1288 Fertility and lambing performance of Katahdin hair sheep under an accelerated breeding system. S. Wildeus* and J. R. Collins, *Virginia State University, Petersburg*.

This study evaluated ewe performance in a flock of Katahdin hair sheep (n=25) managed under an 8-mo breeding schedule. Animals were grazed on moderate quality, permanent pastures or provided hay depending on time of year, and grain mix (16% CP) was supplemented according to stage of production. Ewes were mated in single-sire mating groups during 42-d breeding seasons, starting the first of November, July, and March, respectively. Breeding rams passed a soundness examination and were fitted with marking harnesses for breeding. Conception rate was determined by transrectal ultrasonography on d 1 and 20 after the end of breeding. Ewes lambed unassisted on pasture and lambs were weaned at 9 wk of age. Data were analyzed in a model with season as main effect. Conception rates were similar for all breeding seasons (mean 88%), however, lambing rate was lower (P<.05) for July breeding (65%). Time to mating from onset of breeding was later (P<.01) for July (25.3 d) than for November and March breeding (9.1 and 14.1 d, respectively). Litter size was larger (P<.05) following July (1.67) than November (1.27) breeding, with March intermediate (1.53). Litter birth and weaning weights were larger (P<.05) following July (6.48 and 24.5 kg) than November (4.37 and 15.4 kg) and March breeding (5.27 and 20.3 kg). Litter average daily gain differed between seasons (P<.05) and ranged from 272 g/d for July breeding, to 244 g/d for March, and 196 g/d for November. Litter weight weaned as percent ewe body was not affected by mating season (range: 35-40%). Perinatal lamb survival was similar between breeding seasons (92-95%) and lamb survival to weaning ranged from 84% (March) to 92% (November). Reduced litter size and weights for November breeding in this study may have been associated with a younger ewe age. Data indicate that Katahdin hair sheep can be used in accelerated breeding systems; however, July breeding appears to coincide with the transitional period for seasonal breeding.

Key Words: Katahdin, Lambing performance, Accelerated breeding

1289 Vitamin E supplementation during late gestation and lactation on dam and lamb performance. D. G. Morrical* and A. Ali, *Iowa State University, Ames*.

The objective of this study was to determine if additional vitamin E provided orally to ewes during late gestation and lactation improved pre-weaning lamb performance. Two groups of ewes (123 and 72 hd) were used in the study during 1997 and 1998, respectively, in a split-plot design. Both years, ewes were grouped into four blocks according to ewe age and fetal counts. About one-half of the ewes from each block were supplemented orally with vitamin E (300 IU/hdd) and the other half received no additional vitamin E. Three days post-lambing, one-half of each block was switched to the other E treatment. A sub-sample of ewes and their lambs were monitored for serum vitamin E levels at d 3 pre- and post-lambing, mid lactation (d 28), and at weaning (d 56). Serum E at d 3 pre- and post-lambing was 1.9 and 1.3 mg/l for ewes supplemented with vitamin E during late gestation compared to 1.1 and .9 for non-supplemented ewes, respectively. Serum vitamin E level at d 28 was higher (P < .05) in ewes supplemented with E during lactation than non-supplemented ewes (1.5 and 1.1 mg/l, respectively). Lamb birth weight, weaning weight, and livability were not affected by vitamin E supplementation. Serum E levels at 3 d (P < .05) and 28 d (P < .10) were higher in lambs (1.9 and 1.4 mg/l, respectively) from dams receiving E in late gestation and lactation compared to lambs (1.4 and .9 mg/l, respectively) from non-supplemented ewes. It is our conclusion that additional E in late gestation and lactation had no effect on lamb pre-weaning performance due to excellent serum E levels in the control ewes.

Key Words: Vitamin E, Lamb, Growth

1290 Growth performances and retention rate of small ceramic boluses for electronic identification in fattening lambs. D. Garjn, G. Caja*, and C. Conill, *Universitat Autønoma de Barcelona, Bellaterra, Spain*..

An experiment was conducted to evaluate the effects of two sizes of bolus transponders in the electronic identification and growing performances of a total of 105 lambs (Manchega, n=69; and, Lacaune, n=36). Ceramic boluses were made in Alumina (Al_2O_3) according to the PCT/FR97/00744 patent, to be orally administered to young lambs. A glass encapsulated half-duplex passive transponder (32.5x3.8mm; Tiris®) was placed inside each bolus. Features (diameter x length and specific gravity) of empty boluses were: 'Mini' (M, 9.3 x 36.5 mm and 1.9g/cm^3) and 'Small' (S, 15.0 x 39.1 mm and 3.3g/cm^3) and final weights 5.6 and 20.0 g, respectively. Lambs were randomly assigned after birth to three experimental treatments (n=35 per group): Control (C, without bolus) and M or S boluses. Milk intake in suckling lambs was estimated weekly from wk1 to wk4 (weaning) by using the oxytocin method. Weaned lambs were intensively reared in groups and fed concentrate and straw *ad libitum*, and slaughtered when they reached 23kgBW. Bolus readability, BW and feed intake were recorded weekly and boluses recovered in the slaughterhouse. Administration of M boluses with a silicon probe was possible (95% confidence) during wk1 and health was not apparently altered after application. Administration of S boluses with a small balling gun was tested after weaning, but it was not feasible in all lambs until wk7. Bolus application did not affect (P>0.05) milk suckled (1.29l/d), concentrate intake (0.75kg/lamb) and growth rate (0.267kg/d) of M lambs during the suckling period. Feed intake (0.830 kg/d) and growth rate (0.309 kg/d) were also not affected (P>0.05) during the fattening period in M and S lambs. Bolus retention rates from application to slaughtering were 57.1 and 100 % for M and S boluses (P<0.001), respectively. All boluses were recovered in the rumen-reticulum, of these 83.3% of M and 77.8% of S were found in the reticulum. We conclude that boluses can be applied in very young lambs without negative effects on their growing performances. New designs are necessary to improve the retention rate of mini boluses if earlier application than 7 weeks is required.

Key Words: Transponder, Ruminal Bolus, Suckling Lambs

SWINE SPECIES

1291 The effect of age at first boar contact, feeding regime and lysine concentration in the diet on lifetime performance in female swine. M. Varley and M. Cole*, *SCA Nutrition*.

The rearing protocols used in swine breeding units for new gilt replacements have been open to question recently and in particular because modern genotypes are considerably leaner with higher mature weights compared to 20 years ago. It has also been suggested that for a long breeding life gilts should be given a diet in the rearing phase that contains reduced lysine and protein to promote increased backfat development at the time of first mating. A large-scale experiment was carried out at the SCA Feed Evaluation Unit (UK) at the time the unit was established with a new population of gilts to examine this question. 120 JSR breeding gilts were allocated at 60-kg liveweight to a 2x2x2 factorial experiment where the main factors were different elements of the rearing protocols. The 3 factors were; age at first boar exposure (180 days v 200 days), feeding regime (ad libitum v 80% ad libitum intake between 60 kg and first service) and lysine concentration in the diet (0.55% v 0.85%). At the appearance of first estrus all gilts were mated twice on consecutive days and from that time on the feeding and general management was the same for all animals. They were then followed through 3 parities. Body weight, body fat, litter size and litter weights were measured and recorded. The culling patterns through the 3 parities were similar for all treatments but the animals on the low lysine diet in the rearing phase lost 23% of all females over 3 parities. The high lysine treatment lost only 13%. The number of piglets born alive per litter for parities 1,2 and 3 respectively were for gilts given boar introduction at 180 days of age: 11.1,11.9 and 13.2 and for gilts given boar exposure at 200 days of age were 10.6, 9.4 and 12.1 piglets (p<0.09). The management protocol, which gave maximum reproductive performance over 3 parities, was to expose the gilts at 180 days of age and to offer an ad libitum high lysine diet up to mating. It is concluded that body lean or protein mass may be a more important parameter than body fat per se in the formulation of management protocols for gilt replacements.

Key Words: Swine, Sow, Reproduction

1292 The effect of gender or gonadectomy on growth and plasma cholesterol levels in pigs. C Lee[1] and K Kim*[2], [1]*Cheju Agricultural Experimental Station, Rural Development Administration, Cheju, S. Korea,* [2]*Department of Animal Biotechnology, Cheju National University, S. Korea.*

Studies were carried out to determine the effect of gender or gonadectomy (GDX) on growth and plasma cholesterol levels, using 10 male (26.1 kg) and 10 female (26.4 kg) pigs (Landrace), of which 5 from each sex were gonadectomized (GDX male and female) and the rest were sham-operated (Sham male and female). When these pigs reached an adult size (male 123, and female 99 kg), they were fed a diet containing 0.5% cholesterol and 0.1% cholate for 10 days. Plasma total cholesterol levels (mean ±se) before (and after) feeding the high cholesterol diet in Sham and GDX male, and Sham and GDX female were 97±8 (104±22), 105±12 (136±23), 111±11 (161±28) and 107±8 (160±26) mg/100 mL, respectively. Plasma cholesterol levels were much higher ($P < 0.01$) in female than in male when pigs were fed the high cholesterol diet, and were increased by gonadectomy in male, but remained the same in female pigs. Gonadectomy increased ($P < 0.04$) average daily gain (0.88 vs 1.01 kg) only in female pigs. Results show that gonadectomy increases the plasma cholesterol level in male pigs and increases the growth rate in female pigs, suggesting that testosterone is at least partly responsible for the lower plasma cholesterol level in male, and estrogen for the lower growth rate in female pigs. Further studies are needed to determine how testosterone involves cholesterol metabolism when animals are fed a high cholesterol diet. Estrogen has been considered to be a stress hormone, increasing cortisol excretion and decreasing growth rate.

Key Words: Pigs, Gender, Godnadectomy, Cholesterol, Testosterone, Estrogen

1293 Arginine deficiency in 7- to 21-day-old suckling piglets. N.E. Flynn, D.A. Knabe, B.K. Mallick, and G. Wu*, *Texas A&M University, College Station.*

Arginine (an essential amino acid for piglets and required for hepatic ammonia detoxification) is remarkably deficient in sow's milk. Paradoxically, we discovered that intestinal synthesis of citrulline and arginine from glutamine/glutamate and proline (the major source for endogenous provision of arginine) decreases markedly in 7- to 21-d-old suckling pigs compared with newborn pigs. Our findings have raised an important question of whether arginine is deficient in suckling pigs. Although sow-reared pigs continue to grow during the 21-d suckling period, this does not necessarily imply that arginine supply from milk plus endogenous synthesis meets arginine requirements for optimal growth, as exemplified by suboptimal growth in arginine-deficient young rats. Indeed, recent artificial rearing studies indicate that the biological potential for neonatal pig growth is at least 74% greater than that for sow-reared piglets. Because of the practical limitation in conducting a nitrogen-balance study with suckling piglets, we decided to measure biochemical parameters (e.g., arginine and ammonia) in plasma as indicators of arginine status in piglets. Jugular venous blood samples (3 mL) were obtained from sow-reared piglets (10 males and 10 females) at 1, 3, 7, 14 and 21 d of age for analyses of plasma amino acids and ammonia by HPLC and enzymatic methods. Blood sampling was performed 1.5 h after suckling between 0930 and 1130. Data were analyzed by ANOVA for repetitive measurements. All measured parameters did not differ ($P > .05$) between male and female piglets. Body weights of piglets averaged 1.32, 1.42, 1.75, 2.55, 4.10 and 5.76 kg, respectively, at birth and 1, 3, 7, 14 and 21 d of age. Plasma concentrations of arginine and its immediate precursors (citrulline and ornithine) decreased ($P < .01$) progressively by 20-41%, but plasma ammonia concentrations increased ($P < .01$) progressively by 18-48%, in 7- to 21-d-old pigs compared with 1- and 3-d-old pigs. Plasma concentrations of other amino acids exhibited slight or no changes in piglets during the 21-d suckling period. Our results indicate a hitherto unrecognized arginine deficiency in 7- to 21-d-old pigs. An arginine deficiency may be an important biological factor for limiting optimal growth of sow-reared piglets.

Key Words: Arginine, Development, Pigs

1294 Optimal threonine:lysine ratio for growing pigs of different sexes. W. H. Chang[1], J. D. Kim[1], J. H. Lee[1], I. S. Shin[2], I. K. Paik[3], B. J. Chae[4], and In K. Han[1], [1]*Seoul National University, Korea,* [2]*American Soybean Association, Korea,* [3]*Chung-Ang University, Korea,* [4]*Kangwon National University, Korea.*

This study was conducted to investigate the effects of threonine:lysine ratios on growth performance, apparent nutrient digestibility and blood urea nitrogen (BUN) concentration, and to estimate the optimal threonine:lysine ratios for growing barrows and gilts. A total of 150 pigs (LandraceXYorkshireXDuroc, 16.75 kg average body weight, 75 barrows and 75 gilts) was randomly allotted into six treatments in a 2X3 factorial design. Six diets were formulated to contain 1.12% lysine for barrows, 1.33% lysine for gilts, respectively, with three threonine:lysine ratios (50, 60 and 70%) for both barrow and gilts in the present study. Throughout the whole experimental period (16 to 56 kg body weight), there was no interaction between sex and dietary threonine:lysine ratio on average daily gain (ADG), average daily feed intake (ADFI) and feed conversion rate (FCR). Between sexes, there was a clear sex-effect showing better growth performance of barrows. Barrows ate more feed ($p<0.01$) and grew faster ($p<0.01$) than gilts did. For barrows, there was a trend to improve ADG and FCR with increasing threonine:lysine ratio. For gilts, there was a trend to improve ADG and FCR up to threonine:lysine ratio of 60%, but not significant. Between sexes, total BUN concentration was lower in gilts than barrows ($p<0.05$). However, BUN concentration was not affected by dietary threonine:lysine ratios. In conclusion, 70 and 60% dietary threonine:lysine ratio for barrows (1.12% lysine) and gilts (1.33% lysine), respectively, tended to result in better growth performances and nutrient utilization and lower BUN concentration than other threonine:lysine ratios.

Key Words: Pigs, Threonine:lysine, Growth performance

1295 Effects of extruding corn and wheat grain on growth performance and digestibility of amino acids in early-weaned pigs. B. J. Chae[1], Y. K. Kim*[1], J. D. Kim[2], W. T. Cho[2], and I. K. Han[2], [1]*Kangwon National University, Korea,* [2]*Seoul National University, Korea.*

This experiment was conducted to compare the effects of extruding corn and wheat on growth performance and digestibility of amino acids in early-weaned pigs. Corn and wheat ground by a hammer mill (3mm screen in diameter) were extruded at 130±2°C with a moist-type extruder (Matadora). Treatments were: 1) 3mm ground corn, 2) extruded corn, 3) 3mm ground wheat, and 4) extruded wheat. A total of 160 piglets (14 d of age and 4.3±0.74 kg BW) were allotted with the dietary treatments for a 21 d feeding trial. All diets were mash and contained 30% corn or wheat products. The pigs were allowed ad libitum access to feed and water. For a digestibility trial, 16 piglets (14 d old and 4.2±0.32 kg BW) were employed in individual cages. An additional 4 pigs were allotted to determine endogenous amino acid excretions with a nitrogen-free diet. Each pig was fed a restricted amount of feed (5% of BW/d) three times daily. On the sixth day after feeding, fecal samples were collected for 2 days. There were no significant differences ($p>0.15$) in growth performance of piglets between corn and wheat. Extruding corn or wheat in the piglet diet had no effects on ADG ($p>0.15$) and ADFI ($p>0.15$), but it improved feed/gain ($p<0.01$). Also, extruding corn and wheat reduced true fecal digestibilities of lysine and methionine ($p<0.01$) in the piglets. In conclusion, our results suggest that extruding corn and wheat had no benefit on the growth rate of early-weaned pigs.

Key Words: Pigs, Extrusion, Digestibility

1296 Ileitis, intestinal microflora and performance of growing-finishing pigs fed *Saccharomyces cerevisiae*. A. A. Martinez*[1], L. E. Zapata[1], J. Sierra-Diaz[1], M. P. Perez-Olvera[2], R. P. Pradal[2], R. Mendoza[2], M. O. Velazquez-Madrazo[2], and J. A. Cuaron[1], [1]*Centro Nacional de Investigacion en Fisiologia y Mejoramiento Animal, INIFAP,* [2]*Universidad Nacional Autonoma de Mexico.*

From weaning (22d and 6.5 kg), 144 pigs were fed a sorghum-soy based diet ± a live *Saccharomyces cerevisiae* (SC) culture (3 kg/ton of feed). Pigs were raised to 112d (50 kg body wt) on a healthy farm (S1), when 66 animals (33 fed SC) were moved to a farm where respiratory and digestive diseases were diagnosed (S2). Upon arraival, pigs were alloted to pens in groups of 5, 3 from S1 and 2 from S2 to insure infection and

as an added factor of stress. At S2, 5 treatments were established: (1) a negative control (no yeast or antimicrobial drugs); (2) no SC in S1, SC in S2; (3) SC in S1, no SC in S2; (4) SC in S1 and S2 and (5) a control treated with antibiotics. Feed intake was measured daily and body wt gain biweekly. At arraival to S2 and at d-21, 42 and 63, 3 animals per treatment were sacrificed to collect samples for microbial determinations from 5 portions of the digestive tract and to diagnose ileitis. No differences in performance($P>.05$) were found from weaning to d-112. At S2, histopathology and bacterial findings were similar ($P>.05$), but presence of viable SC was confirmed. Pig ADG was greater ($P<.01$) when SC was fed, notably in S1 (736, 782, 731, 836, and 667 g/pig, for treatments 1 to 5). Pigs fed antibiotics had an ADG similar to those fed SC, but the response dropped after removal of the drugs (d-21 in S2). The experiment was repeated and results were similar. These data suggest that pigs fed SC prior to challenge and through finishing had more resistance to stress.

Key Words: Growing-finishing Pigs, Yeast, Stress, Disease Resistance

1297 Effect of selection for improved piglet survival on prenatal development. J.I. Leenhouwers*[1], T. Van der Lende[1], and E.F. Knol[2], [1]*Wageningen Institute of Animal Sciences, Wageningen University, The Netherlands,* [2]*Institute for Pig Genetics, Beuningen, The Netherlands.*

The objective of this research was to investigate the effect of selection for improved piglet survival on prenatal development. Estimated breeding values for piglet survival (EBVps) were calculated using data on piglet survival in nucleus herds of the Dutch breeding company TOPIGS. Piglet survival was defined as an all or none trait between onset of parturition and weaning. Crossbred gilts (n=46) were mated to boars from a boar line (n=14). Both gilts and boars had known EBVps. Mating was performed in such a way that a wide range of EBVps of litters was achieved. On day 111 $\pm$ 1 of gestation, fetuses were removed by Caesarian section. Data on fetal length and weight, placental characteristics and various fetal organ weights were collected. Statistical analysis was performed on litter averages. The statistical model included the fixed effect of stage of gestation and the covariables average fetal weight, number of fetuses (excluding mummies and macerated fetuses), percentage of males within the litter and EBVps. Significance was tested by the general linear models procedure, using stepwise elimination of non-significant ($p>0.05$) effects. Variation in placental weight within the litter decreased with increasing EBVps ($p<0.05$). EBVps had a negative effect on average fetal length ($p<0.05$) and a positive effect on average fetal liver weight ($p<0.05$). Preliminary data on liver glycogen content of 64 fetuses from 34 litters showed that, after adjustment for fetal weight, 49% of the variation in fetal liver weight is explained by variation in liver glycogen concentration. We conclude that selection for improved piglet survival increases uniformity of placental weight within a litter, decreases average fetal length and increases average fetal liver weight. Furthermore, selection may increase fetal liver glycogen content.

Key Words: Genetic Selection, Piglet Survival, Prenatal Development

1298 Non-invasive cryopreservation of zona pellucida intact morulae stage pig embryos: Birth of multiple litters of piglets after embryo transfer. J. R. Dobrinsky*[1], H. Nagashima[2], V. G. Pursel[3], L. L. Schreier[1], and L. A. Johnson[1], [1]*USDA-ARS, GGPL, Beltsville, Maryland, USA,* [2]*Meiji University, Tama, Kawasaki, Japan,* [3]*USDA-ARS, GEML, Beltsville, Maryland, USA.*

Methods exist to adequately, but not optimally, preserve embryos from genetically superior animals of most of our livestock species except the pig. Whole early stage pig embryos up to the morula stage have not developed after cryopreservation. Our objective was to develop non-invasive methodology to cryopreserve zona pellucida intact morulae stage pig embryos. After a technologically-protected pre-treatment of pig morula, embryos were cryopreserved by vitrification. After indefinite storage, embryos were recovered and rehydrated. After a technologically-protected post-cryopreservation treatment was applied to the embryos, all embryos were cultured further in vitro. Survival in vitro was >80%. Viable embryos were surgically transferred to recipient females. In the first trial, 3 gilts farrowed 8,7 and 4 live and healthy offspring. In a validation trial, 6 of 7 gilts farrowed 42 offspring. Total pregnancy rate was 9/11 (82%) with 61 total piglets born averaging over 6 pigs per litter. This research utilizing technologically-protected, novel methodology produced the first live offspring from non-micromanipulated and vitrified, zona pellucida intact morula stage pig embryos. The methodology provides an avenue for the long term preservation of embryos that can be transported and later transferred internationally. Morulae stage embryos are ideal for surgical or non-surgical embryo transfer in the pig, as these are uterine stage embryos that possess a full, non-thinning zona pellucida, ideal for aseptic embryo washing and transfer. Our previous work, and this novel methodology provide procedures that will allow the cryopreservation of all early stages of preimplantation pig embryos, from zygotes to hatched blastocysts. Implementation of methodologies for long-term embryo preservation and transfer in swine would provide a foundation for effective utilization of the world's most valuable genetic resources on a global basis while modernizing pork production and enhancing genetic improvement programs.

Key Words: Pig, Embryo, Cryopreservation

1299 The use of electrical impedance spectroscopy (EIS) for pig meat quality selection. M.A. Oliver*[1], I. Gobantes[1], J. Arnau[1], J.M. Monfort[1], J. Elvira[2], P.J. Riu[3], and N. GrŠol[4], [1]*IRTA-CTC. Girona. Spain,* [2]*NTE, S.A. Barcelona. Spain,* [3]*UPC. Barcelona. Spain,* [4]*Esteban Espuna, S.A. Girona. Spain.*

Meat quality (pHu) and fatness are important characteristics in the production of dry-cured ham. Measurements of meat quality were made on 95 commercial hams (11.06 $\pm$ 0.76 kg) to evaluate the relationship between quality characteristics (ham weight, conformation, fat thickness in the rump (1.19 $\pm$ 0.61 cm), visual fatness and pHu in the *Semimembranosus* (SM) and electrical parameters, Ro, Rinf, Rinf/Ro, Fc and α obtained with the EIS equipment. Ro and Rinf are the electrical impedance (Ω) of the system at low and high frequencies, respectively. Fc is the frequency (kHz) at which the complex component of the electrical impedance is highest and α is an adjustment parameter. The measurements were carried out at 36 h p.m. in two regions of the ham (SM and *Biceps femoris* (BF)). A general linear model (least square means and SE) of the electrical variables on three different pHu categories were performed: LWHC (low water holding capacity) pHu $<$ 5.65, IQ (Ideal Quality) 5.65 $\geq$ pHu $<$5.95 and DFD group pHu $\geq$ 5.95. Correlation coefficients between all variables were also determined. Significant differences ($p< 0.01$) were observed between the DFD and IQ groups with respect to LWHC group for Rinf/Ro (0.31 vs 0.49 in SM region, and 0.38 and 0.47 vs 0.57 in the BF region) and Fc variables (32.9 and 29.2 kHz vs 50.6 in SM region, and 39.7 and 53.4 vs 68.0 in the BF region). α parameter was significantly different in the SM region between LWHC and IQ groups (0.31) with respect to DFD group (0.29). pHu values were moderately correlated ($p <0.05$) in SM region with ratio Rinf/Ro, Fc and α, and in BF region with ratio Rinf/Ro and Fc. In the BF region, visual fatness and fat thickness were significantly correlated ($p<0.05$) with Ro and Rinf. This study suggests that with EIS we can obtain objective information about the meat quality and fatness of the hams at 36 h p.m. Both parameters are important to optimise dry cured ham selection.

Key Words: Meat quality, Electrical impedance spectroscopy, Dry-cured ham

UNDERGRADUATE AND GRADUATE EDUCATION

1300 A tool for creating online programmed instruction lessons. D.M. Forsyth* and D.L. Lofgren, *Purdue University, West Lafayette, IN.*

A program has been developed for the creation and delivery on the World Wide Web of programmed learning lessons. Programmed learning is an active learning method involving repeatedly delivering a small amount of information followed by a question, with the answer determining the subsequent path of the lesson. Programmed learning was popular in the 1960's and 70's but was text based, or included graphics requiring high levels of programming. Operating system and programming language changes made many programs inoperable or obsolete and much that was developed fell into disuse. Use of the World Wide Web as a