[1] Retter, A., & Heller, S. 2010, ApJL, submitted
[2] Retter, A., 2010a, ApJL, submitted
[3] Retter, A., 2010b, in preparation
[4] Nordlund, A., 2009, ApJL, submitted (arXiv: 0908.3479)
[5] Kaler, J.B., 1989, “Stars and their Spectra”, Cambridge University Press
[6] Bohm-Vitense, E., 1989, “Introduction to Stellar Astrophysics”, Cambridge University Press
[7] Eggleton, P. P., Tokovinin, A. A., 2008, MNRAS, 389, 869

[8] US Census Bureau [http://www.census.gov/population/www/socdemo/hh-fam/cps2008.html], 2008, tables AVG1, AVG2, AVG3, C9, F1, H2,
[9] Bode, M.F. & Evans, A., 2008, "Classical Novae", 2nd ed., Cambridge Astrophysics Series, No. 43, Cambridge: Cambridge University Press
[10] Mauche, C.W. 1991, "Accretion Powered Compact Binaries," Proc. 11th North-American Workshop on Cataclysmic Variables and Low Mass X-Ray Binaries, Santa-Fe New-Mexico
[11] http://en.wikipedia.org/wiki/Binary_star
[12] Wilson, B. & Smallwood S., 2008, "Age differences at marriage and divorce", http://www.statistics.gov.uk/articles/population_trends/PT132AgeDifferencesArticle.pdf
[13] Hut, P. & Bahcall, J.N., 1983, ApJ, 268, 319
[14] Eggenberger, A., Udry, S., & Mayor, M., 2004, A&A, 417, 353
[15] Wolszczan, A. 1994, Sci, 264, 538
[16] Xie, J.W., Zhou, J.L, & Ge, J., 2010, ApJ, 708, 156
[17] Eggleton, P. P., 2009, MNRAS, 399, 1471
[18] Schneider, J, 2010, "The Extrasolar Planets Encyclopaedia" (http://exoplanet.eu/)
[19] http://hypertextbook.com/facts/2002/DavidEngel.shtml
[20] Ida, S. 2010, personal communication
[21] Kenyon, S. 2010, personal communication
[22] Bowler, B.P. et al. 2010, ApJ, 709, 396
[23] http://en.wikipedia.org/wiki/Natural_satellite
[24] Cox, J.P., 1980, "Theory of Stellar Pulsation", (PSA-2) NJ, Princeton University Press
[25] Woosley, S.E. & Weaver, T.A., 1986, ARA&A, 24, 205
[26] Hansen, C.J., Kawaler, S.D., 1994, "*Stellar Interiors: Physical Principles, Structure, and Evolution*", Birkhäuser, p. 28
[27] Sun, Q., Townsend, M.K, Okereke, O. I., Franco, O.H, Hu, F.B., & Grodstein F., 2009, BMJ 339, b3796
[28] Hubble, E. 1929, '*Proc. of the National Academy of Sciences of the United States of America*, 15/3, 168-173
[29] Spergel, D.N. et al. 2003, ApJS, 148, 175-194
[30] Guth, A.H., 1981, Phys. Rev. D, 23, 347
[31] http://en.wikipedia.org/wiki/Universe
[32] http://en.wikipedia.org/wiki/Planet#Solar_System
[33] Whipple, F.L., 1964, PNAS, 52, 565
[34] http://multiples.about.com/od/funfacts/a/twinbirthrate.htm
[35] Knutson, H.A., Charbonneau, D.A., Lori E., Fortney, J.J., Agol, E., Cowan, N.B., Showman, A.P., Cooper, C.S. & Megeath, S.T. 2007, Nat, 447, 183
[36] Rowe, J.F. et al. 2010, ApJL, submitted (arXiv: 1001.3420)
[37] Giuppone, C.A., Beaugé, C., Michtchenko, T.A., & Ferraz-Mello, S. 2010, MNRAS (arXiv:1004.0726)
[38] Goździewski, K., & Konacki, M. 2006, ApJ, 647, 573
[39] http://www.iridium.com/About/CompanyProfile/GlobalNetwork.aspx
[40] Armitage, P.J. 2007, arXiv:astro-ph/0701485
[41] Perets, H.B. 2010, arXiv: 1001.0581
[42] Livio, M., Soker, N., 1984, MNRAS, 208, 763
[43] http://en.wikipedia.org/wiki/Commune
[44] Shikita, B., Koyama, H. & Yamada, S. 2010, arXiv: 1001.3308
[45] http://en.wikipedia.org/wiki/Observable_universe
[46] http://www.google.com/publicdata?ds=wb-wdi&met=sp_pop_totl&tdim=true&dl=en&hl=en&q=world+population

[47] Riess, A. et al. 1998, ApJ, 116, 1009
[48] Perlmutter, S. et al. 1999, ApJ, 517, 565
[49] http://www.ciphersbyritter.com/JAVASCRP/NORMCHIK.HTM#KolSmir

Appendix – significance estimates

In Section 2.1 we discussed the distributions of adults and stars and concluded that they are alike (Fig. 1). In Section 2.2, we derived the distributions of boys and gas planets, and showed that even without considering observational select effects they have a similar decreasing slope. The distributions of girls and solid planets are also alike (Fig. 2). The purpose of this appendix is to check the significance of these results. One may try to use the Kolmogorov-Smirnov (KS) probability test [49] to check whether two different distributions are consistent with each other. However, this test is adequate for a large number of points that can get continuous values, while our relevant distributions only have a few discrete points. Therefore, we decided to check the significance of our results by extensive Monte Carlo simulations.

Given a distribution, $Pa = [Pa_1, Pa_2 \ldots Pa_n]$ for bins [1, 2…n] that complies $Pa_1 + Pa_2 + \ldots + Pa_n = 1$, we posed the question: "what is the chance probability to obtain by random a second vector distribution, $Pb = [Pb_1, Pb_2 \ldots Pb_n]$ with $Pb_1 + Pb_2 + Pb_n = 1$?" We defined a difference parameter δ (Pa, Pb) = sqrt (Σ $(Pb_i - Pa_i)^2$), for i=1…n. For the cumulative distributions of the first pair - adults ([0.209, 0.820, 0.949, 0.990, 1]) and stars ([0.321, 0.800, 0.914, 0.958, 1]), n=5 and δ=0.123; for the second couple - boys ([0.476, 0.845, 0.966, 1]) and gas planets ([0.777, 0.936, 0.990, 1]), n=4 and δ=0.315, and for the third – girls ([0.49, 0.854, 0.969, 1]) and solid planets ([0.526, 0.658, 0.895, 1]), n=4 and δ=0.213. For each test we built one million random distribution samples with noise taken from the data using a few different methods. First, the mean and standard error of the Pa data were found, and then for every simulation we raffled Gaussian distributed noise and obtained n random numbers around the data mean. Negative numbers were shifted upwards and given a random number around 0.01, and the total simulation vector was normalized to 1, so $Ps\_in_1 + Ps\_in_2 + \ldots Ps\_in_n = 1$. From this initial vector the cumulative distribution was calculated to obtain the final probability vector $Ps = [Ps_1, Ps_2 \ldots Ps_n]$. The difference parameter between this simulated distribution and the first given distribution, δ (Pa, Ps), was calculated. For one million simulations, one million values of this parameter were obtained. The significance level was defined as the ratio between the number of values higher than the observed difference parameter, δ (Pa, Pb), calculated above, to the total simulations number. This test suggested that there is 98.9% chance probability that the first pair is significant, 81.7% for the second couple and 92.7% for the third couple. Combining the three values with the natural assumption that all are independent in each other yielded a significance level of ~99.99%.

The highest peak in both distributions of the first pair is at the second bin (2), while it is at the first (1) for the second and third couple. We repeated the simulations, giving a preference for the highest probability number in each simulation to be either at bin 1 or 2, while all other n-1 values were randomly shuffled in the remaining bins. The results of these simulations were that there is 97.4% chance probability that the first two distributions are consistent with each other, 63.2% for the second couple and 85.1% for the third. These values were adopted in the paper, and they mean that the first pair is highly significant, the third is somewhat significant, but the second is not. This is a conservative approach, because a priori given the distribution of adults (or boys or girls), the distribution of stars (or gas or solid planets) could be completely different, say with all multiples above n=5, and there is no reason why the highest peak in the astronomical distribution would be either at 1 or 2 as in humans. From the combination of these three values we obtained a significance level of ~99.9%.

We performed another test that clearly underestimated the significance level of the results. We imposed the highest probability value exactly as observed - in the second bin for the first pair of distributions, and in the first bin for the other cases. The resulting significance levels respectively were 90.8, 34.2 and 63.2 %. These simulations confirmed that once the distribution of adults is given, there is a very low chance probability to randomly obtain the observed distribution of stars.

Another test we applied was to differently model the data. We either fitted a 3D polynomial to the data or arranged the data points in decreasing order and fitted a 2D polynomial to them. The standard errors were found from the difference between the fit and the data. Then we raffled random numbers according to the standard error and added them to the fit to obtain n random numbers. As above, negative values were given random numbers around 0.01, and the total simulation vector was normalized to 1. The data bins were either randomly shuffled or given some preferences as discussed above. The cumulative distribution was calculated to obtain the final simulation vector, and the difference parameters, δ (Pa, Ps), was calculated. The outcome of these simulations was very similar to the previous results with typical differences of tenths percent for the first pair, and a few percent for the other couples, leading to final combined numbers very close to those cited above.