THE CREATED KIND - NOAH'S DOVES, RAVENS AND THEIR DESCENDANTS

EWAN R. J. MORE B.Sc. P.G.C.S.E.
17 BLAMEY CRESCENT, COWDENBEATH
FIFE, KY4 9JS, SCOTLAND
EMAIL: EMORE@COMPUSERVE.COM

KEYWORDS

Robertsonian translocations, Biblical kind, Corvidae, Columbidae, yonah, oreb, hybridisation, hybrid infertility, centric fusion, chromosome polymorphism.

ABSTRACT

The purpose of this paper is to look at the Biblical kind, focussing on the only two known kinds to be on the Ark, the dove and the raven. They give an opportunity to clearly identify the way in which a biblical kind has developed into races in the Post-Flood era. The two bird groups are considered with reference to hybridisation records, karyotypes and genetic variation. A fundamental concept to this paper is the respective authorship of Genesis, Deuteronomy and Leviticus. There is therefore a brief review of the role of Moses, as the editor of documents handed down from the Patriarchs.

INTRODUCTION

Amongst creationist biologists there has been much discussion of the hebrew word "*min*" which is translated "kinds". The word has been studied and there seems little doubt that it is used as distinct unit of classification [28]. There is slight problem when the word is used in Leviticus and Deuteronomy – here it is used in a context which is translated "*in all Its kinds*". This may be a description of different races, which have developed from the original Genesis kind. In making this claim it is important to bear in mind the role of Moses. If Moses wrote the whole of the Pentateuch then we would expect a unity of style and consistency of language. If however Moses was the editor of earlier accounts kept by the patriarchs, then there would be a development in the use language and we would expect a difference in style. There appears to be evidence of this in Genesis itself, where the "toledoth" may in fact be "colophons". These colophons describe the contents as the legal document of the patriarch [49]. This Mosaic editing is vitally important in understanding the change in use of the word "min". In discussing the biblical kind Professor Payne assumes the Mosaic authorship and hence assumes that the word is used 30 times by the one author. This leads inevitably to its plural (plural by context) use being interpreted as contemporary with it's use in the singular. It leads to confusion and wrongly suggests that the usage in the opening chapters of Genesis is as a collective noun.

Most creationists acknowledge that there has been change within the kind but differ from evolutionary biologists by setting limits on that change [31]. The limitation is not purely lack of genetic variation, passive. It is also proactive involving repair mechanisms which prevent damage to the DNA code and mechanisms suppressing mutant mRNA [30]. Despite the acknowledgement of limited change, creationists have sought to identify the biblical kind. Dr. Kurt Wise has sought to further the identification of the kind through phletic discontinuity, which uses a mixture of scripture and scientific investigation [57].

It is extremely pleasing to note that Dr. Wise has also made the observation on which this paper is based. Namely, that scripture strongly implies that "the raven (Genesis 8:7) and the dove (Genesis 8:8-12) must be separated by a real phyletic discontinuity, and reside in separate holobaramins. Since two (or seven) of each land baramin were taken onto the ark, their separate mention indicates that the dove and raven are from different holobaramins ..."

References to the raven and the dove are the closest the Bible comes to giving examples of the originals of plants and animals created by God. When Noah took the animals onto the Ark he was sent two of each animal kind (seven of clean animals) and seven birds of each kind. Only two of the kinds are specified: the dove and raven. If the pigeon has given rise to the Columbidae, then it has been extremely successful giving rise to about 295 species. It would also include the most successful bird ever, the passenger pigeon, which formed huge flocks numbering millions [58]. If the Corvidae are descended from the ravens then they too have been extremely successful giving rise to 105 species [58].

In naming these bird kinds it is important to distinguish between current descendants of these kinds and the original kinds. For example what did Noah's dogs look like? It is known that the coyote, jackal, dingo, wolf and Bengal fox, are all able to interbreed with the domestic dog [22], [35], [24]. It can be expected that they descended from Noah's dogs, so what did those dogs look like? Well they would have had some dingo in them, wolf, coyote and Bengal fox! As these races of dog formed from Noah's pair, they became increasingly homozygous at the expense of their genetic diversity (heterozygosity). As isolated populations they represent a small part of the original gene pool. As we go back in time, hererozygosity increases to the point where the original animals are not true breeding in the modern sense. The same would apply to the raven and the dove.

There are two components necessary to evolutionary theory (leaving aside the spontaneous generation of life), one is mutation and the other, natural selection. Random mutations are viewed as generating the genetic variation on which natural selection works, giving rise to "vertical" evolution. Natural selection then works on these random mutations to give us the organisms we see today. The belief that random mutations are continually topping up the genetic variation of a population leads to the neglect of conservation mechanisms. The creationist viewpoint is much more critical of mutations as a source of genetic variation and would draw distinctions, which make mutations useless as a source of genetic variation. Of far more importance are mechanisms, which conserve and exploit the genetic variation given by our Creator.

BIBLICAL TEXTS

The Biblical texts were examined to see just how closely it is possible to identify today's ravens and doves with the Old Testament examples. Would the assertion that today's doves and ravens are direct descendants of the *oreb* and *yonah* survive a detailed study of the texts?

There are sufficient clues (see fig.1) to identify today's ravens and doves with the *oreb* and *yonah* of the Hebrew text. The *oreb* is described as being a meat eater, black in colour, living away from human habitation in wasteland and it's peculiar habit of pecking eyes out, is also described. The *yonah* have the sheen on their plumage and their characteristic call described, their presence on window ledges and their habit of nesting among rock is also given. The descriptions of the *oreb* and *yonah* allow us to identify them very closely with the present day raven and dove. We also have evidence of *C. livia* (Rock Dove) in the Ancient Near East from cave remains [25]. The Rock dove has undergone considerable alteration in captivity, where it is better known to us as the domestic pigeon. When it escapes and becomes feral, natural selection would appear to undo man's artificial selection, to regain the original rock Dove [25] [26]. If the Old Testament does actually record our earliest history, (this author believes the patriarchs, including Noah may well have contributed to it [49]) then this enables us to identify the latter day ravens and doves as descendants of their Old Testament ancestors carried on the Ark.

The raven and dove in the Old Testament

Oreb - translated as raven, earliest occurences and attributes
Genesis 8:7 - raven sent out from Ark
Leviticus 11:15 - every raven after his kind
Deuteronomy 14:14 - every raven after his kind
1 Kings 17:6 - The ravens feed Elisha
Job38:41 - ravens feed on meat
Psalm 147:9 - ravens given food by God
Proverbs 30:17 - raven picking out eyes
Song of Solomon - raven black in colour
Isaiah 34:11 - raven living in wasteland
Luke 12:24 - consider the raven ...

Yonah - translated as dove, earliest occurences and attributes
Genesis 8:8 he sent forth a dove
Psalm 68:13 - as the wings of a dove covered with silver and the feathers with pure gold
Song of Solomon - doves eyes
Isaiah 38:14 I did mourn as a dove
Isaiah 59:11 - mourn as doves
Isaiah 60:8 - as the doves (fly) to their windows
Jeremiah 48:28 - doves nesting in rocks
Ezekiel 7:16 - doves of the valleys mourning
Nahum 2:7 - doves tabering on their breasts

Old Testament words translated as doves or pigeons

Yonah (Heb.) - dove

Gozal - a young bird
Genesis 15:9 - translated as a young pigeon
Deuteronomy 32:11- translated as a young eagle

Ben yonah - translated as a young pigeon
Leviticus 1:14 - or young pigeon
Leviticus 5:7- two young pigeons

Fig. 1

While authenticating the claim that the *yonah* and *oreb* are identifiable with today's raven and dove, I found three which might allude to the development of races. The first is the use of the Hebrew "sons of the dove", *ben yonah,* which means young pigeons. This may be a reference to the origin of pigeons, descended from an ancestral dove. The second text may be a recognition of the development of different breeds of raven, post-Flood. In Genesis 8 we read of the raven as a kind; yet some generations later in Leviticus 11 and again in Deuteronomy 14 we read of "every kind of raven". There would seem to be a recognition of different races of raven in the subsequent texts. The races possibly formed by adaptive radiation. If this is the case then other birds mentioned in the same passage may have developed into recognisable races or breeds by this time. The third text is from the Old Testament where the word "breed" is used (i.e. translated) in describing the rams of the breed of Bashan. The word translated breed is actually *ben* - son(s) of. Is the Hebrew language recognising the development of breeds but retaining a reference back to the original stock?
To summarise, we have evidence that the *oreb* and *yonah* of the Old Testament can be identified with today's raven and dove. In addition, we have possible allusions to both doves and ravens developing into different races and a possible reference to an early breed/race of sheep characteristic of Bashan.

Dove + raven hybrids

Since evidence indicated that the Biblical raven and dove are related to the dove and raven of today, the next step was to determine how closely the different doves are related, likewise the ravens. This was done by analysing hybridisation records. I studied hybridisations in doves and crows because if hybridisation is possible, a close relationship with a compatible genotype is suggested. This indicates a common ancestor and within the biblical framework, common descent from the Ark in the post-Flood world.

The list of hybrids amongst doves and pigeons (the distinction is rather arbitrary) is extensive [23], [19], [33], [17], [38]. Approximately 70 species of dove have been reported as hybridising. The domestic pigeon *Columba livia* alone has approximately fifteen different species with which it can hybridise. Given the profusion of information on dove and pigeon hybrids it was deemed more profitable to focus on hybrids between different genera (intergeneric). This approach commended itself for two reasons.

Firstly, it can be assumed that the species belonging to a genus are fairly closely related and interspecific hybrids relatively common. Intergeneric hybrids, however, tie what should be fairly distant groups together. Remember that the species is the basic taxonomic unit of evolutionary biologists. It is defined as animals or plants, which can interbreed producing fertile young. This needs some modifications because of "exceptions". An example is the red wolf. There are two opinions in the US – one that it is a species in its own right the other that it is a hybrid and does not deserve the status of a species. At stake is a multi-million dollar conservation programme [56]. The genus is supposed to represent a more distant relationship and hence should be more clear-cut (according to evolutionary theory). The fact that hybrids do take place between genera, is therefore very significant and probably of more importance than interspecific hybrids. (Whilst the genus and species levels hold some interest for the creationist biologist especially the "exceptions", it is the Biblical kind which is of the greatest interest.)

A second reason for choosing inter-generic crosses was that the hybrids between species of the same genus were too numerous to present in a meaningful form. In grouping the doves, I used the criteria advocated by Scherer, namely that if an intermediate hybrid links two types of bird for which evidence of hybridisation is lacking, they be considered as belonging to the same kind [45]. Using this criterion it was possible with records of hybridisations, mostly from Annie Hall, to tie eleven genera of pigeons and doves together. This is recorded in Fig. 2, where the extent of hybridisations is represented as good fertility, some fertility (usually male) and poor fertility/infertility or no information on fertility. It has to be said that these hybridisations are only a summary and should not be considered exhaustive. An absence of hybridisation information does not mean hybridisations are not possible. The hybrids recorded tend to focus on the most commonly kept genera. This becomes even more apparent when one is looking at ravens and their relatives.

For ravens and their relatives this was more difficult because they are not kept in captivity to the extent that doves and pigeons are. It was possible however to form two groups, each of four species [48], [23], [12] shown in Fig. 3.

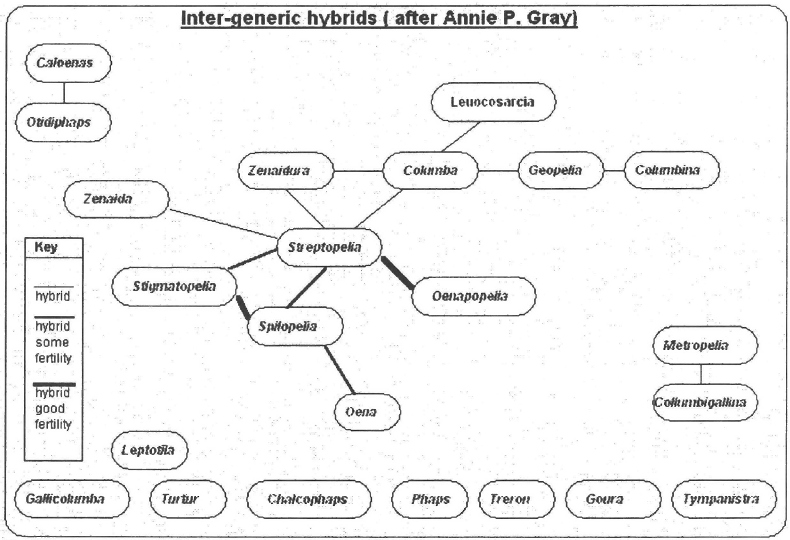


Fig. 2

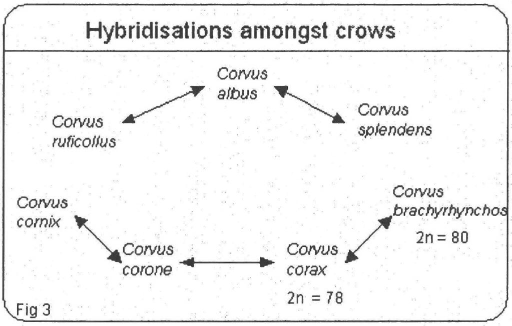


Fig 3

These diagrams are the first steps in identifying the created kinds for the dove and raven. They can do this only in so far as the descendants can be identified. Using the orchard model the created kind started as a thick trunk and has now developed into branches. It is important to note that the y-axis is time. Historically the kind was a single trunk when created. Now it is several isolated branches, see Fig 4.

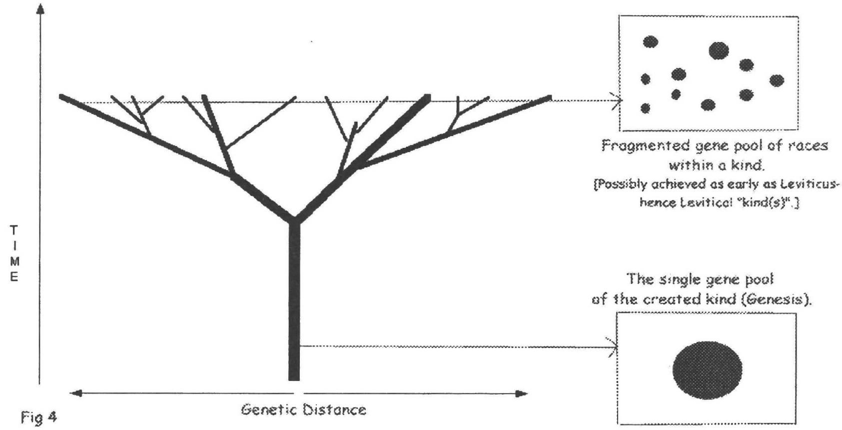


Fig 4

Karyotypes and changes

The chromosome number of the hybridising parents was not always the same. Yet although the chromosome number was different they still produced viable hybrids! A similar incompatible chromosome number exists in a reported hybridisation of a red fox and a domestic dog [45]. In checking this report I discovered that there was no definite chromosome number for the fox; the karyotype was variable [55].

A possible reason for this are chromosomal changes called Robertsonian rearrangements [36]. What happens in a Robertsonian change is that two non-homologous, acrocentric chromosomes fuse together, to produce a metacentric (see Fig. 5). This has the effect of reducing the number of chromosomes, whilst maintaining the amount of DNA. It results in the production of two types of gametes, one normal and one with the Robertsonian rearrangement. A fused chromosome does not prevent the production of oocytes but may lead to a shorter reproductive lifespan in heterozygotes (one fused chromosome). The homozygous female (with two fused chromosomes) does much better, having a selective advantage over the heterozygote [53]. Spermatogenesis does not appear to be affected in heterozygotes [21]. Where the fusions are more complex however spermatogenesis and oogenesis are adversely affected. Studies in sheep have shown no adverse effects on the fertility of heterozygous rams when mated with normal ewes, indeed there may even have been a slight increase in fertility [14].

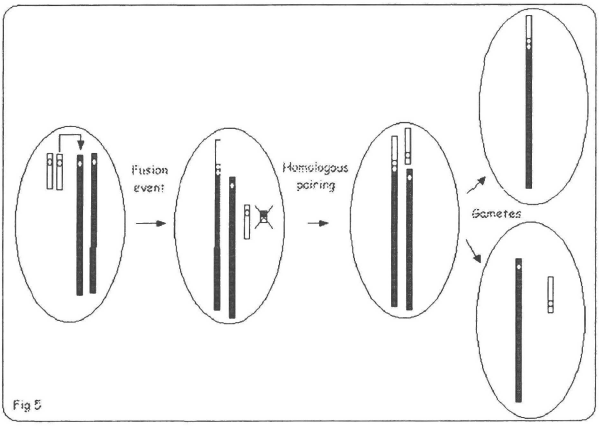
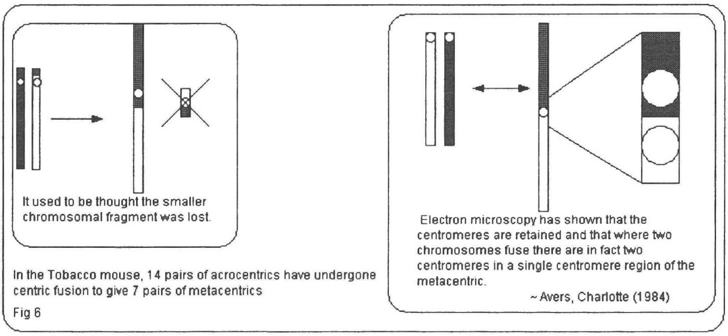


Fig 5

Fission and fusion describe the chromosomal rearrangements whereby chromosomes are split and fused respectively. At one stage it was believed that there was no real evidence of fissioning and that, over time the chromosomal number would be reduced [59]. This meant that fusion was considered the norm and ancestral forms were assumed to have high chromosome numbers. Electron microscopy however has revealed that the centromeres of acrocentric chromosomes are conserved and not lost, as was previously believed. This opened up the possibility of fission, [6] making fusion of chromosomes a reversible arrangement of the DNA (see Fig. 6). Robertsonian rearrangements are very common in the animal kingdom. They have been documented in the least cotton rat [4], various foxes [54], pigs [34], vultures [13], common shrew [20], red fox, tobacco mouse and ground squirrel [36], the impala and cattle [60].



It used to be thought the smaller chromosomal fragment was lost.

Electron microscopy has shown that the centromeres are retained and that where two chromosomes fuse there are in fact two centromeres in a single centromere region of the metacentric.

~ Avers, Charlotte (1984)

In the Tobacco mouse, 14 pairs of acrocentrics have undergone centric fusion to give 7 pairs of metacentrics

Fig 6

With the pigeons, for which more information is available, several examples of differences in chromosome number came to light. The karyotypes of birds are notoriously difficult to establish, due to the presence of numerous micro-chromosomes [46] [47]. Changes in karyotypes have been interpreted as evolutionary evidence relating to speciation. Whilst this would appear to represent a scaling up of micro-evolution to macro-evolution, a critical examination of the evidence undermines this theory. The rearrangement of DNA into fewer or more chromosomes does not actually create new genetic information.

As has been noted, many of the dove genera currently recognised can interbreed. This is indicative of a common ancestor (from the Ark). Upon closer examination it is extremely interesting to note that the Bengal green pigeon has 37 pairs of chromosomes [5], the Picui dove 38, the Wood pigeon 39 and the Domestic pigeon 40 [46]. There have obviously been chromosomal rearrangements if all four doves indeed have a common ancestor. Further evidence of chromosomal rearrangements is found in the crosses between doves with different chromosome numbers. In the cross between *Columba palambus* and *Columba livia* (see Fig. 7) there is a difference of one chromosomal pair. In the case of *Columba livia* and *Columba picazuro* a difference of two pairs of chromosomes exists. That the two are compatible is an indication that they have the same genetic information but organised into a different number of chromosomes.

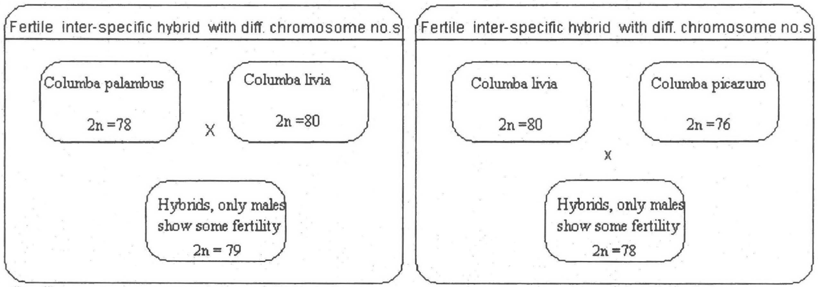


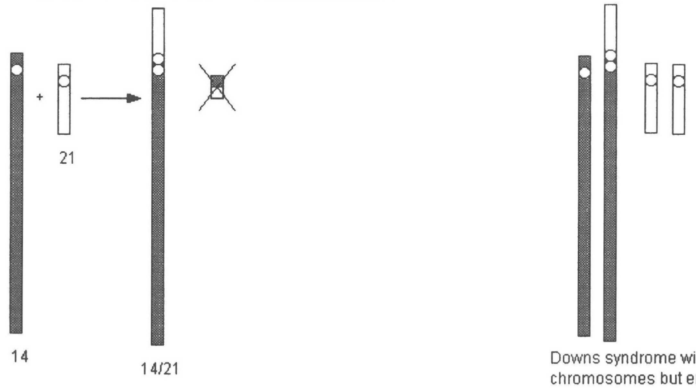
Fig 7

That animals with different chromosome numbers can interbreed is indicative of the similarity of the genotype, albeit arranged into a different number of chromosomes. There are numerous examples of animals with different chromosome numbers hybridising. The Grevy zebra has 17 pairs of chromosomes while the donkey, with which it can hybridise, has 31 pairs of chromosomes [9]. Whilst this hybrid is generally described as sterile in a way similar to the mule [52], similar disparities exist which do not result in sterility. As reported by Meylan there are two species of Tobacco mouse [36], which have a chromosome number of 26 and 40. Hybrids of the two are still fertile despite the difficulties involved at meiosis. So animals with a different karyotype may produce fertile hybrids. This raises the old question of fertile mules, which has been supported by Anderson [3] and refuted by Bernische [10].

In the ravens descendants are there examples of Robertsonian rearrangements? One example is *Corvus corax* which has 39 pairs of chromosomes while *Corvus brachyrhnchos* has 40 pairs of chromosomes [46]. This is indicative of chromosomal rearrangements. Further evidence comes from the ability of *Corvus corax* and *Corvus brachyrhnchos* to interbreed.

The evidence for chromosomal rearrangements in birds is widespread. Although this is usually interpreted as evidence of evolution, the evidence itself is sound enough but the interpretation is biased. This paper would suggest that these rearrangements of the genome be regarded not as the result of random mutations but as having a functional significance. The whole concept of mutations as being random is questionable in any case, and I would add Robertsonian rearrangements to a growing list of random changes to the genome which are having to be reconsidered. There is a growing body of evidence that what used to be considered random mutations are "directed" to some extent. This has been demonstrated with bacteria which shows resistance to phage and streptomycin, generated without exposure to any selection pressure. Changes to phage and streptomycin resistance are not expressed until several generations after the DNA sequence has been altered [15]. Work on *E. coli* indicates a similar directed mutation event [50]. That we have had too simplistic a view of the genome is becoming apparent as apparently useless DNA has proved to have subtle and important regulative functions [37]. We would do well to think carefully about the significance of seemingly random events in the genome.

That Robertsonian rearrangements are not random is borne out by the affinity of specific chromosomes for each other. It might be argued that within a genome there may only be two acrocentric chromosomes but in humans there are four chromosomes known to fuse. Chromosome 14 and 21 form just such a pair. They have a tendency to fuse by Robertsonian rearrangements (see Fig. 8). Were this rearrangement to occur in the gametes of two individuals who conceived a child, that child might develop normally with the information of 46 chromosomes contained on 44!



Robertsonian fusion of human chromosome no. 14 and 21 has been documented (Conner, 1991)

Downs syndrome with 46 chromosomes but enough of 21 on a fused chromosome to cause Downs.

Fig. 8

These conservation mechanisms are valuable during times of habitat stability. They are a disadvantage however when the habitat changes. There are some indications that environmental stress can cause rearrangements releasing genetic diversity.

Genetic advantages

Given the reversible nature of these rearrangements what are the consequences for the organism? When we actually consider the consequences of fusion or fissioning the answer is actually quite profound!

Looking first at the consequences in terms of permutations, fusion results in fewer small chromosomes and more large chromosomes. The consequences of this is that there are fewer combinations possible and the genetic variation is not exposed to the pruning effect of natural selection to the same extent. In other words, there is a tendency towards conservation of genetic variation.

The opposite is the case when there are more small chromosomes and fewer large ones. This results in a quicker exploration of genetic variation by independent assortment and would be ideally suited to conditions of rapid change [6]. If each pair of chromosomes in the diploid nucleus contained one pair of heterozygous alleles, then 2 to the power of *n*, where *n* is the number of chromosomes, shows the combinations possible. The advantage of fusion; a high chromosome number, is dramatically shown in Fig.9. Here we see the permutations double with the addition of an extra chromosome. The chromosome numbers 37, 38, 39 and 40 were chosen because this is a pattern seen in the Bengal green pigeon, the picui dove, the wood pigeon and the domestic pigeon respectively. It would appear then that this is a possible strategy for conservation of genetic variation and its rapid release: fusion and fission.

As noted earlier the problem of generating new centromeres during fission tended to direct attention towards fusion. Although most authors have described fusion events, Todd has gone against this trend by describing fissioning [51]. What is particularly interesting is that he has sought to tie it in with adaptive radiation. This is getting close to the proposal of this paper that fission is an adaptation allowing exploitation of genetic variation!

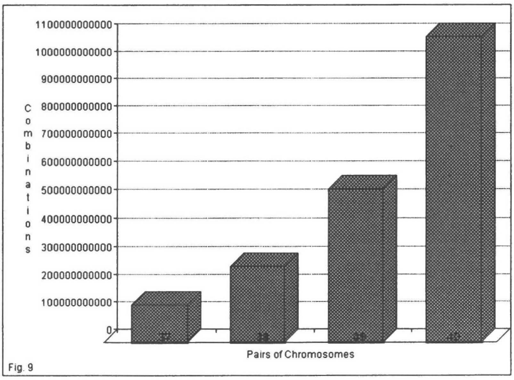


Fig. 9

Barriers to breeding

In a discussion of chromosomal rearrangements as a strategy adopted to both conserve and exploit genetic variation, it is important to address the problem of infertility. Within the Doves and Pigeons (there is no real distinction) we have information on hybrids between several genera, which demonstrates their closeness. Some of the hybrids are infertile, some show limited fertility and some show good fertility. Of those which show limited fertility, it is usually the male hybrid which is fertile in backcrosses. Evidence that there cannot be a genetic basis for this comes from the gametes of the male and female, which will encounter similar problems in meiotic division. So if the production of gametes has the same degree of difficulty in both sexes where does the difference lie?

That the male shows some fertility may be due to the immune system of the female being able to accommodate the antigens of the hybrid more easily. Hybrids are likely to show hybrid vigour in the immune system and therefore produce antigens more readily. In the hybridisation of sheep with goats the hybrids were not carried to full term, being resorbed. Injections of blood (intramuscular) prior to mating seemed to have the effect of desensitising the female in some way allowing the carrying of the hybrids to full term [1]. This work indicates the role that the immune system plays in allowing placental mammals to accommodate the foetus, which will often have different antigens. Although it is generally believed that the fetal and maternal blood never mix, this is incorrect. In a recent Scientific American article the mixing of fetal and maternal blood was discussed [8]. In a follow up to this work the results could not be repeated [2]. This was interpreted as being a result of the individual sheep having different antigens / immune responses. This is a point we should bear in mind - just because certain individuals of the same species are capable of hybridising does not mean that others individuals would be capable of hybridising.

Should this phenomenon be widespread then it may well be that the inability to hybridise may, in some instances, be due to immune system reactions similar to the human Rhesus factor. Given the genetic basis of the immune system, hybrid vigour of the immune system is to be expected in inter-generic hybrids. Such a heightened immune system would lower the fertility of females carrying the developing embryos. Male hybrids however would have a greater degree of fertility in a backcross because they would be using non-hybrid vigour females for egg laying. The backcross female would be suffering heterosis by comparison and would be more accommodating to backcross embryos.

Research on humans has been extensive in the field of infertility and has demonstrated the role of the immune system in permitting or inhibiting conception. The human reproductive tract can produce antibodies locally in response to antigens. This has been demonstrated by the intravaginal inoculation of women with polio virus [44]. The female genital tract has IgA, IgG and IgM present. These antibodies are present at different concentrations throughout the menstrual cycle but can be as high as 280 mg/dL of IgG, 180 mg/dL of IgA and 71mg dL in the uterus. Antigens on sperm were first detected in 1970 [29]. They are now known to produce antisperm antibodies from all three classes [44]. Antibodies can be produced by the female reproductive tract and appear to be responsible for some cases of infertility. They do so by reducing the ability of sperm to penetrate cervical mucus and have been shown to reduce egg penetration from 59% to 15%. Serum antibodies migrate to the mucus linings of the genital tract. If blood serum tests are used in isolation however they are misleading in approximately 35% of infertility cases [44]. This is a very difficult area of study, with false results being caused by fixation of specimens.

Sperm may be highly motile but unable to penetrate cervical mucus and antibodies may be present in the genital tract but absent from serum in 3 – 10% of women. There is even an indication that antisperm antibodies affect embryo survival in rabbits and the pre-implantation embryo in mice [44]. The immune system does play a role in some cases of infertility but is not readily accessible to investigation. This should be remembered when species, which are expected to interbreed, have difficulty in doing so.

Mating behaviour can also cause isolation. In an experiment with doves Davies [19] has shown that hybrids show courtship behaviour that is sometimes intermediate between parental patterns and sometimes surpasses the range of either parent. This indicates two things: the genetic component of behaviour in birds and a possible behavioural mechanism, which could isolate hybrids. As humans we have the power to reason and in our anthropomorphism ascribe the same faculty to animals in kind, if not degree. We would do well to remember that many animals act on instinct, which is frequently genetic in origin.

A further barrier to breeding might arise through the phenomenon of transposons. These genetic elements move from one spot on a chromosome to another. First hypothesised by Barbara McClintlock as a result of her work with maize in 1947, evidence of their existence has been known since the early 70's [6]. They have also been demonstrated to be responsible for fertility problems between different stocks of *Drosophila melanogaster* [40]. If transposons can cause difficulty in crossbreeding they may be partly responsible for incompatibility. Of particular interest is the observation by McClintlock that transposons seemed to be more motile during periods of environmental stress [40]. The post-flood world was probably very stressful and conducive to adaptive radiation.

Hybrid zones and introgression

Where two closely related populations exist in proximity there is the possibility of hybridisation. One theory is that hybrids are thought to arise where mate choice is restricted. This occurs at the margins of a population's area of allopatry. Regardless of the origin of the hybrids, once they have occurred they are subject to natural selection. Predictions vary, from fusion of the two populations to full speciation. If the populations are large enough, the ingression of genes from the hybrid zones may not be significant. Sometimes the hybrids become a population of their own, the Icelandic population of Redpolls is regarded as just such a stabilised hybrid as are various populations of *Pachycephala pectoralis* in the Southwest Pacific [48]. Amongst the crows there is a well known hybrid zone between subspecies of *Corvus corone*.

In Scotland the crow *Corvus cornix* (the Hooded Crow) occupies the East Coast while *Corvus corone* (the Carrion Crow) occupies the West Coast. Where they overlap there is a zone of hybridisation. Despite a degree of isolation into different niches they maintain contact. The hybrid zone is narrower in the Southwest where the transition between the two habitats is sharper than the Northeast where the zone is more than twice the width [47]. There has been a move northwards of the zone and this has tentatively been attributed to global warming [47].

A similar though narrower zone has been studied by Saino in Italy. He has suggested that the hybrid zone is actually constrained by geography; a narrow transition zone between two habitats. Within this habitat the hybrid crows show a generalised feeding pattern in contrast to the parental types, which show more specialised feeding patterns, characteristic of their allopatric areas [42]. There appears to be a non-random mate selection, with pairs showing a preference for mates similar to themselves. This is a finding of Saino [43] and Rolando [41].

Such natural hybridisation zones occur in other bird populations too. It is known to occur between the Capercaillie *Tetrao urogallus* and the black grouse *T. tetrix* [48]. In Northeastern Asia *Corvus orientalis* forms a hybrid zone with *Corvus cornix* in a similar way to the European hybrid zone.

That such natural examples exist is of interest in trying to work out what can properly be lumped together as a Biblical kind. It creates headaches for taxonomists but there is another reason for mentioning it. The degree to which genes from the hybrid zone spreads throughout the population (introgression) is not immediately apparent. Outward appearance is the obvious indication of hybrid genes, in the *C. cornix/corone* hybrids this result in intermediate colouration. The degree of introgression however is not always apparent as has been documented in lizards. A morphological analysis of a hybrid zone of *Cnemidophorus* in southwestern North America revealed a very limited introgression. Biochemical techniques however revealed that introgression was actually extensive [48]. This has also been shown in *Corvus corone* in Italy [42]. The two populations are in contact, the separate gene pools intermix sporadically; two lochs with a seasonal burn (stream) between them. This is of enormous advantage to both populations, which effectively have access to a larger gene pool - another conservation mechanism!

Discussion

Granted that Robertsonian rearrangements are a strategy to conserve variation, chromosome number loses it's importance in distinguishing kinds. One of the consequences of this strategy is the creation of problems for meiotic divisions in hybrids such as the mule. This does not necessarily render the horse and donkey different kinds however. It may simply be a result of speciation (evolutionary terminology) or fragmentation of the original kind/the development of races (creationist terminology). More important than chromosome number is the *nombre fondamental* which is the number of chromosomal arms [60]. This is a better way of counting the amount of genetic material regardless of it's arrangement into chromosomes. Most of the doves that have been karyotyped have an *n.f.* of 90 or 94. Whilst the *n.f.* may vary because of further non-Robertsonian rearrangements of the chromosomes, it is a far better guide to defining the karyotype of a kind than the number of chromosomes.

Looking at the karyotype itself as a mechanism for increasing/releasing variation we might add it to the list of Mendelian laws. Independent assortment releases variation and Robertsonian rearrangements may do the same thing on a bigger time scale.

It is important to understand the role of chromosomes in inheritance. There is much discussion of genes in evolutionary genetics but it is chromosomes **not** genes which obey Mendel's laws of segregation, as Jones reminds us [27]. This is dramatically illustrated in the paper by Bickham and Baker [11]. In Fig. 3 they show the karyotype of two bats, different species and genera; *Lasiurus borealis* (2n = 28) and *Myotis sodalis* (2n = 44). By staining the chromosomes they can be matched, showing their origin from Robertsonian rearrangements. The two bats have basically the same genetic information represented as 22 or 44 pairs of chromosomes. That the two bats are different, is no doubt due to the individual genes they have. It is important however not to overlook the possible role of the karyotypic changes themself.

These changes in karyotype, as has been mentioned could have a role in regulating the release of genetic information. Karyotypic change could be a source of change in itself by altering genetic regulation. There is some evidence for this in the work of Bahn, the so called, "position effect" [7].

The importance of genetic regulation has been well documented and is amply illustrated in the dog where adult dog and puppy have markedly different skulls. Where there is such a dramatic change pedomorphosis is possible. In dogs this undoubtedly contributes to the huge variety of pedigree dogs [55].

If environmental stress can be demonstrated as a catalyst for fission and environmental stability is shown as conducive to fusion, the model is complete. Whilst there may be anecdotal evidence to this effect [16] [40], research in this area could confirm chromosomal rearrangements in their role as guardian of variation.

CONCLUSION

The doves and ravens serve as examples of post-flood diversification. Records of hybridisation confirm that they do in fact represent "kinds". Failure to hybridise does not necessarily mean they are separate kinds and may be due to many factors, even individual incompatibility. Part of the post-Flood diversification included Robertsonian rearrangements. These are still discernible in some pigeons and indeed other animals [11]. The value of these rearrangements lies in the release/conservation of genetic diversity and a possible role in altering gene regulation. Further study of the dove and raven will be extremely valuable to the development of models for creationist Biology. It is hoped that this paper will not be an end in itself but rather stimulate others to study the *oreb* and *yonah*.

ACKNOWLWDGEMENTS

A special thanks to my brother Hamish for his assistance with the software used to prepare this paper.

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APPENDIX 'A' - A SUMMARY OFSOME OF THE MECHANISMS AVAILABLE TO MANAGE THE GENOME

Mechanism	Use
1. Meiosis	Segregation of genetic material as chromosomes giving new combinations
2. Hybridisation	Allows genes to flow between populations/races
3. Crossover	Slow release of genetic variation
4. Speciation	Fixation of combination suited to the environment
5. Polyploidy	Emphasises certain characteristics
6. Chromosome fusion	Allows the sudden release of genetic variation allowing increased number of combinations
7. Chromosome fusion	Allows conservation of genetic variation during periods of stability

APPENDIX 'B' - UNUSUAL HYBRIDS

Animal	Ref.	Chromosomal difference
Red deer(70) and Sitka deer(67)	[60]	1
Donkey(62) and Grant's zebra(44)	[22]	2
Wild pig 36) and domestic pig(38)	[34]	2
Horse(64) and Preswalski's horse(66)	[22]	2
Arctic fox(48-50) and red fox(34-38)	[59]	10 -16
Horse(64) and Grevy's zebra(46)	[22]	18
Horse(64) and Hartmann's zebra(32)	[60] [22]	32

APPENDIX 'C' - A SUMMARY OF CHROMOSOMAL REARRANGEMENTS IN THE DOVES AND PIGEONS - based on Shields [46]

Taxa	English name	Change observed
Columbiformes		
Treron phoenicoptera	Yellow-legged Green Pigeon	Centric dimorphism in chromosome 1 and 2
Columba palambus	Wood Pigeon	Reduction of two microchromosomes
Columba cayennensis	Rufous Pigeon	Fusion to form chromosome 8
Columba passerina	Common Ground-Dove	Fission-fusion in chromosome 8
Columba minuta	Plain-breasted Ground-Dove	Fission-fusion in chromosome 7
Columba Picui	Picui Ground-Dove	Fission-fussion in chromosomes 2,3,Z,5and 8
Leptotila verrauxi	White-fronted Dove	Centric rearrangement in chromosome 7, fusion to form chromosome 9, increase of two microchromosomes
Corvidae		
Corvus Brachyrhynchos	Common Crow	Centric rearrangement in chromosome Z, increase of two microchromosomes