not found, nor is sodium urate. These have sufficiently different main layer spacings to be ruled out. If the true solution (solvent : water or acid) is evaporated to dryness, a very small white deposit is obtained, which gives an "amorphous" x-ray diffraction pattern, and which we have not identified.

We have extended Folk's experiments as follows: (i) Some of the white excrement was ashed. This gave a small quantity of white (mineral) powder, from which an excellent x-ray diffraction pattern could be obtained, with lines corresponding to spacings of 7.57 (weak), 6.26 (medium), 5.21 (medium-weak), 4.34 (weak), 4.04 (medium-weak), 3.143 (strong), 2.965 (medium-strong), 2.720 (medium-weak), 2.588 (medium-strong), 2.371 (medium), and 2.252 Å (medium). (ii) A white chunk of dry excrement giving only the 3.20-Å spacing, was placed in water, stirred thoroughly, removed, and dried. In a second experiment, the sample was thoroughly washed after removal and before drying. In both cases, the dried chunk was found to be covered with glistening crystals of uric acid dihydrate, easily identifiable by x-ray diffraction. (iii) A similar chunk boiled in excess water yielded an insoluble residue which was crystalline uric acid dihydrate. The boiled solution, evaporated to dryness (by heating), gave a very small white deposit which showed only one weak x-ray diffraction line. The solubility of uric acid increases with temperature, but is never large. (iv) A chunk placed in 1*N* HCl, then removed and dried, gave the x-ray diffraction pattern of uric acid dihydrate. The evaporated solution gave a very small quantity of material which was amorphous, the amorphous pattern being similar to that obtained by evaporation of a cold aqueous solution.

Folk (*2*, p. 99) claimed that "the spectacular microscopic display" seen when parrot excrement is mixed with vinegar proves that the nature of the bird droppings has been changed. The truth of this statement depends on the meaning given to the word "nature." All the x-ray and microscopic evidence, for wet and dry samples, is compatible with the following statement of the composition and behavior of the white, soft part of bird excrement: (i) The little uniaxial birefringent spheres (or clumps of spheres) observed by Folk consist of at least two constituents, the major part being uric acid dihydrate in a disordered, layer form, and the minor part being some soluble material which includes those salts giving the mineral ash. (ii) Wetting of a sphere, whether with water or weak acid, can break up the sphere (probably by penetration parallel to the aligned polar axes) and dissolve out the minor constituent(s). The disordered uric acid dihydrate "needles," no longer bound together in bundles, readily transform to normally ordered uric acid dihydrate crystals. Such a disorder-to-order transformation can be quite spectacular as seen under the microscope and would give exactly the change of x-ray diffraction pattern illustrated in Figs. 1 and 2. (iii) Aging alone could well produce the same change of order, both textural and structural. It is not surprising that this happens in some cases. In others, it could possibly be accelerated by mild heating. But such textural and structural changes are not a change of "nature"; the separation of soluble minor constituents from insoluble major constituents would involve a major textural change.

What is not changed is the substance of the major constituent. Disordered or ordered, in the plastic (liquid crystal or "pyrolytic") form or recrystallized as clear, glistening single crystals, it is still uric acid dihydrate, according to the most probable interpretation of all the x-ray evidence. We do not know why the disordered form crystallizes as spheres in the first place, but even well-ordered crystalline materials sometimes do the same (for example, $CaCO_3$ plus organic matter in pearls, H_2O in hailstones, and a variety of substances grown in gels).

Note added in proof: A quantitative analysis of the carbon, hydrogen, and nitrogen content of the white bird urine, before "treatment" of any kind, was carried out by placing the material in a furnace at 800°C; carbon was determined as CO_2, hydrogen as H_2O, and nitrogen as N. The results are shown below by comparison with values calculated for uric acid dihydrate and uric acid, respectively.

		C(%)	H(%)	N(%)
Uric acid dihydrate	Obs.	29.36	3.48	27.39
	Calc.	29.41	3.92	27.45
Uric acid	Calc.	35.7	2.37	33.3

There is no reason to suppose, therefore, that urates or purines other than uric acid dihydrate are present in more than trace quantities.

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Intelligence and Blood Pressure in the Aged

Abstract. *Diastolic hypertension was related to significant intellectual loss over a 10-year period among individuals initially examined in their 60's. Such loss was not found in their age peers in association with normal or mild elevations of blood pressure. Of the subjects initially examined at 70 to 79 years of age, none with hypertension completed the follow-up program, and those with normal and mildly elevated blood pressure showed some intellectual decline over the decade. At the initial examination, hypertension was related to lower intelligence test scores only among those subjects who subsequently did not complete the follow-up program. The results suggest that hypertension is related to intellectual changes among the aged.*

The incidence of hypertension increases with age and is frequently complicated by cardiovascular disease and strokes (*1*, *2*). Among middle-aged adults and the aged, hypertension may also be related to psychomotor slowing (*3*, *4*), lowered flicker fusion threshold (*5*), and organic brain impairment (*6*). Despite these findings, however, relatively little attention has been paid to the long-term behavioral effects associated with hypertensive disorder.

This report examines the relation between blood pressure (BP) and intelligence, as measured by the Wechsler

Adult Intelligence Scale [WAIS (*7*)] in aged individuals over a 10-year period. It was hypothesized that intellectual decline over time would be related to heightened BP.

The results reported here stem from a longitudinal, multidisciplinary study at the Duke University Center for the Study of Aging and Human Development. The noninstitutionalized participants in this program were ambulatory volunteers, and although they do not represent a random sample, their sex, race, and socioeconomic characteristics approximate those in the Durham, N.C., area. The project was not designed specifically to investigate the relation between BP and intelligence, but rather the BP values were obtained during the programmed physical examination and the WAIS was one of several psychological tests administered. Each evaluation consisted of physical, psychiatric, psychological, and sociological examinations and various laboratory tests. Subjects for the study were examined for a 2-day period about every 2½ years (*8*).

In this report we focus on data obtained during the first and fourth examinations, separated by a 10-year period. The sample involved 202 individuals, initially aged 60 to 79 (mean age, 68.9), 87 of whom completed the follow-up study.

Because intellectual decline may be related to age, the subjects in both the returning and nonreturning groups were divided into a 60- to 69-year-old group ($N = 106$) and a 70- to 79-year-old group ($N = 96$) at the time of the first evaluation and further subdivided into categories based on the BP data obtained at the initial examination. The BP values in this report were obtained by standard auscultation technique with the person in a recumbent position. Diastolic rather than systolic pressure was used since the two measures were highly correlated ($P < .01$), and diastolic pressure is less sensitive to minor fluctuations. The physician rounded the BP values to the nearest 10 mm-Hg. Approximating Masters, Garfield, and Walter's classification (*2*), the subjects were divided into a normal group with diastolic pressures between 66 and 95 mm-Hg, a borderline elevated group with pressures between 96 and 105 mm-Hg, or a high group with pressures of over 105 mm-Hg. All the subjects with high BP who returned

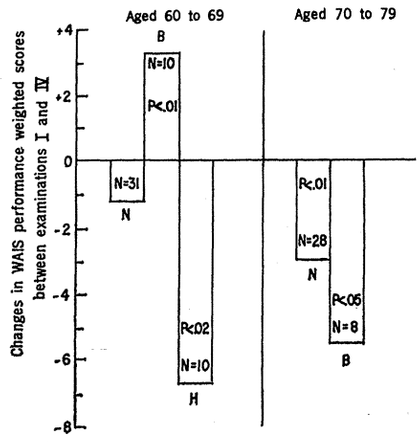

Fig. 1. Intellectual change (delta scores) over a 10-year period, as measured by the Wechsler Adult Intelligence Scale (WAIS) among individuals initially examined at ages 60 to 69 and 70 to 79 with either normal (*N*), borderline elevated (*B*), or heightened (*H*) diastolic blood pressure on the initial examination.

and 86 percent of their nonreturning counterparts had evidence of end-organ change (that is, a cardiac-thoracic ratio of more than 50 percent on the basis of actual measurements taken from x-ray photographs and clinical signs of eyeground changes of grade II or III at their last examination). In the group with mildly elevated BP, approximately 35 percent of the 60- to 69-year-olds and 60 percent of the 70- to 79-year-olds, as well as approximately 10 percent of the normotensives, had eyeground changes of grade II, with heightened cardiac-thoracic ratio occurring significantly less often ($P < .02$) than in the high group. In terms of these indices of end-organ change, few differences were noted between the returning group and the nonreturning normotensive and borderline groups. Because of the nature of the study, antihypertensive drug usage could not be controlled. However, Spieth (*4*) reported evidence that suggests that such drugs would tend to attenuate rather than exaggerate any differences in performance between our subjects.

Since the focus is upon normal BP and mild and heightened elevations of BP among older individuals with no clinical evidence of cerebrovascular disease, the data from 25 additional persons originally examined in the longitudinal study ($N < 5$ in each condition) were excluded here because of either missing data on intelligence tests, the presence of diagnosed cerebrovascular disease, hypotensive BP, or highly labile BP.

Among the returnees, there was no notable statistical difference between BP groups in terms of education, sex, race, or socioeconomic characteristics. Since the subjects were divided into two age groups at the time of the first examination and followed for 10 years, the WAIS weighted scores uncorrected for age were used rather than intelligence quotients (IQ). The WAIS full scale weighted score is the sum of the verbal and performance weighted scores, which are based upon six and five subtest scores, respectively. Intellectual change (as delta scores) was obtained by subtracting the subjects' WAIS weighted scores on the first examination from those of the fourth examination.

Among the subjects initially examined at age 60 to 69, an analysis of variance indicates that there were significant ($P < .01$) differences between the BP groups on the full scale and performance delta scores (d.f. = 2/48, $F = 6.5$ and 11.6, respectively) with the hypertensives having a greater loss in overall intellectual ability than the normotensive and borderline elevated groups (d.f. = 48, $t = 2.9$ and 4.3, respectively), with these differences reflected in the performance scores ($t = 3.3$ and 5.9, respectively). Over the 10-year period, none of the BP groups at this age had a significant change in verbal ability; however, only the normals remained relatively stable in all areas. As depicted in Fig. 1, the borderline elevated group had significantly higher scores in the performance area over time (related mean $t = 4.7$, $P < .01$, d.f. = 9). In contrast, the hypertensive group had a significant decline in the performance area which was reflected as a loss in the full scale score (d.f. = 9, related $t = 3.1$, $P < .02$ and related $t = 2.4$, $P < .05$, respectively).

Figure 1 shows the performance weighted delta scores for the normal and borderline groups who were initially aged 70 to 79. There were no subjects with high BP at this age who completed the 10-year study. The normotensives had a significant decline in overall intellectual ability (related $t = 2.9$, d.f. = 27, $P < .01$) which was reflected in the performance area ($t = 3.3$, $P < .01$), as did the borderline group (d.f. = 7, $P < .05$, $t = 2.5$ and 2.6, respectively). Although the borderline group tended to have a slightly

greater loss in verbal ability than the normals, the two BP groups were not statistically different.

The data from individuals in each age group were pooled and a product moment correlation (see Table 1) was used to determine the relation between BP and intellectual change (delta scores) on the WAIS subtests and weighted scores. For the group initially aged 60 to 69, a heightened BP was significantly correlated with the loss on the verbal, performance, and full scale weighted scores. Among the subtests, the digit span, digit symbol, block design, and object assembly delta scores were also positively correlated with BP. Among those initially aged 70 to 79, a decline on the verbal weighted score was positively related to BP. However, since there were no subjects at this older age with high BP who completed the follow-up study, this correlation was limited to the group with normal and mildly elevated BP.

On the first examination, the verbal, performance, and full scale WAIS weighted scores of the returnees were compared with those of their nonreturning counterparts in relation to BP. These full scale weighted scores are shown in Fig. 2. In the 60- to 69-year-old group, a series of 2 by 3 analyses of variance indicated the returnees had significantly higher verbal, performance, and full scale scores than the nonreturnees (d.f. = 1/100, $P < .05$, $F = 5.3$, 5.1, and, 5.6, respectively). However, among the BP subgroups only the returning hypertensives had significantly higher verbal, performance, and full scale scores than did their nonreturning counterparts (d.f. = 100, $P < .05$, $t = 2.3$, 2.3, and 2.4, respectively). Within the returning group there were no significant differences between the BP subgroups. In contrast, within the nonreturning group, the hypertensives had lower verbal, performance, and full scale scores than did the normals (d.f. = 100, $P < .05$, $t = 2.4$, 2.5, and 2.1, respectively), as well as lower performance scores than the borderline subgroup ($t = 2.1$, d.f. = 100, $P < .05$). Since the two subgroups with high BP were functioning at different levels, when data from all returning and nonreturning subjects were pooled, a product moment correlation (Table 1) indicated that on the first examination BP was not related to intelligence.

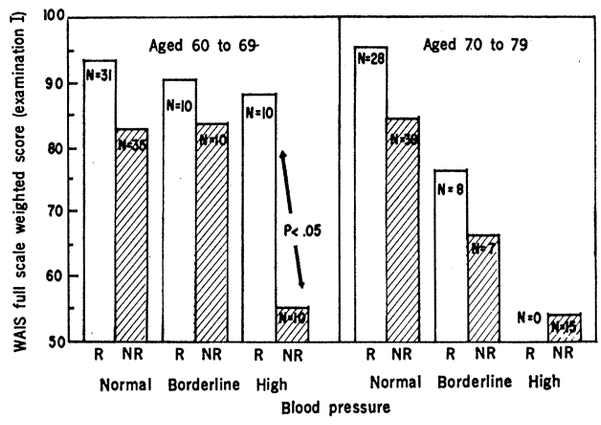

Fig. 2. The initial intelligence test scores [Wechsler Adult Intelligence Scale (WAIS)] of aged individuals with normal, borderline elevated, or heightened diastolic blood pressure who either returned (*R*) to complete a 10-year follow-up study or did not return (*NR*).

Figure 2 also shows the full scale scores for the 70- to 79-year-olds on the first examination. There were no returning subjects with high BP and those who did return with normal and borderline pressure had WAIS scores similar to scores on the initial examination. In contrast, within the nonreturning group, the hypertensives had significantly lower verbal, performance, and full scale scores than did the normals (d.f. = 51, $P < .01$, independent $t = 3.1$, 3.1, and 3.2, respectively). When data for the returning and nonreturning subjects at this age were pooled, a product moment correlation (Table 1) indicated that heightened BP was associated ($P < .01$) with low verbal, performance, and full scale weighted scores, and this was also true of all the subtests except for vocabulary and picture arrangement.

These results indicate that among individuals initially examined at ages 60 to 69, hypertensive levels of BP were associated with significant intellectual loss over a 10-year period. In contrast, their normotensive age peers remained relatively unchanged over time, while a group with borderline elevations of BP had higher performance scores. Since practice effects would be expected to slightly increase the scores across four testing sessions, the differences between the BP groups may reflect differential rates of decline in mental abilities rather than actual intellectual improvement among those with mildly elevated BP. Nevertheless, the increase in performance scores

Table 1. Product moment correlations between diastolic blood pressure (BP) and the Wechsler Adult Intelligence Scale (WAIS) scores. The "Initial examination" columns include all subjects initially examined and reflects the one test score. The "Longitudinal study" columns include those subjects completing the 10-year follow-up and relates initial BP with intellectual change over the 10-year period. Subjects were grouped according to their ages on the first examination. A negative correlation indicates an inverse relation between BP and performance.

WAIS	Initial examination		Longitudinal study	
	Aged 60 to 69 ($N = 106$)	Aged 70 to 79 ($N = 96$)	Aged 60 to 69 ($N = 51$)	Aged 70 to 79* ($N = 36$)
Verbal weighted scores	−.10	−.27†	−.27‡	−.36‡
Information	−.10	−.26†	.04	−.25
Comprehension	−.10	−.25‡	−.21	−.19
Arithmetic	−.13	−.27†	−.08	−.11
Similarities	−.06	−.25‡	−.18	−.10
Digit span	−.01	−.22‡	−.27‡	−.29
Vocabulary	−.12	−.19	−.06	−.12
Performance weighted scores	−.09	−.32†	−.44†	−.23
Digit symbol	−.04	−.26†	−.40†	−.03
Picture completion	−.12	−.34†	.07	−.07
Block design	−.11	−.30†	−.35†	−.13
Picture arrangement	−.09	−.18	−.12	−.12
Object assembly	−.04	−.27†	−.39†	−.30
Full scale weighted scores	−.10	−.30†	−.42†	−.27

* In this age group, no individuals with heightened BP completed to 10-year study. † $P < .01$. ‡ $P < .05$.

during this period for the group with borderline elevations of pressure tends to support Obrist's (*9*) contention that mild elevations of BP may be necessary among the aged to maintain adequate cerebral circulation. Our failure to duplicate this pattern for the older subjects (those initially examined at ages 70 to 79) suggests that even in the face of mild elevations of BP other factors may be operating to compromise cerebral circulation. Perhaps the duration of cardiovascular disease, with consequent structural change or other interacting pathology relating to more advanced age, may intervene.

These results raise questions about adaptation to the effects of high BP. Since none of the older subjects with high BP completed the follow-up study and those of younger age who completed it were superior to their counterparts who were subsequently lost to the study, it might be appropriate to ask whether some individuals develop compensatory mechanisms to hypertension and therefore adjust to it with minimum difficulty for protracted periods, whereas others who do not develop adequate physiologic or anatomic compensations manifest central nervous system difficulties with cognitive deficits and progressively severe physical pathology.

An earlier cross-sectional study (*10*), in which the same subjects were tested, suggested that socioeconomic status may be a contaminant in any investigation of cardiovascular disease difficulty, since the incidence of cardiovascular disease is high in the low socioeconomic group. In this context, it should be noted that in this 10-year longitudinal study, approximately 70 percent of the subjects within each BP group were of a nonmanual occupational background, and, furthermore, the amount of intellectual change over time was approximately the same for all subjects within each BP category regardless of whether the subjects were of a manual or nonmanual occupational background.

It is also of particular significance that in contrast to cross-sectional studies (*11*) which report a decline in intelligence across the later decade of life, longitudinal studies of intellectual ability (*12*) have raised some doubts as to the generality of such decline in relatively healthy aged at least through age 75. To this end, the presence of large numbers of aged with cardiovascular illness suggests that the basis for the cognitive decline associated with aging after maturity should be considered secondary to some pathologic processes and not merely as a "normal" aging process.

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Intersexes and Sex Determination in Chickens

Abstract. *Chickens sexed as females in commercial flocks show a low frequency of intersex individuals. Gross anatomical examination of the intersexes revealed malformed gonads. Histological examination proved that these gonads were not ovotestes but were composed of testicular tissues. Karyotype analysis of 15 intersex individuals showed 13 of them to be 3A-ZZW triploids (normal females are 2A-ZW) while the other 2 were mosaic for male and female karyotypes. Red blood cell volume accurately reflects the ploidy level and is suggested for use in screening for polyploids. Intersex triploids may develop parthenogenetically or from fertilization between reduced and unreduced gametes.*

In commercial flocks, hybrid chickens developed for egg production are sexed at hatching so as to retain only the females. In addition to the occasional males observed before or at sexual maturity, recent observations indicate that intersex chickens appear in these flocks in a low frequency of about 1/2000 of the commercially sexed females.

Phenotypically, the secondary sexual characteristics of most intersexes are intermediate between normal males and females. Their body size and feathers on the neck, saddle, sickle, and tail are usually intermediate. However, some exhibit a definite trend toward masculinity, since they show a much larger size of head, comb, and wattles than the females, as well as possessing spurs which are lacking in the females.

Fifteen intersex individuals were secured from a number of commercial flocks. Seven of these intersexes as well as a rooster and a laying hen were killed and their internal anatomies, especially that of their reproductive systems, were compared. Tissues were fixed in buffered 5 percent formalin for histological examination. Wax-embedded blocks were sectioned 8 μm thin and stained with hematoxylin and eosin and finally prepared as permanent slides.

All intersexes had both right and left gonads except two (B130 and Y147) that lacked the right gonad. Their gonads looked like ovotestes and varied in shape and size, ranging between 0.08 and 9.30 g (Table 1). They lacked vasa deferentia and all had a left oviduct similar in shape to that of laying hens but smaller in size, ranging in weight between 1.91 and 44.5 g. None had a right oviduct except for P2 and P47, in which the duct was similar to the rudimentary right oviduct of adult females.

Karyotype analysis of these seven intersexes revealed two separate groups, one being triploid 3A-ZZW and the other mosaic (Table 1). One of the latter (G32) was diploid, but 70 percent of its mitotic plates represented